Occupational Closure and Wage Inequality in Germany and the United Kingdom

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Abstract
The rapid rise in inequality has renewed scholarly interest in how labor market institutions affect wages and their distribution across labor market positions. This article examines the relationship between institutionalized closure practices and occupational wages in the United Kingdom, a prototypical liberal market economy (LME), and Germany, a prototypical coordinated market economy (CME). Hierarchical models applied to micro data from the German Microcensus and the British Labor Force Survey, and newly collected occupation-level data on closure practices (licensure, credentialing, unionization, and apprenticeships) show that in both countries, closure practices increase mean occupational wages. The magnitude of the closure wage premium varies across both practices and countries, with important implications for comparative inequality research.

Keywords: social closure; income inequality; rents; comparative inequality; occupations; varieties of capitalism

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[1] This is a slightly adapted version of the paper presented at ISOL. The participants of the February 2012 session noted several mistakes in the descriptive statistics tables. This is the version with the correct tables – with thanks to ISOL.

In the wake of the recent take-off in wage inequality in many advanced industrialized societies, an extensive literature has emerged to identify the sources of inequality, explain why it has risen so dramatically, and account for cross-national differences in its levels and patterns. Within the inequality literature, institutional approaches that focus on "non-market" or post-market income-setting processes are often pitted against market approaches that focus on supply and demand factors, especially on demand factors driven by technology and trade (Fortin and Lemieux 1997). More recently, scholars have sought to understand how contemporary institutions affect the labor supply, thereby implying a possible reconciliation between the institutional and supply-and-demand approaches. In particular, there has been a resurgence of interest in institutionalized sources of social closure (Weber 1978 [1922], see also Parkin 1974; Tilly 1998; Weeden 2002; Tomaskovic-Devey 2003, 2010, Grusky and Weeden 2010) that restrict the supply of labor in "closed" positions below the level of demand, generating higher returns for position members than one would observe in the absence of such institutions.

The returns to closure can be understood as economic rents, where rents are defined in the usual way as the wages above that which would be necessary to keep that asset in production in a competitive labor market (e.g., Tullock 1967; Sørensen 2000, 1996). Or, more simply, rents are "the surplus of pure profit obtained from owning the resource […] independently of the efforts of whoever owns [that] resource" (Sørensen 1996, p. 1337-1338). These rents may emerge from newly erected or long-established barriers that prevent the supply of labor from rising in response to an exogenous increase in demand. The closure argument thus does not deny the importance of demand-side factors in affecting the wage distribution, but it emphasizes the institutional barriers that create long-term shortages in the labor supply.

To date, the closure argument has primarily been applied to understand patterns and trends in inequality in the United States (see, e.g., Weeden 2002; Grusky and Weeden 2010; Tomaskovic-Devey 2003, 2010), leaving its implications for comparative inequality research woefully underdeveloped. We simply don't yet know whether wage effects of closure are unique to liberal market economies (such as the US or UK), or whether they are instead a more universal feature of advanced industrialized societies. Likewise, although much research has examined how particular institutions, especially unions, contribute to cross-national differences in inequality and inequality trends, unionization is but one source of closure, and its impact on the wage distribution but one piece of a larger puzzle of closure effects.

Closure is, we argue, critical to understanding how and why inequality varies so

dramatically across advanced industrialized societies. Comparative inequality scholars correctly note that wage inequality is relatively high in liberal market economies (LMEs), where economic coordination is achieved through competitive markets and arms-length contracting, compared to coordinated market economies (CMEs), where economic coordination is achieved through "strategic interaction" between employers, trade unions, the state, the education system, and other institutional actors (e.g., Hall and Soskice 2001; see also Estevez-Abe 2009). The focus then shifts to identifying the institutions (e.g., trade unions) in CMEs that raise wages for workers at the bottom of the wage distribution, thereby compressing inequality. The implicit assumption is that the relatively high inequality in LMEs is due to the *absence* of institutions that suppress the inequality-exacerbating effects of arms-length contracting in a competitive labor market. Institution-poor LMEs thus serve primarily as a foil against which institution-rich CMEs are compared.

This near-exclusive emphasis on wage-compressing institutions in CME has, in our view, led to an impoverished understanding of the institutional sources of inequality and how they differ across market contexts. The characteristically high levels of inequality in LMEs is generated not only by the near absence of institutions that create or redistribute economic rents to workers at the bottom of the wage distribution, but also by the presence of top-end rents, including those secured through occupational closure. Conversely, the characteristically low levels of inequality in CMEs stem not only from the inequality-supressing effects of institutions that generate rents for lower-wage workers (e.g., unions, collective bargaining), but also weakly developed institutions that generate top-end rents. Put differently, the labor markets in both types of economies are entirely polluted by rents, but cross-national variations in the distribution of closure strategies across the occupational structure and the magnitude of the returns to different forms of closure generate the distinctive levels and patterns of inequality in CMEs and LMEs.

In this article, we elaborate the closure argument for understanding cross-national differences in the patterns of wage inequality, and offer the first systematic assessment of its predictions in the European context.[2] Our specific goals in this article are twofold. At the most basic level, we offer the first systematic assessment of the extent of closure and its impact on the wage structure in two European countries, Germany and the United Kingdom (UK). This analysis serves as an extension and replication of extant efforts to assess the inequality-generating effects of closure in the United States (US). If closure theory is to serve as a

[2] As we discuss in the conclusion, our findings also have implication for understanding cross-country differences in the *aggregate* level of wage inequality. The latter is not the primary focus of this article.

general account of wage inequality in advanced industrialized societies, it is surely necessary to demonstrate that it receives empirical support beyond the home turf of its major proponents.

Our second goal is to contribute to the scholarly dialogue on comparative inequalities, using the closure framework. We argue that cross-national variation in the relative prevalence of closure practices (e.g., educational credentialing, licensure) and the relative strength of their effects on wages are explicable in terms of the rules and institutions that govern economic exchange in a given societal context. To choose an obvious example, one might expect that educational credentialing creates stronger barriers to entry, and generates higher wage premia, in Germany, where the education system is highly vocationalized and integrated into a highly coordinated system of exchange, than in the UK, where the education system emphasizes general rather than vocational education. At the same time, we argue that although the distribution and wage effects of *particular* closure practices vary in systematic ways across institutional contexts, occupational closure of some form is present in multiple institutional contexts, and generates much cross-occupational wage inequality thereby.

In light of this second goal, our choice of countries in which to examine closure effects is strategic: in the comparative inequality literature, Germany represents the prototypical CME, while the UK represents the prototypical (European) LME. By identifying differences across these two countries in (a) the pattern and prevalence of closure, and (b) the wage effects of closure, we offer important new insight into institutional differences in the sources of economic inequality. Granted, we can't make general claims about all CMEs based solely on the German case, nor can we make claims about all LMEs based solely on the UK case. At the same time, if any systematic differences in the distribution and payoff to closure strategies across the economic types highlighted in the comparative inequality literature are to be found, one would expect them to be revealed in a comparison of these two countries.

Our empirical analysis features new and extensive data on closure practices in these two countries. As we discuss in the next section, we are especially concerned with closure that restricts access to occupations, or "occupational closure." We have accordingly collected data on four sources of occupational closure (licensure, credentialing in the formal education system, unionization, and apprenticeships) and the extent to which they are found in detailed occupations: 330 in Germany and 344 in the UK. We link these country-specific closure data to (1) occupation-level data on skill requirements, and (2) individual-level microdata from 2006-2007 (UK) and 2006 (Germany). We analyse these data with multilevel models that take full advantage of the data's nested structure, in which workers with varying human capital

attributes are nested within occupations of varying degrees of closure and skills. Although we cannot formally model differences in the estimated parameters across the two countries, our measures and models are sufficiently comparable to allow us to draw informal conclusions about how the wage effects of closure compare in these two contexts. To foreshadow our results, we find a strong positive relationship between occupational closure and wages in both countries, but the prevalence and wage impact of specific closure practices (e.g., apprenticeships, licensure, educational credentialing) vary across Germany and the UK in systematic ways.

In the rest of this article, we briefly review the occupational closure argument, the mechanisms through which closure ostensibly generates wage returns to members of closed occupation, and the major institutional forms through which occupational closure is secured. Next, we discuss variations in the distribution and strength of closure practices across our two countries, as prototypes of CMEs and LMEs. After a necessarily detailed discussion of the data we collected for this project, we describe the basic contours of occupational closure in Germany and the UK and present results from multilevel models that identify the net relationship between occupational closure and wages in the UK and Germany. We conclude with a discussion of the implications of our results for understanding the oft-observed differences between these two countries in aggregate levels of inequality.

Occupational closure and its sources

One of the key findings of empirical research on wage inequality is that a large, and by some accounts growing, proportion of such inequality occurs between occupations (Juhn, Murphy, and Pierce 1993; Weeden et al. 2007; Mouw and Kalleberg 2010; but see Kim and Sakamoto 2008). In much of the neoclassical economic literature, these cross-occupational differences in wages are understood as little more than a statistical artefact of the clustering of workers with particular skills into different occupations (e.g., Juhn, Murphy, Pierce 1993; Katz and Autor 1999). In the sociological tradition, by contrast, occupations are understood as deeply institutionalized labor market structures that fundamentally affect the allocation of all sorts of life chances, including wages (e.g., Kalleberg and Griffin 1980, p. 735; Grusky and Sørensen 1998; Weeden and Grusky 2005, 2012 [forthcoming]).[3]

The occupational closure argument falls squarely in the latter camp. According to this

[3] These disciplinary boundaries are blurring, with some institutionally oriented economists devoting attention to the wage consequences of occupational monopolies (Kleiner 2006; Baker 2000) and some sociologists retreating from the strong claim that occupations "form the backbone of the inequality system" (Parkin 1971, p. 18; see, e.g., Kim and Sakamoto 2008).

argument, occupations, or their representatives, seek to secure closure through various legal and normative barriers to entry. As with other forms of closure, these barriers protect occupational incumbents from external competition, either by restricting the supply of labor that receives the training necessary to enter an occupation or by restricting the supply of labor that can legally practice the tasks that are under the occupation's jurisdiction (Sørensen 2000; see also Weeden 2002; Abbott 1988; Larson 1977). Where labor supply is held below demand, closure secures rents for occupation members. It is a "rising tides lifts all boats" argument, in that these rents accrue to all members of the closed occupation.[4]

Occupational closure may not, of course, reflect purely self-interested, rent-seeking behaviour. Closure is often defended, by occupational incumbents and outsiders alike, as a way to protect the public from incompetent or malfeasant practitioners and to ensure the efficient provision of an occupation's services (e.g., Halliday 1987; Law and Sukkoo 2005). As such, even in liberal market societies in which ideological commitments to "free markets" are deeply held, laws that protect occupations from competition are tolerated if they are also understood as protecting the public (see, e.g., Council of State Governments 1952). For our purposes, the motivations underlying closure are far less important than its consequences.

Although the concept of closure has a long history within inequality scholarship and the sociology of the professions (e.g., Murphy 1988; Larson 1977; Parkin 1974, 1979), surprisingly few empirical studies have assessed its effect on wages. In one of the few exceptions, Weeden's (2002) analysis of US data showed that occupations characterized by closure have higher wages than is predicted by individual-level attributes and occupation-level measures of skills and gender composition; the wage effects of licensure and educational credentialing were especially strong, the wages effects of voluntary certification and unionization relatively modest, and the wage effect of representation by occupational associations non-existent, a pattern of findings she attributes to the effectiveness of closure practices that restrict the supply of labor compared to those that attempt to increase demand for the occupation's services (Weeden 2002). More recently, Kleiner (2006; see also Kleiner and Krueger 2010) demonstrates a positive effect of licensure on occupational wages in the US and the UK (Humphris et al 2011). By and large, though, the empirical record on the closure-wage relationship remains exceedingly sparse, a curious state of affairs given sociologists' longstanding fascination with social closure and its effects on life chances.

