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Economic returns to occupational closure in the German skilled trades

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ABSTRACT

Recent sociological studies argue that wage differentials between occupations are partly attributable to occupational closure. Occupations set up barriers which restrict the supply of occupational labor, thereby generating an economic rent. In this article we study occupational closure in the skilled trades of Germany, where the Trade and Crafts code restricts self-employment in 41 occupations to those who are master craftsmen. Newly gathered occupational data about the Trade and Crafts code is mapped on micro data from the German Microcensus of 2006. The central finding of our empirical analyses is that self-employed workers with comparable levels of human capital and demographic characteristics earn structurally more in closed occupations. We argue that this earnings premium is a rent, obtained by self-employed because of the entry restriction that is laid down by the Trade and Crafts code.

1. Introduction

Occupational wage inequality has been the subject of many studies. In explaining occupational wage differentials, authors point to occupational closure (Weeden, 2002; Sørensen, 1996; Weeden and Grusky, 2014). The closure approach argues that some occupations pay more than others because occupations differ in their capacity to set up and maintain institutional barriers to access (Weeden, 2002). Because these barriers restrict the supply of occupational labor, individuals in closed occupations obtain an economic rent: returns on top of what would be paid for their labor in a perfect market (Sørensen, 1996, 2000). Although the concept of closure has a long history within inequality scholarship and the sociology of the professions (e.g., Weber, 1978 [1922]; Murphy, 1988), relatively few authors have studied the impact of occupational closure on wages (but see Weeden, 2002; Giesecke and Verwiebe, 2009; Haupt, 2012; Bol and Weeden, 2013).

In this article we investigate how occupational closure affects the earnings of workers in the German skilled trades.[1] In Germany the skilled trades ("Ausbildungsberufe im Handwerk") are tightly linked to vocational programs, where a combination of occupation-specific education and on-the-job training in the form of apprenticeships can lead to a master craftsman's diploma ("Meisterbrief"). Although such vocational training is often discussed in terms of its skill-enhancing capacity (e.g., Witte and Kalleberg, 1995), others claim that apprenticeships do not solely provide individuals with work-relevant skills, but also restrict entry into the skilled trades (Parkin, 1974, p. 13; Solga and Konietzka, 1999). Vocational programs and apprenticeships are

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[1] Skilled trades are all occupations that are preceded by an apprenticeships. Most skilled trades produce individually manufactured products (e.g., shoemakers) or provide customized services (e.g., plumbing), although in Germany many other occupations (e.g., secretary) are preceded by an apprenticeship as well.

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argued to be institutionalized forms of occupational closure, that restrict the supply of workers in the skilled trades and thereby raises earnings for occupational incumbents (Weber, 1978 [1922], p. 344; Weeden, 2002).

Here we empirically investigate this latter claim, and study if there are wage returns to occupational closure in the German skilled trades. We focus on the entry regulation that is imposed by the German Trade and Crafts code (''Handwerksordnung''). For 41 occupations in the skilled trades, this law demands individuals who want to start an independent firm to obtain a master craftsman's certificate from the relevant occupation-specific vocational training program. The Trade and Crafts code is essentially a system of occupational licensure (Hansen, 2011), as it restricts access to self-employment to those individuals that are master craftsmen. Our research question is if occupational closure by the Trade and Crafts code generates an economic rent. Put differently, do (self-employed) individuals with comparable human capital and demographic characteristics earn more in occupations that are regulated by the Trade and Crafts code than in occupations that are not regulated?

Empirically, we map newly gathered occupation-level data on the Trade and Crafts code on official German microdata (Microcensus [''Mikrozensus''] 2006). We model the returns to occupational closure in the German skilled trades by using multilevel techniques, which enables us to estimate earnings premiums associated with the Trade and Crafts code net of individual level characteristics. We make three important contributions to current literature.

First, we expand the closure framework to the German context. Although some studies did focus on occupational closure in Germany (Giesecke and Verwiebe, 2009; Bol and Weeden, 2013), the vast majority of research on occupational closure takes the United States (US) as the object of study (Weeden, 2002; Kleiner, 2006). Empirical evidence for the existence of an earnings premium to occupational closure is mostly limited to the US as well, and research focusing on European countries is scarce.