[4] Closure theory does not assume that the economic returns to closure are equally distributed across all positional incumbents. In this article, we are concerned solely with the closure effect on mean occupational wages, not on its within-occupation distribution.

It also bears emphasizing that institutionalized sources of closure may differ across countries. That is, the closure argument does not claim that there is a fixed menu of closure practices in all advanced industrialized societies, nor that the returns to a given closure practice will be constant across contexts. Building on Weeden's results, we estimate wage returns to educational credentialing, licensure and related forms of state regulation, and unionization. We extend Weeden's analysis, though, in that we include measures of closure through apprenticeships, a labor market institution prevalent in Europe but only weakly developed in the U.S.

In selecting educational credentialing, licensure, unionization, and apprenticeships, we do not mean to imply that these are the *only* possible sources of closure. We do not examine voluntary certification or association representation, two occupational closure strategies that Weeden (2002) found to have a weak net effect in the U.S. context, nor closure secured through social networks (including intergenerational inheritance). We believe, however, that the four closure practices represent the *main* institutionalized forms of closure in contemporary labor markets. If closure has any impact on cross-occupational differences in wages, it should surely appear as a positive association between our four measures of closure and mean occupational wages.

Educational credentials

Educational credentials refer to the degrees and certifications earned in the formal education system. The longstanding debate in the education literature is whether credentials serve primarily as a filtering device for children of privileged class positions, with no necessary relationship to actual skills (Collins 1979, p. 21; Berg 1979), or whether they signify the successful completion of a training program that teaches job-relevant and productivity-enhancing skills. For our purposes, it only matters that educational credentials are (for whatever reason) required for entry into particular labor market positions, whether these requirements are embedded in licensure laws (see below) or "merely" in employers' beliefs in the necessity or value of educational credentials.

If opportunities to obtain educational credentials were unrestricted, presumably workers would respond to market signals and invest in education in sufficient numbers to meet employer demand; in such a market, there would be no education rents. Instead, modern education systems are characterized by rationing, both of primary and secondary training that prepares all adolescents for college and of slots in the educational programs whose graduates are sought by employers (see Grusky and Weeden 2011, Weeden and Grusky 2012). For those

who obtain the necessary preparatory training and successfully navigate through college, the wage returns to their educational credentials in excess of the wage returns necessary to pay for the costs of training can be understood as rents (Sørensen 2000, p. 1554; Weeden 2002).

If the education system is a rent-generating institution, is it also a source of *occupational* closure and rents? We argue that wherever entry into an occupation requires (a) an educational credential that can only be obtained in the formal education system (the credentialist view) and socially produced restrictions on the supply of credential holders; or (b) training and skills that can only be acquired through the formal education system (the training view), educational closure produces occupational closure. As we discuss below, the correspondence between educational closure and occupational closure may differ across countries. Here we wish only to make the general point that educational credentials that are themselves in short supply will limit the potential supply of workers in those occupations where credentials are required, whether legally or normatively.

Licensure

The closure and professions literatures have long acknowledged the role of the state in creating and enforcing barriers to entry into particular occupations, chiefly through licensure but also through mandatory registration and legal mandates. Mandatory registration is typically a low barrier to entry: new occupation members must simply register their names with the relevant bureaucracy, perhaps paying a small fee or showing proof of insurance. Licensure, by contrast, typically requires that practitioners demonstrate a minimum level of competence (e.g., by passing a test), pay an often substantial fee, and meet other non-task-relevant requirements such as residency, citizenship, or "moral turpitude." Competence may be evaluated by the licensing agency or by organizations representing the occupation, and in either case may be based on standards set by occupational agents. Many licenses also require evidence that the applicant has earned a specific educational credential and has completed mandatory continuing education, but the credential is itself not sufficient for licensure.

Licensure protects occupation members' exclusive right to sell a particular set of services and, often, to claim a specific title, and as such serve as a "patent on a practice" (Larson 1977; see also Weber [1922] 1978, p. 342). Like patents on technology or intellectual property, licenses embed rights to the asset – in this case, a particular type of labor – in the state, which has the power to enforce the rights of the "patent holders" by prosecuting those who practice without a license. This legal backing makes licensure one of the stronger sources of closure (Friedman 1962), especially where occupational agents have direct control over the

number of new entrants that meet the licensure requirements (e.g., passing bar exams). Even where licenses are administered by the state, rather than by occupational agents, they represent barriers to entry that require time, energy, and resources for potential occupational practitioners to clear. By restricting the supply of workers who can legally practice an occupation or claim an occupational title, licensure generates rent.

Unionization

Unions have long been understood as institutions that generate rents for union members and for non-union workers in heavily unionized industries (e.g., Freeman and Medoff 1984; see also Western and Rosenfeld 2011). The union literature identifies two mechanisms through which unions generate rents: exclusion and negotiation. Exclusion generates rents for union members by protecting them from competition by outsiders (e.g.,Wright 2009, p. 106); they do so wherever union agreements impose barriers to entry that fix the supply of labor below the demand for it. Unions may also have an indirect exclusionary effect on wages wherever they control access to training and the acquisition of skills necessary to perform particular tasks (see, e.g., Bills 2005, p. 78). The second mechanism refers to unions' ability to help workers negotiate a larger share of firm profits, or what Morgan and Tang (2007) call "negotiated rents." In both cases, the key to union-generated rents lies in the unions' state-granted right to bargain collectively, with the threat of the withdrawal of labor (e.g., through strikes) as a key weapon in the negotiations.

Unions do not exclusively represent occupations. The relationship between unionization and occupational closure depends on the type of union (see also Weeden 2002: 64). Unions that represent entire industries or social classes (e.g., "workers' unions") will affect occupation-level wages to the extent that occupations are unevenly distributed across the represented industries or classes: e.g., a union that represents workers in the telecommunications industry will, in theory, generate a wage premium for line repairers, simply because line repairers are concentrated in telecommunications. Unions that explicitly represent particular occupations (e.g., teachers, airline pilots, mail carriers) are more directly source of *occupational* closure. The efficacy of unionization as an occupational closure strategy thus depends not only on the strength and power of unions, but also whether the unions in a particular national labor market are predominantly organized around occupations, industries, or aggregations of these labor market structures.

Apprenticeships

Parkin (1974, p. 13; see also Weber [1922] 1978: 344) argues that apprenticeship systems serve much the same function for the skilled trades as educational credentialing does for the professions: they restrict entry into occupations. In the classic apprenticeship system, virtually all job-relevant training takes place on the job itself, with employers taking primary responsibility for "educating" workers and administering the apprenticeships (Ryan 2001). Today, the majority of master-apprenticeship relations are institutionalized in dual systems, where vocational training in the education system is combined with "on the job" training through practical work experience.

Apprenticeship systems can have both direct and indirect effects on the supply of labor. A direct limit on supply emerges wherever restrictions, whether formal or informal, limit the number of apprentices that a master can take on and hence the number of future workers who obtain the "credential" of journeyman. In addition, apprenticeships may limit the supply of labor indirectly, as when training in the trade's skills can only be acquired through apprenticeship (Shavit and Muller 1998). In the latter view, it is not merely that masters certify apprentices and give them an official stamp of approval that allows the apprentices to *claim* skills (which they may have had prior to becoming apprentices), but that there are barriers to access to skill acquisition itself. As we discussed in the context of educational closure, if the apprenticeship system fails to produce as many skilled workers as are necessary to meet demand, the returns to skill accruing to individual workers is appropriately understood as a combination of returns necessary to compensate for the costs of training and of economic rents (see, e.g. Sørensen 2000; Weeden and Grusky 2012).

Occupational closure in comparative context

We have intentionally avoided making claims about the relative prevalence of these closure strategies or the magnitude of the economic rents they generate, reflecting our interest in testing the simpler claim that occupational closure is positively associated with mean wages. In our view, this hypothesis strikes closer to the heart of closure theory as it has so far been developed. In this section, we extend the closure argument with the goal of identifying and making sense of differences across countries in both the relative prevalence of the closure strategies and the relative magnitude of their anticipated wage returns.

As we noted above, closure strategies restrict the supply of labor indirectly, by restricting access to training or directly, by restricting access to the right to practice an occupation (even assuming training). Somewhat ironically, direct restrictions on the supply of

labor are more prevalent in LMEs than in CMEs. In LMEs, the reliance on market-based exchange fosters closure practices that correct, or at least are understood as correcting, the market failures that occur in conditions of imperfect information. Take, for example, licensure, which almost by definition violates the "first principles" of free markets. Licensure is nevertheless prevalent in LMEs because its proponents have successfully argued that it weeds out incompetence and malfeasance, thereby overcoming information shortfalls and improving the efficiency of market exchanges. In CMEs, by contrast, it is assumed that the education system, which is closely monitored and integrated with production needs, weeds out incompetence, and there is hence less perceived need for further filtering in the form of licensure.

Conversely, closure practices that restrict access to training and skills are more prevalent and more effective in generating rents in CMEs than in LMEs. In CMEs, various institutions (e.g., the education system, unions, the state) collaborate and coordinate to grease the wheels of economic exchange, emphasizing long-range planning more than the short-term market exchanges characteristics of LMEs (Hall and Soskice 2001). The education system, for example, is closely monitored by the state and plays an overt role in coordinating economic exchange (Rubery 1999, p. 196; Estevez Abe et al. 2001). It does so not only by training workers in occupation-specific skills – the oft-noted vocationalism of education in CMEs – but also by setting standards of minimum competence. Unlike in LMEs, the competency filter is embedded in the educational credential itself, with the assumption that the credential is sufficient for filtering. Similarly, apprenticeship systems are well-developed, which is consistent with CME's emphasis on long-term planning and labor market coordination. Far from being a mere accident of history, then, closure in CMEs is thus much more likely to be embedded in practices – e.g., vocational education, apprenticeship, unionization – that limit the supply of labor in an occupation by limiting access to training.

We do not mean to imply that barriers to access to training are altogether absent in LMEs, or that barriers to legal rights to practice (independent of training) are absent in CMEs. As we discuss below, both can be found in our two contexts. However, the two countries are expected to differ in the prevalence of the four types of closure and the relative wage returns associated with each of them.

Occupational Closure in the UK

The formal institutions of closure in the UK reflect its status as a liberal market economy characterized by few efforts to coordinate between educational institutions,

employers, unions, and state agencies. The output of the education system, for example, is not coordinated to anticipate the input needs of the labor market; indeed, UK educational institutions guard their independence jealously, and look askance at efforts by employers to dictate the content of educational training. Tertiary education in the UK emphasizes intellectual exploration, critical thinking, and personal development rather than narrow job training. As a result, educational degrees in the UK are neither highly differentiated nor, with a few notable exceptions (e.g., the JD), occupation specific, and the correspondence between educational degrees and occupational placement is accordingly weak.[5]

The relatively limited control that occupations exert over the supply of labor through mandatory and occupation-specific educational qualifications is partially offset by the relatively well developed system of occupational licensure. In the UK system of licensure, licenses vary in restrictiveness from voluntary licenses, which as the name suggests offer very few constraints on access, to statutory licenses, which are required to practice the occupation legally. In most cases, statutory licenses (the only kind with which we are concerned) are mandated by the state but administered by state-recognized professional organizations, thereby giving occupational representatives control over the content of licensing criteria. Gas installers, for example, are required to obtain the appropriate National Vocational Qualification, register with the Confederation of Registered Gas Installers (CORGI), and renew their license each five years (Frontier Economics 2003: 30). As this example suggests, educational credentials are often necessary, but not sufficient for licensure. Although prior research suggest a positive correlation between licensure and occupational earnings in the UK (Humphris et al. 2011), it is not clear whether this effect obtains when conditioning on mandatory educational credentialing.

If licensure is relatively well-developed in the UK, unionization is not. The level of collective bargaining coverage is comparatively low in the UK and has been declining rapidly (from 70 percent in 1980 to 30 percent in 2000; OECD 2004, p. 145). Moreover, what bargaining remains is highly decentralized and exercised at the company or plant level rather than the occupation level. The direct control unions have over the supply of labor in an occupation is limited to whatever restrictions they can implement through their involvement in the apprenticeship system (Steedman 2001), which, as we argue below, is itself weakly

[5] Educational institutions in Northern Ireland, Scotland and Wales offer slightly different degrees than England. In 2005, the member states in the UK tried to harmonize their qualification systems through the National Qualification Framework (NQF). In the NQF, each state-specific qualification is assigned a level, under the assumption that this would help standardize degrees. For clarity, we offer English examples, although there are comparable degrees in Northern Ireland, Scotland and Wales.

developed. We therefore anticipate that the wage returns to occupations accruing through unionization will be relatively modest.

The apprenticeship system is similarly undeveloped in the UK. Although the UK, like many LMEs, has attempted to set up apprenticeship systems to overcome skill shortages, they seldom succeed. A dual system, in which educational institutions and employers (often with input from unions) coordinate to provide apprenticeships, is altogether absent. Instead, the approximately 190 apprenticeships currently offered in the UK are a heterogeneous array of programs, with no coordination amongst employers (Thelen 2004), no agreed-upon meaning of the "apprenticeship" label, and no state-coordinated or national regulation of programs that adopt the label (Ryan 2001; Ryan and Unwin 2001).[6] Apprenticeships are rarely required to practice an occupation, although they may be incorporated as part of a National Vocational Qualification (NVQ) or professional qualification. This high level of decentralization of apprenticeships, coupled with their voluntary status, makes apprenticeships a relatively ineffective closure strategy, with weak effects on occupational wages.

Occupational Closure in Germany

The German education system is justly famous for its vocational orientation and emphasis on occupation-specific skills (Brauns, Scherer, and Gangl 2001; Busemeyer 2009). It is highly differentiated, with a relatively large number of educational qualifications that can be obtained given similar years of training. Tertiary education, for example, is provided through two types of institutions: state universities, which offer general degrees (similar to most universities in LMEs); and the *Fachhochschule* (University of Applied Sciences), which offers occupation-specific degrees. Critically, in the German system, the content of the credential, and not just its level, drives job placements (Solga and Konietzka 1999, p. 28). The high differentiation in the education system, an emphasis on occupation-specific training, and limits on the number of slots for several disciplines in universities and *Fachhochschulen* (Mayer, Muller, and Pollak 2007, p. 251), translates into a restricted pool of workers who have access to occupation-specific training and credentials (Klein 2011). These barriers to access to training are further reinforced by state mandates that specify the educational credential requirements in occupations. To become a self-employed baker in Germany, for example, one must obtain a "master craftsman" diploma in baking or the equivalent

[6] The Adult Learning Inspectorate (since 2007 known as Ofsted) was set up in 2001 to inspect the quality of apprenticeship programs, but has few "teeth" relative to the national regulation of the German apprenticeship system (Ryan & Unwin 2001).

qualification.[7] The result is a highly developed system of education-based occupational closure in Germany, and, we predict, accordingly high wage returns to educational credentialing.

If educational credentialing is well-developed in Germany relative to the UK, licensure is only weakly developed. There are nonetheless several occupations that require professional registration, often voluntary (OECD 2006), and a handful of others in which the state imposes restrictions above and beyond the mandated educational credentials. In the latter occupations, which are primarily in medicine and the law, performing the tasks of the occupation, using the title, and carrying the official uniform or badge without official permission is punishable under criminal law (Article §132a of the *Strafgesetzbuch*[8]). Compared to the UK, however, we anticipate relatively little licensure in Germany, and relatively weak net effects of licensure on wages above and beyond that which is secured through educational credentialing.

In Germany, as in other CMEs, unions take a central role in negotiations over wages, negotiations that often culminate in legally binding and enforceable collective labor agreements (CLAs). Although trade union membership rates are lower in Germany (22.6%) than in the UK (29.3%, see Visser 2006), CLA coverage in Germany is relatively high at 68 percent of all employees (OECD 2004, p. 145). Most of these CLAs govern wages at the industry or company level, meaning that their effect on occupational wages is indirect. Trade unions nevertheless exert indirect occupational closure by virtue of their involvement in the development and implementation of occupations-specific apprenticeships, as trade unions define the requirements for entry for some 300 occupations (Busemeyer 2009, p. 394). Although the trade union effect on occupational closure *per se* may thus be indirect, we expect the relatively strong bargaining power of trade unions and their involvement in the apprenticeship system to translate into large wage premium in unionized occupations in Germany compared to the UK.

The German apprenticeship system has been described as the heart of the "German skills machine" (Culpepper and Finegold 1999). It is a dual system in which the education system and employers jointly administer the apprenticeship. According to the Federal Ministry of Education and Research (BMBF), two-thirds of German secondary school students learned a "*recognised* occupation requiring formal training" (BMBF 2003, p.1;

[7] See the *Handwerksordnung*, Appendix A, nr. 30 (http://bundesrecht.juris.de/hwo/anlage_a_195.html, accessed 12 July 2011).
[8] The article can be visited at http://dejure.org/gesetze/StGB/132a.html, accessed April 22 2011.

emphasis added). Recognised occupations formally require a master craftsmanship degree, per the Crafts and Trade Code (*Handwerksordnung*), meaning that an apprenticeship is mandatory for self-employment.[9] Although less than a third (41 out of 153) require an apprenticeship, slightly more than a third (53) offer a voluntary apprenticeship program, and the remainder do not offer an apprenticeship. Apprenticeships are regulated by regional Chambers of Industry and Commerce and the Crafts Chambers, which set the curriculum and requirements for apprenticeships, and advise and monitor employers who offer apprenticeships.[10] Even so, occupational groups are closely involved in setting up apprenticeship systems, and thereby exercising control over the number and training of new entrants (see, e.g., Thelen 2004). This should, in theory, generate higher average wages for occupations in which apprenticeships are mandatory for entry, but with one important caveat: because apprenticeships are part of a dual system, some of the wage-enhancing effects of apprenticeships may be "absorbed by" measures of educational closure, particularly insofar as they capture requirements for vocational training.

Summary

As the preceding discussion implies, all four closure strategies are present in the UK and Germany, but they differ in prevalence and in strength (of anticipated wage returns) across these two contexts. Educational credentialing, unionization, and apprenticeship systems are much better developed in Germany than in the UK, while licensure is better developed in the UK than in Germany. Although we anticipate wage returns to all four closure strategies, we expect greater payoffs to credentialing, apprenticeships, and unionization in Germany (relative to the UK), with the caveat that the union effect may be mediated by apprenticeship systems, and any residual effect driven by industry composition. Conversely, we anticipate high wage returns to licensure in the UK, modest wage returns to tertiary credentialing, and relatively weak payoffs to closure through unionization and apprenticeship systems.

Methods and data

Our analytic task is to estimate the wage returns to occupational closure (rents) in excess of the wages that would accrue in the absence of artificial restrictions on supply. The challenge,

[9] An English translation of the *Handwerksordnung* can be found online at http://www.zdh.de/en/trade-and-crafts-code.html , accessed 14 July 2011.
[10] Almost a quarter of all companies offer apprenticeships. Of all large companies (more than 500 employees) more than 93 percent offered apprenticeships (BMBF 2003: 7).

which faces virtually all rent-based analyses, is that competitive market wages are unobserved (see, e.g., Sørensen 2000; also Morgan and Tang 2007). Weeden (2002) addresses this problem by estimating the returns to closure after adjusting for individual level human capital and, in some models, occupational skills. This strategy "gives away" all of the individual wage returns to education, for example, to competitive market processes, whereas the closure argument implies that some portion of these individual-level returns is properly understood as rents. Similarly, adjusting for occupational skills "gives away" all of the effects of closure that accrue by virtue of barriers to access to training in those occupations for which training is necessary, i.e., those that require especially high levels of skills. As such, the adjusted occupation-level wage returns to closure practices can be understood as a lower-bound estimate of the total closure effect, and the unadjusted wage returns an upper-bound estimate.

Methods

We estimate the association between occupational closure and wages with multilevel random intercept models in which individuals (*i*) are nested in occupations (*j*). Multilevel models have several advantages, among them that individual level and occupational level variances are estimated simultaneously (Raudenbusch and Bryk 2002). The basic multilevel model is given by the following equation:

$$\mathrm{Y}_{ij} = \alpha_{ij} + \beta_x \mathrm{A}_{ij} + \beta_x \mathrm{B}_j + u_j + e_{ij} \quad \textbf{(1)}$$

In this equation, Y are the logged earnings, A are the individual level characteristics, B are the occupational level characteristics, u_j is the error term at the occupational level and e_{ij} is the error term at the individual level. By changing the covariates in B, we construct a series of nested models that allow us to identify gross and net closure effects. We apply these nested models to data for Germany and the UK separately, mostly because differences in the meanings and measures of each closure strategy (see below) and in the individual-level data make a single model problematic.

Individual-level data and measures

The individual-level data were obtained from nationally representative household surveys conducted in 2006 (Germany) and 2006 and 2007 (UK). The German micro-data are extracted from the public use file of the German Microcensus, which is collected by states

under the direction of German Federal Statistics Office.[11] The UK micro-data are extracted from the Quarterly Labor Force Survey (QLFS), which is collected by the Office of National Statistics.[12] In the QLFS, data are collected quarterly, and each sampled household participates in five waves; to eliminate duplicate observations, we limit our analytic sample to new observations in the first and fifth wave of data collected in 2006 and in the first wave of data collected in 2007. We restrict our analyses to respondents who are currently employed, who are between the ages of 18 and 65, and who indicated that their reported income is predominantly from wages and salaries (Germany only). The final analytic sample for Germany consists of 134,376 individuals nested in 330 occupations, and the final analytic sample for the UK consists of 75,681 individuals nested in 344 occupations.

In all models, the dependent variable is the natural logarithm of monthly earnings.[13] In the German data, earnings are measured in 24 categories. To approximate a continuous measure, we assign each category its midpoint earnings value. In the waves of the UK data that we analyse here, earnings are measured as a continuous variable and no transformation is necessary. We also fit our models to data in which we discretize the UK earnings measure into an ordinal variable comparable to the German measure, and found highly similar results.

Our models estimate coefficients for the same set of individual level covariates, at least to the extent possible given the constraint of each nation's labor force survey (see Table 1 for the UK, Table 2 for Germany). The demographic covariates include binary indicators for gender (female = 1), marital status (married = 1), ethnicity[14] (ethnic minority = 1), and the presence of dependent children in the home (yes = 1). We also control for geographic region: in the German models, we fit a binary indicator of residence in former Eastern Germany; and in the UK models, we add a series of dummy variables corresponding to the member states (Scotland, Wales, and Northern Ireland, with England as the omitted category).

Our individual-level models also include measures of labor force participation and human capital. In each model, we adjust for the number of hours normally worked in a week, a binary indicator for full-time or part-time employment (part-time = 1), work experience, and work experience squared. Work experience is measured by the difference between the date at

[11] For a more detailed description of the Microcensus see http://www.gesis.org/en/services/data-analysis/official-microdata/microcensus/ , accessed November 23, 2011.
[12] For a more detailed description of the QLFS see http://www.esds.ac.uk/government/lfs/, accessed November 23, 2011.
[13] In the Microcensus not earnings but monthly net income is asked. However, as we only analyze those individuals which reported that their income consists primarily from employment wages (instead from, for example, social benefits), we come closest to earnings as possible with this data.
[14] The German Microcensus asks respondents to indicate if they belong to an ethnic minority. The best available analog in the UK data is a flag for whether respondents were born in non-Western countries.

which the respondent completed his or her formal education and the date of the interview, which in most cases is compatible with the standard proxy (of age minus years of education minus 6) used in analyses of labor force surveys that lack direct measures of work experience.