Second, we are the first to investigate if occupational closure generates rents in a ''lower'' segment of the labor market; the skilled trades. Traditionally, studies focused on social closure in the professional occupations (e.g., Abbott, 1988), for example by looking at how medical occupations set up institutional boundaries (such as licenses) to restrict access (Freidson, 1988 [1970]). This study takes a different focus, and investigates if the occupational closure framework is applicable to the skilled trades as well. We will mainly concentrate on how the master craftsman's certificate, obtained in the German dual system, functions as an institutional barrier to access the skilled trades.

Third, we contribute to the literature that examines the role of vocational education and training in the labor market (e.g., Ryan, 2001). The majority of studies argue that returns to vocational degrees are relatively high because of the skills that are provided in vocational training programs (e.g., OECD, 2010). While we do not refute this finding, our study nuances this view, and shows that the reason why vocational training pays off for German self-employed workers is partly explained by rents resulting from regulation by the German Trade and Crafts code.

This article is structured in the following way. First, we provide a theoretical background, in which we discuss occupational closure theory and give a description of the German case. Next, we describe our research methods (Section 3) and our data (Section 4). In Section 5 we present the results of our multilevel analyses.

2. Theoretical background

2.1. Occupational closure

Social closure, a concept introduced by Max Weber, is the process by which social groups increase their rewards by excluding others from access to their resources (Weber, 1978 [1922]; Murphy, 1988). Occupational closure is a specific form of social closure, where occupational groups set up institutional boundaries to access, such as licenses (Kleiner, 2006) or educational credentials (Collins, 1979). As with other forms of closure, occupational closure generates rents for occupational incumbents by restricting the supply of labor that receives the training necessary to enter an occupation or is allowed to perform the labor tasks (Weeden, 2002). Following Sørensen we define rents as ''the surplus of pure profit obtained from owning the resource [...] independently of the efforts of whoever owns [that] resource'' (1996, pp. 1337–1338). Occupational closure lays restrictions on the supply of labor, for example in the form of educational credentials, thereby increasing the wages of those protected by closure. The closure argument does not deny the significance of skills in generating returns in the labor market, but it emphasizes that earnings are based on more than individual level (human capital) characteristics.

This description of rent accumulation builds on the neo-classic economical idea of supply-and-demand in a perfect market: occupational closure is then a form of ''market failure'' (Weeden and Grusky, 2014), as it lays artificial restrictions on the supply of labor. Other scholars argue that in generating labor market returns we should shift away from the dominant supply and demand model, and instead focus on how actors in relation to each other maximize their returns (Avent-Holt and Tomaskovic-Devey, 2010, 2014). This relational view on how earnings are accumulated in the labor market argues that rents are obtained because actors use institutions—in this case the monopoly rights that come with occupational closure—to channel resources to themselves (Avent-Holt and Tomaskovic-Devey, 2014). Occupational closure allows individuals to ask consumers more for their products or service than they could have in the absence of institutional barriers to access.

Occupational closure in the skilled trades takes place in the form of apprenticeships accompanied by vocational credentials. In the classic apprenticeship system, almost all job-relevant training takes place on the job itself, with employers taking primary responsibility for ''educating'' workers and administering the apprenticeships (Ryan, 2001; Soskice, 1994; Bol and

Van de Werfhorst, 2013). The majority of master–apprenticeship relations are institutionalized in dual systems, where vocational education is combined with "on the job" training through practical work experience. Graduating from the dual system can provide students with a master certificate, a vocational credential that provides access to occupations in the skilled trades. Apprenticeship systems have long been understood as a source of closure (Weber, 1978 [1922], p. 344). Parkin (1974, p. 13) argues that apprenticeship systems serve the same function for the skilled trades as licensure does for the professions: they restrict access to occupations, thereby securing rents for those who completed the apprenticeship. In this case rents are obtained because the supply of skilled laborers is restricted to those who have obtained a master certificate.

At this point, the main argument we want to make is that master craftsmen certificates should generate returns in excess of what is predicted by the human capital and demographic characteristics of the apprenticeship-holders.

2.2. Occupational closure in the German skilled trades: the Trade and Crafts code

Germany is famous for its highly occupation specific education system, that provides apprenticeship training in about 350 occupation-specific vocational programs. The vocational training takes place in the dual system, where students combine part-time occupation-specific education with training at the workplace (e.g., Soskice, 1994). Apprenticeships are undertaken in recognized learning companies, supervised by both the about 80 Chambers of Industry and Commerce and the 54 Chambers of Skilled Crafts.[2] After finishing a regulated apprenticeship program, which takes 2–3.5 years and includes collecting work experience and passing examinations, individuals can acquire a master craftsman certificate.[3] The vocational training programs are regulated by the Vocational Training Act ("Berufsbildungsgesetz") and the German Trade and Crafts code.