Our models also include measures of individual-level educational attainment: years of formal education, and level of the highest degree earned.[15] Level of education is measured in different ways across the two countries, in line with their very different education systems. For the German data, we use the CASMIN scale (Brauns, Scherer and Steinman 2003), which differentiates between vocational and general education. CASMIN is measured in five categories: "CASMIN 1abc" (elementary education or less, the reference category), "CASMIN 2ab" (vocational secondary education from *Realschule*), "CASMIN 2c" (full vocational maturity degree [*Abitur, Fachhochschulreiffe*]), "CASMIN 3a" (*Fachhochschule*-degree) or "CASMIN 3b" (university degree). In the UK data, educational degrees are standardized into levels of National Vocational Qualifications, and we perforce rely on these categories. The seven available categories are: "no qualifications" (the reference category), "other qualifications," "below NVQ Level 2," "NVQ Level 2," "trade apprenticeships," "NVQ Level 3," and "NVQ Level 4 and above". Rather than impose a hierarchy on these categories, we fit them as dummy variables.

[Tables 1 and 2 about here]

Occupational-level data

We adopt the most detailed coding scheme of occupations that the data allow, which in practice means relying on the "indigenous" occupational classification scheme in which the data were collected in each country.[16] The German data are coded on into the 1992 *Klassifizierung der Berufe* (KldB-1992), which contains 369 categories defined, for the most part, by occupational activities. Eleven categories are reserved for respondents who are still in school or who can only be coded into an industry. Given our theoretical focus is on occupational closure, we exclude respondents who fall into these categories from the analysis. The UK occupation data are coded into the 2000 Standard Occupational Classification (SOC-2000), the official UK coding scheme. Unlike the KldB-1992, the SOC categorizes occupations based not only on tasks but also on skill level. We use the most detailed (353-

[15] Some respondents reported 35 or more years of education. We assume these are errors or outliers, and exclude these respondents from the analysis.
[16] In 2010 a new version of both the KldB and the SOC was made, this is however not yet available in the micro data we use.

category) version of SOC-2000. Due to missing individual- and the occupational-level data, we perforce lose 27 occupational categories in the German data and 9 in the UK data. These are either very small occupations (e.g., saddlers, craft shoe makers, musical instrument makers) that are unrepresented in the sample or, less commonly, residual categories (e.g., "metal workers not elsewhere classified") for which we could not obtain reliable information on occupation skills or closure practices.

Neither Germany nor the UK systematically collects official occupation-level data on skills or closure practices at a sufficient level of detail or comprehensiveness for our goals.[17] We instead constructed our own occupation-level data set from an array of sources, many of which are country-specific or use coding schemes other than the KldB-1992 or SOC-2000. We first describe the occupation-level "controls" that we fit in some models, then our measures of closure practices.

Occupational skills and demographic controls

A long tradition of research, primarily using US data, shows a net effect of the gender composition of occupations on wages (see, e.g., Kilbourne et al 1994; Tomaskevic-Devey 1993; Huffman and Cohen 2004). The gender composition effect, in particular, persists when adjusting for occupational closure (see Weeden 2002). In keeping with this prior research, we constructed aggregate measures of the percentage of women and the percentage of ethnic minorities in each occupation, using the micro-data in the Microcensus and QLFS for Germany and the UK, respectively.

Indicators of occupational skills and demographic composition were extracted from the BIBB/BAuA Employment Survey of 2006 (Germany)[18] and the British Skill Survey (BSS) of 2001 and 2006 (pooled) for the UK.[19] Both surveys are based on a representative sample of the employed workforce, ask detailed questions about occupational skills, and contain sufficient cases (N = 20,000 for the BIBB/BAuA, N = 12,257 for the cumulative BSS) to generate measures of occupational skills at the level of detail in the KldB-1992 and SOC-2000.

[17] The EurOccupations data (Tijdens et al 2009) represents a recent collaboration among several European countries to construct a comparative occupation-level data set. It is insufficient for our purposes, however, in that it is limited to approximately half of the occupations in the labor force surveys, and also that many of the key closure variables have missing values.

[18] More information on the BIBB/BAuA Employment Survey can be found at: http://www.bibb.de/dokumente/pdf/BIBB_BAuA_2006_Data_Manual_neu.pdf , accessed November 23, 2011.

[19] More information on the British Skill Surveys can be found at: http://www.esds.ac.uk/findingData/snDescription.asp?sn=4972 and http://www.esds.ac.uk/findingData/snDescription.asp?sn=6004, both accessed at November 23, 2011.

Our measures of occupational skills include scales of physical abilities, technical skills, complex mental processing, mathematical skills, interaction skills, and presentation skills. Each scale combines information from multiple questions in the BIBB-BAuA survey and the British Skill Surveys. We chose composite items for each skill scale by matching the available items to the items used to construct skill measures in O*NET, an occupational-level database in the U.S.[20] We constructed our scales using factor analysis, saving the factor scores with a mean of zero and a standard deviation of one; the composite items in each of the six skill scales loaded predominantly on one factor, thereby confirming that we chose the appropriate composite items. We then mapped the factor scores onto the categories in our occupation coding schemes, thereby generating occupation-level measures. A more detailed description of all skill variables, a list of the specific items used in each scale, and the results from the factor analysis are available in Appendix A.

Measures of occupational closure

The featured measures in our analysis are the indicators of occupational closure. Very few of these indicators can be aggregated from standard labor force data, so we instead collected and merged in data from external sources. Take, for example, educational credentialing, which we measure with two indicators: the required level of education, and an indicator of whether the occupation is regulated by the European Qualifications Network (discussed below). In our German data set, the required level of education was estimated by aggregating (to the occupation level) responses to a question in the BIBB/BAuA survey, "What qualification is normally required to do the job you have now?" This question has three possible response categories: (1) no qualification needed, (2) vocational training or *Meister*/*Techniker* degree, and (3) university degree. We constructed occupation-level measures of the percentage of occupational incumbents who reported each of the latter two levels of education. For our UK data base, we obtained measures of educational entry requirements directly from the SOC-2000 manual (Office for National Statistics 2000). If the SOC-2000 listed more than one entry route, we coded the minimum level of education that was needed for entry. The UK version of the educational requirements variable is thus a three-category variable: (1) no formal requirements (the reference category), (2) low qualifications (GCSEs, NVQ 1-2), and (3) high qualifications (A-levels, university degrees, NVQ 3-4).

The second indicator of educational credentialing measures whether or not an

[20] For more information, see http://www.onetonline.org, accessed at March 7, 2012.

occupation is regulated by the European Qualifications Network. In 2005, the EU passed a directive that requires all member states to generate a list of occupations that, according to national law, require a particular educational degree to enter. We code this into a simple dummy variable, where occupations listed in the directive are assigned a value of 1 and those that are not listed constitute the reference category.

Licensure also varies across our two national contexts. For the German data, we identify all occupations that are covered by licensure laws. We obtain this information primarily from Article §132a of the criminal law, but supplemented it with information on legal job protection from the German occupational database.[21] Rather than simply code each occupation as licensed or not, we obtained more fine-grained information on the percentage of occupational incumbents who are licensed, in recognition that the occupations as defined by laws and the occupational categories in administrative classification schemes do not always overlap perfectly (see also Weeden 2002). Similarly, for the UK we identified the percentage of workers in an occupation category that are hold mandatory licenses or the Chartered designation, which is likewise a legally protected designation. As in Germany, we anticipate that this continuous measure will provide more precise estimates of the closure effect than a simple dummy variable. We collected information on occupational licensure in the UK based on an extensive investigation of legal codes, annual reports and websites of professional associations, websites with job profiles, e-mail contacts and telephone calls; additional details are available from the first author.

Our measures of unionization are aggregated from individual-level survey questions on trade union membership (0 = no, 1 = yes).[22] For the German case, we obtain unionization data from the cumulative file of the European Social Survey, which was collected in four waves from 2002-2008.[23] From this survey, we constructed a measure of union density in each of the three-digit ISCO codes collected in this survey, and matched these codes to the KldB-1992 occupation scheme used in the Microcensus. For the UK, we could obtain union participation by occupation directly from the QLFS, although due to the survey design only from the fourth quarter of the 2006 and 2007 QLFS.

[21] This database can be found at http://berufenet.arbeitsagentur.de, accessed May 14, 2011.
[22] In the QLFS data on collective labour agreement coverage exists, unfortunately, no direct measures of worker's protection were available for Germany. For this reason we decided to use the better comparable trade union density as our measure of unionization.
[23] The European Social Survey (ESS) is a cross-national survey in Europe that focuses on topics that are especially relevant for social scientists. In Germany the survey is conducted by GESIS, and the data is a random sample of the German population. The combined number of observations of the 4 surveys that we can use for the aggregation is 11,413. More information on the ESS can be found at http://www.europeansocialsurvey.org/ , accessed November 23, 2011.

Finally, we coded the percentage of workers in an occupation who completed apprenticeships for each country. For our German data, we identified apprenticeships based on the education question in our micro-data, which indicates whether respondents had a vocational degree or any other apprenticeship, and aggregated this to the occupation level. For the UK we aggregated responses to the QLFS question, "Are you doing or have you completed a recognised apprenticeship?" In both cases, we recorded the percentage of workers in each occupation who answered "yes" as our indicator of closure through apprenticeships.

Results

We first examine the descriptive statistics for our closure measures in Germany and the UK, thereby gaining new insight into the pervasiveness of occupational closure in these contexts. We then turn to the heart of our analysis, which examines the gross and adjusted wage premia associated with occupational closure.

Levels of occupational closure

Tables 3 and 4 provide descriptive statistics for our occupation-level covariates (table 3) and their bivariate correlations (table 4). The means and standard deviations are estimated in two ways: unweighted, and weighted by occupation size.

[Table 3 about here]

Table 3 reveals, firstly, that within each of our two countries, educational credentialing is the most pervasive closure strategy, at least as measured by the percentage of workers who are in occupations (or, at the occupation level, the percentage of occupations) that require a university or vocational degree (Germany) or a university degree (the UK). In Germany, apprenticeships are also a quite common closure strategy. EU regulation and unionization rates are lower but still substantial, while licensure covers but a small fraction of German workers and occupations. In the UK, apprenticeship is relatively rare and licensure, while still the least prevalent of the four closure strategies, more substantial.

More central to our story, however, are the between-country comparisons. In line with our earlier discussion, credential closure is much more pervasive in Germany than it is in the UK, reflecting the Germany's notoriously differentiated and vocationalized education system and the strong ties between credentials and job placement. These between-country differences

emerge not in the share of occupations that require the highest level of educational qualifications for that country, but rather in the greater share of UK occupations that have no formal or perceived educational requirements. Put differently, the German labor market places greater emphasis on intermediate levels of education, which corresponds to vocational education. Similarly, a much higher percentage of occupations require apprenticeships in Germany than in the UK.

Licensure, by contrast, is far more prevalent in the UK than it is in Germany. In the UK, about 13 percent of individuals are in occupations that are closed by professional licenses, on average (see also Humphris et al 2011), compared to 5 percent in our German data. The average occupational union density is also higher in the UK than it is in Germany, which is consistent with studies that compare the proportions of workers in each country (not accounting for occupations) that are unionized (see, e.g., Visser 2006).[24]

[Table 4 about here]

The correlations in table 4 are calculated from unweighted occupational level data. The table reveals positive correlations between the various closure strategies in both countries. Licensure is more common among occupations that require the highest level of educational qualification, as well as among occupations that are regulated by the European Union. While these correlations are consistent across countries, others are not. In Germany, for example, unionization rates have relatively low correlations with either educational credentialing or licensure; in the UK, by contrast, the occupations that have the highest rates of licensure and educational closure also tend to be those with the greatest levels of unionization. For example, in Germany the correlation between the proportion of occupational incumbents who are union members and the measure of tertiary degree requirements is a (non-significant) -0.07, whereas in the UK these measures are correlated at a statistically significant level of 0.23.