While for all of the 350 occupations in the skilled trades a master certificate is available, it is not mandatory for all of them. Access to some of the skilled trades is regulated by law in the German Trade and Crafts code. The code has its origin in the historical guilds (Prantl and Spitz-Oener, 2009) and became formalized nationwide in the late 19th century, when the government passed the Act to Protect the Crafts ("Handwerkschutszgesetz"). In this act it was determined that membership of a guild became compulsory for some of the skilled trades. In 1953 the Trade and Crafts code was established, and it regulated entry requirements for 111 occupations in the skilled trades and crafts (Deissinger, 1996). After a liberalization of the Trade and Crafts code in 2004, more than half of the regulated occupations became unregulated.

For this study, the crucial aspect of the Trade and Crafts code is that it lists all occupations where a master craftsman's certificate is a legal requirement to be self-employed. Only those individuals who are master craftsmen are, by law, allowed to be self-employed and start up their own business. Annex A in the Trade and Crafts code determines all occupations for which a master craftsman's certificate is a prerequisite for self-employment, which are currently 41 occupations. Occupations that are regulated are diverse, and include for example butchers, plumbers, hairdressers, roofers, carpenters, bakers, and chimney sweepers. For a complete list of all occupations that are regulated by the Trade and Crafts code, see Appendix A.

Occupations listed in the code are not only selected on pre-determined criteria (for example because they are susceptible to dangers) and uncovering why some occupations are regulated and others not is hard. Hairdressers, for example, are regulated by the Trade and Crafts code, and to become a self-employed hairdresser in Germany a master craftsman title is required. Cosmeticians—probably the occupational group that is most closely related to hairdressers with respect to labor tasks—on the other hand, are not regulated anymore, as this occupation became liberalized in 2004.

We argue that the regulation as imposed by the Trade and Crafts code is a form of occupational closure. Entry into some skilled trades is regulated by law, although only for the self-employed. In this article we are interested if this form of occupational closure generates economic rents, and for whom.

2.3. Self-employment, closure, and rents

Self-employed are not equally successful in the labor market. Earlier research indicates that individual level human capital characteristics are important predictors of the success of self-employed in the labor market (e.g., Unger et al., 2011). We investigate if returns to self-employment in Germany are also affected by occupational characteristics, and more specifically the entry regulation as laid down in the Trade and Crafts code. For all skilled trades that are listed in Annex A of the code self-employment is restricted to master craftsmen who hold a master craftsman certificate. This means that there are artificial restrictions on the supply of self-employed entrepreneurs in regulated skilled trades. We argue that this restriction on the labor supply of self-employed potentially produces two types of rents: (1) monopoly rents and (2) exploitation rents.

First, the Trade and Crafts code lays restrictions on competition, which generates a monopoly rent for self-employed in closed skilled trades. Whereas many individuals might want to respond to changes in demand, they are unable to do so because of the legal requirements as laid down in the code. Self-employment is restricted to master craftsmen, and the self-employed obtain an earnings premium from this monopolization of labor tasks. Furthermore, master craftsmen can directly control the supply of new master craftsmen, as they are the only ones that are legally allowed to train apprentices

[2] For more information, see http://www.zdh.de/en/organisation.html and http://www.research-in-germany.de/meta/partners/partner-organisations/37508/profil-ahk-ihk.html, both accessed on March 18, 2013.

[3] Not all students do not obtain the master craftsman certificate, as a portion stops after obtaining the journeyman certificate "Gesellenbrief", a vocational degree that is of lower status than the "Meisterbrief"; the master craftsman degree.

(Deissinger, 2001, p. 428). Occupational groups can thus artificially restrict the supply of labor, thereby generating a rent for self-employed in regulated occupations. Self-employed in regulated occupations can ask higher prices for their services or products than they would have been able to do in the counterfactual scenario in which they were not regulated. The Trade and Crafts code grants them monopoly rights that gives them the ability to obtain economic rents.