A second notable difference across our two countries emerges in the observed correlations between closure through apprenticeships and educational credentialing. In the UK, the apprenticeship measure has a lower correlation with educational credentialing than in Germany, reflecting the prominence of apprenticeships in Germany in occupations that

[24] On average, UK occupations contain a higher percentage of workers from ethnic minority groups than German occupations, although this could be due to the more expansive definition of ethnic minorities used in the UK micro-data. Occupations in the UK contain a greater proportion of women, on average, than in Germany. Because our measures of occupational skills are standardized with a mean of zero, we cannot usefully compare skill levels across the two countries.

require a vocational qualification. Although it is somewhat tangential to the main focus of this paper, we also note cross-country differences in the (negative) correlations between apprenticeship coverage and the percentage of women in the occupation, which are much stronger in the UK (-0.58) than in Germany (-0.20). This likely reflects the greater diffusion of apprenticeships throughout the occupational structure in Germany, compared to its concentration in the male-dominated occupations in the craft sector in the UK.

Finally, we note that there are some differences across the two countries in the correlations between the closure strategies and occupational skills, although few differences between the countries in the correlations of the skill measures with each other. Physical abilities are more often required in occupations that do not entail educational credentialing through tertiary degrees and, in Germany, in occupations where vocational credentials limit access. Not surprisingly, the German data also show a strong correlation between occupations that require technical skills and those that require a vocational degree or are unionized, whereas neither is true in the UK.

Almost all "soft" skill requirements correlate positively with credentialing, licensure and unionization. In both countries, closure is more likely in occupations that require high levels of complex processing skills or interaction skills (see also Weeden 2002), and less likely in occupations that require technical or physical skills; the notable exception is closure through apprenticeship, which is negatively correlated with two (UK) and four (Germany) "soft" skill requirements.

Our descriptive results thus reveal significant, albeit predictable, differences between Germany and the UK, in the levels of closure, their relative strength in each country, and their correlation with skills. In the UK, occupational closure is more likely to take the form of occupational licensure or tertiary degree requirements, whereas in Germany it is more often secured through vocational educational credentialing and apprenticeships; unionization rates are relatively compatible in both countries, although as noted this masks differences in the level of union organization (i.e., firms or industries). These are consistent with our claim that, firstly, institutionalized closure practices can be observed in LMEs and CMEs alike, and secondly, that closure practices that directly and explicitly reduce competition (e.g., licensure) are, ironically, more prevalent in LMEs than in CMEs.

Wage effects of occupational closure in the UK and Germany

We next turn to our multivariate analyses of the wage effects of the occupational closure in our two countries. For ease of presentation, we will first discuss the results for the UK and

Germany separately, and then explicitly compare the findings. In our tables, we present only the coefficients for the occupation-level covariates. The models on which these results are based, however, include all individual-level covariates as well (see Appendix B).

[Table 5 about here]

Table 5 presents the results of the multilevel models applied to the UK data. We begin, firstly, with a null model that fits no occupation or individual-level covariates. This model shows that nearly 40% of the variation in logged earnings takes place between occupations and 60% within them. [25] This percentage decreases by roughly 1/3 (to 28%) in a model (not shown) that fits individual-level effects but no occupation-level covariates, that is, a model that adjusts the between-occupation variance for compositional differences between occupations in the human capital and other individual-level attributes of their incumbents. In model 1, which fits the occupational demography measures, this is further reduced to 27%, the "baseline" against which the contributions of the closure measures can be compared. In model 2, which adds the closure measures, the unexplained occupation-level variance declines to 18.3 percent. These results show, firstly, that occupations remain an important source of heterogeneity in wages in the UK labor market, and secondly, that closure practices can account for much (but not all) of the occupation-level variation that remains after compositional effects are purged out.[26]

Our main interest is, of course, in the estimated effects of the occupation level closure variables, which are introduced in Model 2; this model also fits all individual-level covariates and the measures of occupational demography, but not measures of occupational skills. We find that in the UK, three of the four closure strategies have the anticipated positive wage returns at the occupation level: educational credentialing, licensure, and unionization. The wage premium for educational credentialing is observed for occupations that have low educational requirements and high educational requirements, relative to those with no requirements, and for occupations that are regulated under EU directives. The impact of tertiary educational requirements is quite substantial, generating a wage premium of 24.6% (0.246) relative to those with no requirements. Fully licensed occupations have a wage

[25] As Weeden argues (2002, p. 92), the share of between-occupation heterogeneity is affected by the specificity of the occupational classification schemes. Although we use the most detailed schemes we could find, these classifications are still aggregations of the occupational boundaries that exist in practice.
[26] In the final model, which includes measures of skills as well as of closure practices, the unexplained occupation-level variance shrinks to 10.8 percent.

premium of nearly 8% (0.076), compared to unlicensed occupations, while fully unionized occupations offer an anticipated earnings premium of 15.7% (0.157)[27]. Apprenticeships, by contrast, have no significant effect on wages in the UK context, a finding that we will unpack below. These results are consistent with the general claim of the closure approach, namely that institutionalized closure practices generate rents for occupation members even in prototypical liberal market economies.

Model 3 adds our measures of occupational skills to the occupation-level equation. As we argued above, the inclusion of measures of skills will likely underestimate the "true" effects of closure, because the wage returns to skills are a mix of marginal returns to productivity, compensation for investments in training, and rents derived from restrictions on access to skill training. These occupational skill-adjusted estimates are nevertheless useful insofar address the alternative interpretation of the closure effects in Model 2, namely that our closure measures are *only* picking up returns to skills that, unfortunately, are unobserved at the individual level. Model 4 indeed shows that after adjusting for skills, closure effects on earnings are greatly reduced, but not altogether eliminated.[28] The most striking change, relative to Model 2, is the absence of adjusted effects of credential closure: in the UK, credentials generate rents only insofar as occupations that require high levels of education are also those that are highly skilled. By contrast, the positive effect of licensure persists: even after adjusting skill, licensure generates a wage premium for the occupations in which it is prevalent. These findings are in line with our general argument about closure in the UK: in a deregulated labor market with an education system that emphasizes general learning, professional licenses are the principal means through which occupations generate rents. Unionization, however, also shows a persistent positive effect in Model 4, indicating that this institutionalized form of closure generates rents even after adjusting for skill levels.

Do the same patterns obtain in Germany, our representative CME? Before addressing this core question, we note that the German data reveals a different pattern of association between the two measures of occupational demography (gender and ethnic composition) than

[27] It must be noted that when we use an aggregate of trade union membership we are likely to overestimate the effect of unionization in the UK. When we use an aggregate measure of CLA coverage, based on the QLFS question "Are your pay and conditions of employment directly affected by agreements between your employer and any trade union(s) or staff association?", the effect of unions on wages is much smaller. In model 2 the wage premium for occupations that are fully covered by a CLA would only be 9 percent, instead of the 15 percent for occupations from which all members are union members. However, due to the absence of a comparable CLA measure for Germany, we use trade union membership.

[28] The coefficients pertaining to skills show effects comparable to other analyses: complex processing skills and presentation skills are positively associated with earnings, and physical complexity is negatively associated with earnings. Given the dearth of surprises in these coefficients, we will not devote further space to them.

the UK data. In the UK, as in the US, ethnic composition had no net association with earnings whereas gender composition was negatively associated with earnings (see also Weeden 2002). In the German data, both measures of occupational demography are negatively correlated with wages, although the wage penalty associated with high percentages of ethnic minorities in an occupation disappears when adjusting for skills. Gender segregation contributes to wage inequality in both countries, and moreover these effects cannot be attributed to either the skills associated with "women's work" or the higher levels of closure found in male-dominated occupations (see, e.g., Tomaskovic-Devey 1993).

[Table 6 about here]

As much as scholars emphasize differences between CMEs and LMEs in the extent to which institutional configurations affect levels and patterns of wage inequality, Model 2 in Table 6 also shows that similarities between the UK and Germany extend beyond segregation effects: the pattern of closure effects on wages estimated for the German data are remarkably similar to the pattern of effects estimated in the UK. Educational credentialing has a positive effect on occupational wages, even after adjusting for individual-level educational attainment. As in the UK, occupations that require either a mid-level degree (here, a vocational degree) or a general university degree benefit have higher wages than those that do not require a degree. Also as in the UK, occupations that require a tertiary degree have higher wages, all else equal, than occupations that require a vocational degree. In Germany, the estimated coefficient of our crude indicator of EU regulation, does not reach statistical significance, although its effect is in the anticipated direction. In Germany, licensure positively affects occupational earnings, with fully licensed occupations receive a wage premium of 8.2% (0.082) relative to unlicensed occupations, an effect size comparable to the analogous effect in the UK. Striking differences between Germany and the UK emerge, however, in the estimated wage effects of unionization. In Germany, unlike in the UK, the wage effect of licensure is trivial relative to the wage effect of unionization. In a hypothetical occupation in which all workers are unionized, occupational earnings would exceed those in a nonunionized occupation by 40.6%, or 0.406. Apprenticeships, by contrast, do not have a positive effect on occupational earnings in Germany, an unanticipated result to which we return below.

The unadjusted closure estimates for Germany and the UK are thus remarkably similar: occupational closure secured through credentialing, licensure, and unionization generates higher occupational earnings in both countries, whereas apprenticeships do not.

This pattern of results persists in models that adjust for occupational skills (see Model 4 in Table 6). Indeed, although the credentialing and licensure effects are reduced in size in the skill-adjusted models, the unionization effects is essentially unchanged.

How do these results compare to those we observed for the UK? The most striking feature of the skill-adjusted closure results in Table 6, compared to the analogous results for the UK, is the persistence of the educational credentialing effect in the skill-adjusted models. German employees with similar individual level attributes, including education, benefit from working in an occupation in which educational credentialing is prevalent. This disparity with the UK case can, we think, be understood as a consequence of the highly stratified German education system, which not only provides and signals highly occupation-specific skills but also limits the supply of labor into the occupations that are at the end of the vocational track. The more general qualifications secured through the UK education system, by contrast, only generate wage premia to occupational incumbents by virtue of the association between educational closure and occupational skills.

Unionization, too, has a strong net effect on occupational wage levels in Germany. Indeed, its coefficient is barely changed when adjusting for occupational skill (compare models 2 and 4 in Table 6). Moreover, the union effect has the strongest effect among the closure variables that are specified in comparable ways, i.e., with density measures. This result confirms our hypothesis that unionization would be especially effective in Germany, at least relative to the other closure practices.

The third result of the skill-adjusted model that we wish to highlight is the persistent, positive wage premium associated with occupational licensure in Germany. In absolute terms, the wage premiums to licensure in Germany are comparable in magnitude to those in the UK. At the same time, it bears emphasizing that licensure in Germany covers a much narrower range of occupations, primarily in the health field. Although we do not wish to downplay the importance of licensure in securing economic rents for members of these occupations, the aggregate effect of licensure on the occupational earnings distribution is perforce limited to this sector. Moreover, relative to the other closure practices, and in particular educational credentialing and unionization, licensure has a more modest effect on the wage distribution in Germany than in the UK.

The results for credentialing, unionization, and licensure thus largely conform to our expectations for the German data. We did not, however, anticipate the absence of an apprenticeship effect, which we observe in both the unadjusted and the skill-adjusted multilevel models. In interpreting the absence of an observed apprenticeship effect, two points

are worth noting. First, our models also fit effects for vocational training that is secured in the formal education system. Although we have treated this, we think properly, as an educational credentialing effect, in the dual system apprenticeships are of course tightly linked to vocational training in schools. Put differently, apprenticeships may secure rents, but only through the barriers to access to vocational education.

It is also plausible that apprenticeships have a sector-limited effect, raising wages of apprenticed occupations relative to non-apprenticed occupations in the same aggregate "class" (e.g., craft, manual labor), but not relative to wages in the average occupation. A closer examination of the distribution of apprenticeships reveals that they are primarily concentrated in the skilled trade and operative occupations, which are, on average, lower paid than the skilled non-manual sector occupations. When we apply our models to data from the manual sector, we indeed find that an apprenticeship pays off with statistically and substantively significant wage returns compared to other occupations in this sector (see Appendix C). It thus seems to be the case that apprenticeships generate economic rents, much as the closure approach suggests, but their effect on overall levels of wage inequality is more complex than our three other closure practices: apprenticeships raise the average wages of occupations that have secured this form of closure relative to comparable manual occupations, but because these occupations tend to be found in the lower half of the wage distribution, the aggregate effect of apprenticeships is to reduce income inequality rather than increase it, as is the case for licensure. This pattern of results is consistent with Parkin's observation long ago of dual closure in the manual sector (Parkin 1974, p. 13).

Finally, it is useful to examine the variance decompositions in the German data, and how these compare to the UK. A null model fit to the German data suggests that 26 percent of the total variance in earnings takes place between occupations, which is less than the comparable percentage in the UK (40%) but still substantial. (The overall variance in earnings is compressed in the German data, not only because of the cruder measure of income available in the microdata, but also because of the lower levels of inequality that are characteristic of CMEs [OECD 2008; Solt 2009]). The reduction in variance attributable to our occupation-level measures, however, shows a similar pattern in Germany as in the UK, with residual occupation-level variance declining by nearly three quarters (to 7.2%) in models that estimate occupational demography and closure effects (see Model 2, Table 6). In Germany, just as in the UK, occupational closure practices generate much of the occupation-level heterogeneity in earnings.

Conclusion and discussion

In this article, we analyzed four key, institutionalized occupational closure practices and their relationship to wages in Germany and in the UK. In so doing, we extended the geographic range of extant empirical tests of the closure approach. Although many studies have examined the effects of unionization and educational credentialing on wages outside the United States, ours is the first, so far as we know, to have incorporated a broader range of closure practices, and in the context of multilevel models that also adjust, as best as we can, for occupational skills and demography.

Our theoretical contribution is to elaborate the closure approach to the comparative context, and link this work to the much broader comparative inequality literature on labor market regimes, we think to the benefit of both closure theory and the VoC literature. Just as the occupational closure framework has developed largely without reference to the broader system of institutions that coordinate economic exchange, so too has the comparative inequality literature developed largely without reference to institutionalized forms of occupational closure and their effects on labor prices within systems of economic exchange. While in the VoC-literature rent-generating institutions at the bottom of the income distribution are fully acknowledged for their role in mitigating wage inequality, almost no attention is given to rent-generating institutions at the top of the income distribution. This article takes a critical step toward addressing these gaps in the inequality literature.

Our empirical analysis supports three important conclusions: 1) occupational closure, at least by the four institutionalized practices we examined, is more prevalent in Germany than in the UK; 2) occupational closure generates economic rents in both countries; and 3) the closure practices that have the strongest and weakest impact on occupational wages differ in systematic ways between Germany, our representative CME, and the UK, our representative LME. Formal educational credentials and apprenticeships are more important closure strategies in Germany, with its highly stratified and vocationally oriented education system, than in the UK. The opposite is true for licensure: in the UK almost three times as many individuals are in licensed occupations than in Germany, however, both countries do not outreach each other much on the levels of unionization. We can therefore conclude that, overall, there is more closure in Germany, which is hardly a surprise as the ideal typical CME is often characterized by its high levels of institutionalized (government) regulation. While differences in the levels of closure are a finding in itself, we are especially interested in how occupational closure generates inequalities.

Our second main finding is that occupational closure generates economic rents for

incumbents of closed occupations, thereby affecting the wage distribution and wage inequality in critical ways. In both Germany and the UK unionization and licensure generate a wage premium, even after controlling for the individual-level human capital attributes of occupation members and other features of occupations. Educational credentialing is also an effective closure practice, although the lower-bound estimates presented in models that also adjust for skill requirements suggest this effect may be limited to Germany; similarly, apprenticeships appear to have a "local" effect on wages, raising wages in manual occupations relative to other manual occupations, but not relative to the "average" occupation. These measures of closure, moreover, account for a substantial portion of the (substantial) between-occupation variance in earnings. Occupational closure generates rents across two very different European contexts.

Even so, our third main conclusion is that the prevalence and strength of the four closure practices vary in systematic and predictable ways between Germany, the prototypical coordinated market economy, and the UK, the prototypical European liberal market economy. Educational credentialing is an especially effective form of closure in Germany, in terms of wage returns, which is consistent with an economy in which educational institutions are highly vocationalized and educational degrees tightly linked to particular occupational positions. In the UK, by contrast, educational credentialing largely generates wage returns insofar as it limits access to training for highly skilled occupations; and once occupational skills are controlled, the credentialing effect disappears. Licensure, by contrast, exerts strong wage effects in the UK, and serves as the primary institution through which occupational representatives can exert some measure of control over the supply of labor into their occupations.

So far, we have framed these findings in terms of their implications for understanding differences across countries in patterns of wage inequality between occupations. Are they also relevant for understanding differences across countries in the level of aggregate wage inequality? Logically, the impact of occupational closure on aggregate levels of inequality depends on (a) the closure effect on mean occupational wages, (b) the closure effect on within-occupation wage inequality, (c) the distribution of closure practices across occupations, and (d) the relative size of the closure effect across different kinds of occupations. If closure is primarily found in, or generates the greatest wage premia in, occupations that even in the absence of closure would fall near the top of the occupational wage distribution, closure will have an exacerbating effect on aggregate levels of wage inequality. Conversely, if closure is primarily found in, or has the greatest benefits for,

occupations that would in the counterfactual closure-free world fall at the bottom of the wage distribution, closure will suppress aggregate levels of inequality.

We cannot, in the present article, formally test the impact of closure on aggregate levels of inequality. Our results nevertheless allow us to make tentative statements in this regard, if only to highlight the importance of examining these distributional and interaction effects more closely in future research. Our data suggest that in Germany, compared to the UK, closure practices are diffused more evenly throughout the division of labor, and moreover that the strategies that have the strongest positive association with wages are also those that are most likely to be found in the manual and unskilled sectors. We show, for example, that trade unionization and vocational degree requirements generate net occupational returns, and that apprenticeships have uneven effects: they raise wages of apprenticed occupations in the manual sector, but not in other sectors. Although it remains to be demonstrated more formally, the net result is that closure in Germany is likely to compress overall levels of wage inequality (even as it creates greater wage differences within the manual sector, for example). In the UK, by contrast, closure that generate rents for members of unskilled occupations is less prevalent (e.g., apprenticeships), and their wage effects weak relative to the wage premiums generated by the closure practices (e.g., licensure) favored by the professions.

More generally, our analysis serves as a useful corrective to the comparative inequality literature, which overemphasizes the institutions “at the bottom” of the wage distribution that compress inequality in CMEs, in particular, at the expense of the many labor market institutions that generate rents for occupations at the top of the wage distribution. If we want to understand why LMEs have so much more inequality than CMEs, we need to understand not only how the institutions in the institution-rich CMEs compress wage inequality, but also how the institutions in ostensibly liberal market economies exacerbate it. We are hesitant to make *too* many grand claims about inequality in CMEs relative to LMEs, given we have “only” examined occupational closure effects in two countries, carefully chosen though they may be. Nevertheless, our analysis demonstrates the ongoing importance of closure practices in generating wage inequality in liberal and coordinated market economies alike.

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Table 1

DESCRIPTIVE STATISTICS OF INDIVIDUAL LEVEL VARIABLES FOR THE UK.

Variable	Mean	SD	Min.	Max.
Female	0.53	0.50	0	1
Married	0.71	0.45	0	1
Kids in home	0.38	0.48	0	1
Ethnic minority	0.10	0.29	0	1
Country of residence:				
England	0.83	0.37	0	1
Scotland	0.09	0.29	0	1
Wales	0.05	0.21	0	1
Northern Ireland	0.03	0.16	0	1
Highest educational qualification:				
No qualifications	0.09	0.29	0	1
Other qualifications	0.07	0.26	0	1
Below NVQ Level 2	0.14	0.35	0	1
NVQ Level 2	0.16	0.36	0	1
Trade Apprenticeships	0.05	0.22	0	1
NVQ Level 3	0.15	0.35	0	1
NVQ Level 4 and above	0.34	0.47	0	1
Years of education	13.83	2.83	1	35
Experience	23.39	12.55	0	53
Experience squared	704.47	612.84	0	2,809
Normal hours in workweek	34.23	10.59	1	97
Parttime	0.24	0.43	0	1
ln Monthly earnings	6.82	0.66	3.73	10.49
Net monthly earnings	1,119.54	815.55	40.00	36,000

SOURCE. – Author's calculations using the Quarterly Labor Force Survey, all quarters of 2006 and 2007.

Table 2

DESCRIPTIVE STATISTICS OF INDIVIDUAL LEVEL VARIABLES FOR GERMANY.

Variable	Mean	SD	Min.	Max.
Female	0.43	0.49	0	1
Married	0.60	0.49	0	1
Kids in home	0.52	0.50	0	1
Ethnic minority	0.02	0.14	0	1
Former Eastern Germany	0.23	0.42	0	1
Highest qualification				
CASMIN 1abc	0.27	0.45	0	1
CASMIN 2ab	0.39	0.49	0	1
CASMIN 2c	0.13	0.33	0	1
CASMIN 3a	0.07	0.26	0	1
CASMIN 3b	0.14	0.35	0	1
Years of education	16.44	4.98	9	35
Experience	19.60	11.41	0	50
Experience squared	514.30	480.05	0	2,500
Normal hours in workweek	37.98	10.41	1	90
Parttime	0.18	0.39	0	1
ln Monthly earnings	7.32	0.60	4.32	9.99
Net monthly earnings	1,821.30	1,452.06	75.00	22,000

SOURCE. – Author's calculations using the German Microcensus, wave 2006.

Table 3

DESCRIPTIVE STATISTICS OF ALL OCCUPATIONAL VARIABLES

	United Kingdom				Germany			
Variable	$Mean_{ij}$	SD_{ij}	$Mean_j$	SD_j	$Mean_{ij}$	SD_{ij}	$Mean_j$	SD_j
% Ethnic minority	0.10	0.06	0.09	0.06	0.03	0.03	0.04	0.04
% Female	0.51	0.32	0.38	0.30	0.44	0.32	0.34	0.29
No educational requirements	0.59	0.49	0.59	0.49	0.16	0.20	0.22	0.25
Low (UK)/Vocational (Germany) degree required	0.18	0.38	0.19	0.39	0.61	0.31	0.60	0.32
University degree required	0.23	0.42	0.22	0.41	0.23	0.33	0.18	0.31
EU regulated	0.25	0.43	0.24	0.43	0.25	0.43	0.22	0.41
Licensure	0.13	0.32	0.18	0.36	0.05	0.22	0.05	0.21
% Unionized	0.29	0.23	0.28	0.22	0.14	0.08	0.15	0.09
% Apprenticeship	0.11	0.15	0.15	0.16	0.52	0.22	0.53	0.21
Physical abilities	-0.05	0.56	0.05	0.61	0.03	0.61	0.20	0.61
Technical skills	-0.06	0.43	0.10	0.52	0.05	0.56	0.28	0.58
Complex processing skills	0.00	0.47	0.04	0.48	-0.01	0.44	-0.10	0.48
Interaction skills	0.04	0.45	-0.05	0.52	-0.04	0.51	-0.18	0.53
Presentation skills	0.04	0.55	-0.03	0.57	-0.03	0.33	-0.14	0.35
Mathematical skills	0.00	0.49	-0.04	0.49	0.52	0.17	0.50	0.20

SOURCE. – Author's calculations using the Quarterly Labor Force Survey, all quarters of 2006 and 2007 and the Microcensus of 2006.

NOTE. – The *i* refers to individuals and the *j* to occupations. Consequently, the $mean_{ij}$ and sd_{ij} are the weighted mean and standard deviation, while the $mean_j$ and sd_j show the unweighted mean and standard deviation.

Table 4

DESCRIPTIVE STATISTICS OF ALL OCCUPATIONAL VARIABLES AND THEIR BIVARIATE CORRELATIONS FOR THE UNITED KINGDOM.

		United Kingdom														
Variable		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	% Ethnic minority	1.00														
2	% Female	0.16	1.00													
3	No educational req.	*-0.08*	-0.14	1.00												
4	Low educational req.	*-0.09*	*0.07*	-0.59	1.00											
5	High educational req.	0.18	0.10	-0.63	-0.26	1.00										
6	EU regulated	*0.07*	*0.06*	-0.40	0.16	0.32	1.00									
7	Licensure	*0.08*	*0.00*	-0.35	*0.07*	0.35	0.51	1.00								
8	% Unionized	*0.08*	*0.01*	-0.20	*0.02*	0.23	0.18	0.33	1.00							
9	% Apprenticeship	-0.30	-0.58	*0.07*	*0.05*	-0.13	*-0.09*	*-0.08*	*-0.06*	1.00						
10	Physical abilities	-0.13	-0.37	0.41	-0.15	-0.35	-0.22	-0.13	*0.04*	0.31	1.00					
11	Technical skills	*-0.07*	-0.38	0.23	*-0.03*	-0.24	*-0.10*	*-0.04*	*-0.02*	0.49	0.66	1.00				
12	Complex processing skills	*-0.02*	-0.12	-0.50	0.17	0.43	0.30	0.23	0.11	0.15	-0.27	*-0.02*	1.00			
13	Interaction skills	*0.03*	0.24	-0.44	0.13	0.41	0.24	0.21	0.26	-0.24	-0.35	-0.39	0.62	1.00		
14	Presentation skills	*0.03*	0.19	-0.56	0.14	0.53	0.37	0.29	0.26	-0.24	-0.59	-0.52	0.68	0.76	1.00	
15	Mathematical skills	*0.05*	*-0.08*	-0.37	0.13	0.32	0.26	*0.06*	-0.19	0.12	-0.35	-0.11	0.51	0.35	0.40	1.00
		Germany														
1	% Ethnic minority	1.00														
2	% Female	-0.12	1.00													
3	No educational req.	0.50	*0.10*	1.00												
4	Vocational degree req.	*-0.10*	-0.19	-0.43	1.00											
5	University degree req.	-0.30	0.11	-0.36	-0.68	1.00										
6	EU regulated	-0.15	*0.02*	-0.24	*0.04*	0.16	1.00									
7	Licensure	*-0.11*	*-0.01*	*-0.09*	-0.26	0.34	0.19	1.00								
8	% Unionized	*-0.03*	-0.38	*-0.10*	0.14	*-0.07*	*-0.07*	*0.00*	1.00							
9	% Apprenticeship	0.21	-0.20	0.21	0.69	-0.88	-0.18	-0.29	0.14	1.00						
10	Physical abilities	0.32	-0.37	0.17	0.37	-0.52	0.20	-0.16	*0.05*	0.45	1.00					
11	Technical skills	0.11	-0.67	-0.20	0.47	-0.32	*0.07*	-0.10	0.29	0.35	0.55	1.00				
12	Complex processing skills	-0.55	*-0.04*	-0.65	*0.01*	0.52	0.20	0.15	*0.08*	-0.49	-0.24	*0.00*	1.00			
13	Interaction skills	-0.50	0.21	-0.46	-0.18	0.56	0.34	0.14	*-0.05*	-0.56	-0.25	-0.29	0.72	1.00		
14	Presentation skills	-0.49	0.24	-0.43	-0.37	0.73	0.14	0.16	*-0.10*	-0.70	-0.55	-0.44	0.69	0.78	1.00	
15	Mathematical skills	-0.37	-0.28	-0.61	0.26	0.23	*0.07*	-0.02	*0.09*	-0.16	*-0.07*	0.35	0.47	0.25	0.26	1.00

SOURCE. – Author's calculations using the Quarterly Labor Force Survey, all quarters of 2006 and 2007 and the German Microcensus, wave 2006.

NOTE. – The correlations are unweighted, all occupations have equal weight. All correlations that are shown in italics are not significant.

Table 5

MULTILEVEL RANDOM INTERCEPT MODELS TO ESTIMATE THE WAGE EFFECTS OF OCCUPATIONAL CLOSURE IN THE UNITED KINGDOM.

	Model 0	Model 1	Model 2	Model 3	Model 4
Composition controls					
% Ethnic minority		0.287	0.034	0.223	0.180
		(0.210)	(0.177)	(0.138)	(0.136)
% Female		-0.156***	-0.210***	-0.232***	-0.218***
		(0.040)	(0.039)	(0.031)	(0.032)
Occupational closure variables					
No educational requirements			ref.		ref.
Low educational degree required			0.110***		-0.013
			(0.026)		(0.021)
Higher educational degree required			0.246***		0.036
			(0.027)		(0.025)
EU regulated			0.053*		0.002
			(0.027)		(0.021)
Licensure			0.076*		0.093***
			(0.033)		(0.025)
% Unionized			0.157**		0.197***
			(0.048)		(0.041)
% Apprenticeship			-0.047		-0.019
			(0.078)		(0.066)
Occupational skill variables					
Physical abilities				-0.094***	-0.100***
				(0.021)	(0.020)
Technical skills				0.043	0.013
				(0.025)	(0.024)
Complex processing skills				0.132***	0.156***
				(0.031)	(0.030)
Interaction skills				0.031	0.010
				(0.027)	(0.025)
Presentation skills				0.147***	0.067*
				(0.030)	(0.030)
Mathematical skills				-0.008	0.026
				(0.020)	(0.020)
Constant	6.917***	5.992***	5.900***	6.032***	5.956***
	(0.021)	(0.037)	(0.045)	(0.033)	(0.039)
σ^2u (occupations)	0.151***	0.047***	0.028***	0.019***	0.015***
	(0.012)	(0.002)	(0.001)	(0.001)	(0.001)
σ^2e	0.228***	0.127***	0.127***	0.127***	0.127***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
ICC (occupations)	0.398	0.272	0.183	0.130	0.108
-2LL	104,232	59,853	59,516	59,398	59,334
N (occupations)	344	344	344	344	344
N (individuals)	75,681	75,681	75,681	75,681	75,681

SOURCE. – Author's calculations using the Quarterly Labor Force Survey, all quarters of 2006 and 2007.

NOTE. – Dependent variable is the natural logarithm of monthly earnings. Standard errors are listed in brackets under coefficients. All coefficients in model 1, 2, 3, and 4 are controlled for all individual level variables. These individual level estimates are not shown but can be found in Appendix B1.

* *p<0.05*

** *p<0.01*

*** *p<0.001*

Table 6

MULTILEVEL RANDOM INTERCEPT MODELS TO ESTIMATE THE WAGE EFFECTS OF OCCUPATIONAL CLOSURE IN GERMANY.

	Model 0	Model 1	Model 2	Model 3	Model 4
Composition controls					
% Ethnic minority		-1.976***	-0.714***	-0.154	-0.076
		(0.242)	(0.214)	(0.228)	(0.218)
% Female		-0.101**	-0.050*	-0.201***	-0.132***
		(0.031)	(0.025)	(0.032)	(0.031)
Occupational closure variables					
No educational requirements			ref.		ref.
Vocational degree required			0.136***		0.083*
			(0.034)		(0.041)
Higher educational degree required			0.423***		0.234***
			(0.054)		(0.055)
EU regulated			-0.020		0.031
			(0.017)		(0.017)
Licensure			0.082*		0.090**
			(0.034)		(0.031)
% Unionized			0.406***		0.381***
			(0.078)		(0.072)
% Apprenticeship			-0.021		0.040
			(0.071)		(0.069)
Occupational skill variables					
Physical abilities				-0.107***	-0.075***
				(0.016)	(0.016)
Technical skills				-0.023	-0.039*
				(0.021)	(0.019)
Complex processing skills				0.077**	0.049*
				(0.026)	(0.021)
Interaction skills				0.008	-0.027
				(0.024)	(0.023)
Presentation skills				0.131**	0.099*
				(0.043)	(0.042)
Mathematical skills				0.071	0.077
				(0.044)	(0.043)
Constant	7.306***	6.710***	6.436***	6.694***	6.466***
	(0.017)	(0.022)	(0.058)	(0.033)	(0.057)
σ^2u (occupations)	0.089***	0.025***	0.013***	0.013***	0.010***
	(0.004)	(0.001)	(0.001)	(0.001)	(0.000)
σ^2e	0.251***	0.163***	0.163***	0.163***	0.163***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ICC (occupations)	0.262	0.132	0.072	0.073	0.057
-2LL	197,017	138,537	138,340	138,344	138,271
N (occupations)	330	330	330	330	330
N (individuals)	134,376	134,376	134,376	134,376	134,376

SOURCE. – Author's calculations using the German Microcensus, wave 2006.

NOTE. – The dependent variable is the natural logarithm of monthly earnings. Standard errors are listed in brackets under coefficients. All coefficients in model 1, 2, 3, and 4 are controlled for all individual level variables. These individual level estimates are not shown but can be found in Appendix B2.

* *p<0.05*
** *p<0.01*
*** *p<0.001*

Appendix A

OVERVIEW OF SKILL MEASURES

	United Kingdom	Germany
Physical ability	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Physical strength (for example, to carry, push or pull heavy objects). 2) Physical stamina (to work for long periods on physical activities). Eigenvalue: 1.38 Cronbach's α: 0.86	*How often appear the following condition to you (0= never, 1= rarely, 2=sometimes, 3=frequently)* 1) Work standing up. 2) Carry heavy stocks of more than 20kg (men), 10 kg (women). 3) Working crouched down, kneed, reclined, overarm. Eigenvalue: 1.33 Cronbach's α: 0.75
Technical skills	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Skill or accuracy in using your hands or fingers (for example to mend, repair, assemble, construct or adjust things). 2) Knowledge of how to use or operate tools, equipment or machinery. Eigenvalue: 0.94 Cronbach's α: 0.74	*Do you require the following skills in your job (0=no, 1=basic skills, 2= specialized skills)* 1) Manual/craft skills. 2) Technical skills. *How often does the following task appear in your job?(0=never, 1=sometimes, 2=often)* 3) Operating, controlling machines Eigenvalue: 1.20 Cronbach's α: 0.70
Complex mental processing	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Working out the cause of problems or faults. 2) Thinking of solutions to problems. 3) Analysing complex problems in depth. 4) Planning the activities of others. 5) Thinking ahead. Eigenvalue: 2.37 Cronbach's α: 0.81	*How often appear the following tasks to you (0= never, 1= rarely, 2=sometimes, 3=frequently)* 1) You are confronted with new problems that remain to be understood. 2) Process optimization or trying out new things 3) You are asked to do things you haven't learned yet or aren't proficient in. 4) There are diverse processes and job tasks which you have to keep an eye on simultaneously. *How often does the following job characteristics appear in your job?(0=never, 1=sometimes, 2=often)* 5) Having to react to and solving unforeseeable problems. 6) Recognizing and closing own knowledge gaps. Eigenvalue: 2.34 Cronbach's α: 0.77

Interaction skills	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Dealing with people. 2) Instructing, training or teaching people, individually or in groups. 3) Persuading or influencing others. 4) Counselling, advising or caring for customers or clients. 5) Listening carefully to colleagues. 6) Working with a team of people. Eigenvalue: 2.10 Cronbach's α: 0.72	*How often does the following job characteristics appear in your job?(0=never, 1=sometimes, 2=often)* 1) Having contact to customers, clients, patients. 2) Notifying /communicating difficult issues in an intelligible to all way. *How often does it appear that (0=never, 1=sometimes, 2=often)* 3) You feel being part of a team. Eigenvalue: 1.19 Cronbach's α: 0.61
Presentation skills	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Writing short documents. 2) Writing long documents with correct spelling and grammar. 3) Making speeches or presentations. Eigenvalue: 1.51 Cronbach's α: 0.81	*Do you require the following skills in your job (0=no, 1=basic skills, 2= specialized skills)* 1) German language skills, writing, spelling *How often does the following job characteristics appear in your job?(0=never, 1=sometimes, 2=often)* 2) Speechmaking, giving talks. Eigenvalue: 0.88 Cronbach's α: 0.46
Basic mathematical skills	*How important is… (0=not at all important, 1=not very important, 2=fairly important, 3=very important, 4= essential)* 1) Adding, subtracting, multiplying or dividing numbers. 2) Calculations using decimals, percentages or fractions. Eigenvalue: 1.38 Cronbach's α: 0.87	*Do you require the following skills in your job (0=no, 0.5=basic skills, 1= specialized skills)* 1) Mathematical, statistical skills As there is only one variable the average score per occupation was taken.

SOURCE. – The British Skills surveys of 2001 and 2006 (the UK, N=12,257) and the BIBB-BAuA Employment Survey of 2006 (Germany, N = 20,000).

NOTE. – Over all items a factor analysis was performed and the factor scores were saved as regression coefficients. All individual factor scores were then aggregated to the occupational level.

Appendix B1

INDIVIDUAL LEVEL COVARIATES OF MULTILEVEL REGRESSIONS FOR THE UK

	Model 1		Model 2		Model 3		Model 4	
	b	se	b	se	b	se	b	se
Female	-0.775***	(0.028)	-0.792***	(0.021)	-0.793***	(0.021)	-0.793***	(0.021)
Married	0.060***	(0.005)	0.059***	(0.005)	0.059***	(0.005)	0.059***	(0.005)
Children in home	0.023***	(0.005)	0.023***	(0.005)	0.023***	(0.005)	0.023***	(0.005)
Ethnic minority	-0.040***	(0.007)	-0.038***	(0.007)	-0.038***	(0.007)	-0.038***	(0.007)
Country of residence								
England	ref		ref.		ref.		ref.	
Scotland	-0.014*	(0.007)	-0.014*	(0.007)	-0.013*	(0.007)	-0.013*	(0.007)
Wales	-0.067***	(0.009)	-0.067***	(0.009)	-0.067***	(0.009)	-0.067***	(0.009)
Northern Ireland	-0.044***	(0.012)	-0.043***	(0.012)	-0.043***	(0.012)	-0.043***	(0.012)
Highest level of education								
No qualification	ref		ref.		ref.		ref.	
Other qualifications	0.061*	(0.027)	0.057*	(0.027)	0.056*	(0.027)	0.056*	(0.027)
Below NVQ level 2	-0.033	(0.025)	-0.036	(0.025)	-0.037	(0.025)	-0.037	(0.025)
NVQ level 2	-0.019	(0.024)	-0.022	(0.024)	-0.024	(0.024)	-0.024	(0.024)
Trade apprenticeships	0.061	(0.035)	0.059	(0.035)	0.057	(0.035)	0.058	(0.035)
NVQ level 3	-0.017	(0.023)	-0.019	(0.023)	-0.022	(0.023)	-0.022	(0.023)
NVQ level 4 and above	-0.009	(0.022)	-0.011	(0.022)	-0.015	(0.022)	-0.015	(0.022)
Years of schooling	0.020***	(0.001)	0.019***	(0.001)	0.019***	(0.001)	0.019***	(0.001)
Experience	0.017***	(0.002)	0.017***	(0.002)	0.017***	(0.002)	0.017***	(0.002)
Experience squared	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Normal hours in workweek	0.013***	(0.000)	0.013***	(0.000)	0.013***	(0.000)	0.013***	(0.000)
Part time	-0.518***	(0.010)	-0.517***	(0.010)	-0.517***	(0.010)	-0.516***	(0.010)
Experience * Highest level education								
*Experience * No qualification*	ref		ref.		ref.		ref.	
*Experience * Other qualification*	-0.001	(0.002)	-0.001	(0.002)	-0.001	(0.002)	-0.001	(0.002)
*Experience * Below NVQ level 2*	0.006**	(0.002)	0.006**	(0.002)	0.006**	(0.002)	0.006**	(0.002)
*Experience * NVQ level 2*	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.007***	(0.002)
*Experience * Trade apprenticeships*	0.004	(0.003)	0.004	(0.003)	0.004	(0.003)	0.004	(0.003)
*Experience * NVQ level 3*	0.011***	(0.002)	0.011***	(0.002)	0.011***	(0.002)	0.011***	(0.002)
*Experience * NVQ level 4 and above*	0.017***	(0.002)	0.017***	(0.002)	0.017***	(0.002)	0.017***	(0.002)
Experience sq.* Highest level education								
*Experience sq. * No qualification*	ref		ref.		ref.		ref.	
*Experience sq. * Other qualification*	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
*Experience sq. * Below NVQ level 2*	-0.000**	(0.000)	-0.000**	(0.000)	-0.000**	(0.000)	-0.000**	(0.000)
*Experience sq. * NVQ level 2*	-0.000**	(0.000)	-0.000**	(0.000)	-0.000**	(0.000)	-0.000**	(0.000)
*Experience sq. * Trade apprenticeships*	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
*Experience sq. * NVQ level 3*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
*Experience sq. * NVQ level 4 and above*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Female * Country of residence								
*Female * England*	ref		ref.		ref.		ref.	
*Female * Scotland*	0.024**	(0.009)	0.024**	(0.009)	0.024**	(0.009)	0.024**	(0.009)
*Female * Wales*	0.052***	(0.012)	0.052***	(0.012)	0.052***	(0.012)	0.052***	(0.012)
*Female * Northern Ireland*	0.052**	(0.016)	0.051**	(0.016)	0.050**	(0.016)	0.051**	(0.016)
Female * Highest level education								
*Female * No qualification*	ref		ref.		ref.		ref.	
*Female * Other qualification*	-0.010	(0.014)	-0.010	(0.013)	-0.010	(0.013)	-0.010	(0.013)
*Female * Below NVQ level 2*	-0.002	(0.012)	-0.002	(0.012)	-0.002	(0.012)	-0.002	(0.012)
*Female * NVQ level 2*	-0.002	(0.012)	-0.002	(0.012)	-0.001	(0.012)	-0.001	(0.012)
*Female * Trade apprenticeships*	-0.049**	(0.018)	-0.049**	(0.018)	-0.049**	(0.018)	-0.049**	(0.018)
*Female * NVQ level 3*	-0.015	(0.012)	-0.016	(0.012)	-0.014	(0.012)	-0.015	(0.012)
*Female * NVQ level 4 and above*	0.006	(0.012)	0.001	(0.011)	0.004	(0.011)	0.003	(0.011)
Female * Married	-0.059***	(0.006)	-0.059***	(0.006)	-0.059***	(0.006)	-0.059***	(0.006)
Female * Children in home	-0.041***	(0.006)	-0.041***	(0.006)	-0.042***	(0.006)	-0.042***	(0.006)
Female * Ethnic minority	0.033***	(0.010)	0.031**	(0.009)	0.031**	(0.009)	0.031**	(0.009)
Female * Years of education	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)
Female * Normal hours in workweek	0.021***	(0.000)	0.021***	(0.000)	0.021***	(0.000)	0.021***	(0.000)
Female * Part time	0.482***	(0.012)	0.481***	(0.012)	0.480***	(0.012)	0.480***	(0.012)
Female * Experience	-0.007***	(0.001)	-0.006***	(0.001)	-0.006***	(0.001)	-0.006***	(0.001)
Female * Experience sq.	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)

* p<0.05, ** p<0.01, *** p<0.001

Appendix B2

INDIVIDUAL LEVEL COVARIATES OF MULTILEVEL REGRESSIONS FOR GERMANY

	Model 1		Model 2		Model 3		Model 4	
	b	se	b	se	b	se	b	se
Female	-0.517***	(0.019)	-0.518***	(0.019)	-0.519***	(0.019)	-0.519***	(0.019)
Married	0.156***	(0.004)	0.156***	(0.004)	0.156***	(0.004)	0.156***	(0.004)
Children in home	0.059***	(0.003)	0.059***	(0.003)	0.059***	(0.003)	0.059***	(0.003)
Ethnic minority	-0.083***	(0.010)	-0.082***	(0.010)	-0.083***	(0.010)	-0.083***	(0.010)
Former East Germany	-0.310***	(0.004)	-0.310***	(0.004)	-0.310***	(0.004)	-0.310***	(0.004)
Highest level of education								
CASMIN 1abc	ref.		ref.		ref.		ref.	
CASMIN 2ab	0.025**	(0.010)	0.025**	(0.010)	0.025**	(0.010)	0.025**	(0.010)
CASMIN 2c	0.029*	(0.012)	0.028*	(0.012)	0.027*	(0.012)	0.027*	(0.012)
CASMIN 3a	0.141***	(0.014)	0.136***	(0.014)	0.137***	(0.014)	0.136***	(0.014)
CASMIN 3b	0.105***	(0.012)	0.099***	(0.012)	0.100***	(0.012)	0.098***	(0.012)
Years of schooling	0.008***	(0.000)	0.008***	(0.000)	0.008***	(0.000)	0.008***	(0.000)
Experience	0.019***	(0.001)	0.019***	(0.001)	0.019***	(0.001)	0.019***	(0.001)
Experience squared	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Normal hours in workweek	0.010***	(0.000)	0.010***	(0.000)	0.010***	(0.000)	0.010***	(0.000)
Part time	-0.267***	(0.009)	-0.268***	(0.009)	-0.269***	(0.009)	-0.269***	(0.009)
Experience * Highest level education								
*Experience * CASMIN 1abc*	ref.		ref.		ref.		ref.	
*Experience * CASMIN 2ab*	0.002*	(0.001)	0.002*	(0.001)	0.002*	(0.001)	0.002*	(0.001)
*Experience * CASMIN 2c*	0.007***	(0.001)	0.007***	(0.001)	0.007***	(0.001)	0.007***	(0.001)
*Experience * CASMIN 3a*	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)	0.006***	(0.002)
*Experience * CASMIN 3b*	0.017***	(0.001)	0.018***	(0.001)	0.018***	(0.001)	0.018***	(0.001)
Experience sq. * Highest level education								
*Experience sq. * CASMIN 1abc*	ref.		ref.		ref.		ref.	
*Experience sq. * CASMIN 2ab*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
*Experience sq. * CASMIN 2c*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
*Experience sq. * CASMIN 3a*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
*Experience sq. * CASMIN 3b*	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Female * Highest level education								
*Female * CASMIN 1abc*	ref.		ref.		ref.		ref.	
*Female * CASMIN 2ab*	0.015*	(0.006)	0.015*	(0.006)	0.015*	(0.006)	0.015*	(0.006)
*Female * CASMIN 2c*	0.023**	(0.009)	0.024**	(0.009)	0.024**	(0.009)	0.024**	(0.009)
*Female * CASMIN 3a*	-0.006	(0.011)	-0.005	(0.011)	-0.005	(0.011)	-0.005	(0.011)
*Female * CASMIN 3b*	0.003	(0.009)	0.004	(0.009)	0.004	(0.009)	0.004	(0.009)
Female * Married	-0.300***	(0.005)	-0.300***	(0.005)	-0.300***	(0.005)	-0.300***	(0.005)
Female * Children in home	-0.075***	(0.005)	-0.075***	(0.005)	-0.075***	(0.005)	-0.075***	(0.005)
Female * Ethnic minority	0.058***	(0.016)	0.058***	(0.016)	0.059***	(0.016)	0.059***	(0.016)
Female * Former East Germany	0.168***	(0.006)	0.168***	(0.006)	0.168***	(0.006)	0.168***	(0.006)
Female * Years of education	0.002*	(0.001)	0.002*	(0.001)	0.002**	(0.001)	0.002*	(0.001)
Female * Normal hours in workweek	0.010***	(0.000)	0.010***	(0.000)	0.010***	(0.000)	0.010***	(0.000)
Female * Part time	0.192***	(0.011)	0.193***	(0.011)	0.194***	(0.011)	0.194***	(0.011)
Female * Experience	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)
Female * Experience sq.	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)

* p<0.05, ** p<0.01, *** p<0.001

Appendices C1 and C2 are available from the first author on request