Exploitation rents also accrue from the restrictions that the Trade and Crafts code lays on the supply, but are substantively different from monopoly rents. Employees working in regulated skilled trades cannot always respond to changes in demand and become self-employed. This means that self-employed employers in the regulated skilled trades can pay lower wages to their employees than they would have to in the absence of regulation. Since employees are unable to quit their job and immediately set up a business themselves, they have to accept these lower wages – if they want to keep working in that occupation of course.[4] Because of the Trade and Crafts code employees are less able to negotiate higher wages for themselves (cf. Morgan and Tang, 2007). In a similar vein, self-employed employers in occupations covered by the Trade and Crafts code can extract a larger share from the firm profit than they would have been able to do were the occupation not regulated.

Empirically we will not distinguish monopoly rents from exploitation rents. Instead, our argument for now is that the potential earnings premium that is obtained by the self-employed is a mixture of both rents. More formally, we estimate the rent obtained by self-employed as the positive interaction effect of being in a regulated occupation and self-employment on earnings, indicating that self-employment pays off more in those occupations that are regulated by the Trade and Crafts code.

H1. Self-employment yields higher returns in occupations that are regulated by the German Trade and Crafts code than in unregulated occupations.

We therefore do not expect regulation by the Trade and Crafts code to increase earnings for all workers in an occupation. In contrast to other studies that show that several forms affect the wages for all occupational incumbents (e.g., Weeden, 2002; Bol and Weeden, 2013), regulation by the Trade and Crafts code is expected to only affect returns for self-employed. More formally, we do not expect there to be a main effect of regulation by the Trade and Crafts code on the wages of all workers.

H2. Employment yields similar returns in occupations that are regulated by the German Trade and Crafts code and in unregulated occupations.

3. Methods

Our aim is to investigate if returns to (self-)employment vary structurally across regulated and unregulated occupations in the skilled trades. In other words, we want to know if (self-)employment generates higher returns in those occupations that are listed in the German Trade and Crafts code. In line with earlier studies (Weeden, 2002; Bol and Weeden, 2013), our methodological strategy is to estimate occupational closure effects on wages after adjusting for individual level indicators of human capital and occupation-level indicators of skills. If occupations are only relevant insofar they capture skill differentials that can be measured with conventional measures of human capital as well, we expect no effects of occupational closure on earnings in our models. When our variable of regulation by the German Trade and Crafts code still has an effect after adjusting for individual and occupation-level skill variables, we interpret this effect as an economic rent.

More formally, we test our hypotheses in two-level multilevel regression models, in which individuals (i) are nested in occupations (j). By using multilevel models we exploit the nested structure of the data, which furthermore allows for estimating earnings effects of occupation-level variables. In our case, we are able to estimate the effect of being regulated by the Trade and Crafts code as a main effect (see hypothesis 2), and the cross-level interaction effect between self-employment and regulation by the Trade and Crafts code (see hypothesis 1). Our general empirical model is given in the equation below.

$$\ln Y_{ij} = \beta_0 + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_1 * X_{2ij} + c'V_{ij} + d'W_j + \mu_{0J} + \mu_{1J} + \varepsilon_{ij} \quad (1)$$

The dependent variable, lnY, is the logged monthly income for individual i in occupation j; β_1 is the fixed effect of self-employment, β_2 the main effect of being listed in the Trade and Crafts code and β_3 the cross-level interaction between the two. In Eq. (1) c' is a vector for the fixed effects of all other individual level control variables V_{ij} and d' a vector for the effects of all occupation level control variables W_j. We allow the intercept β_0 to vary randomly across occupations (u_{0j}) and since we estimate a cross-level interaction (β_3) we also allow the slope of self-employment (β_1) to vary randomly across occupations (u_{1j}).[5] By changing the covariates in c' and d', and interacting occupation skill variables (d') with self-employment, we construct a series of models that estimate the wage effects of occupational closure in the German skilled trades net of several control variables. We are mainly interested in β_2 and β_3, our estimates of the returns to occupational closure. To check the

[4] Employees could of course avoid being exploited if they would leave the regulated occupation and start working somewhere else. In such a scenario, employers are less able to exploit firm profit from their employees, as employees will choose a different occupation until their wages are on the level that they find acceptable. Another way of avoiding the lower wages is to obtain a master certificate themselves, but this is relatively costly and takes time.

[5] In initial models we checked if the covariance between the two occupation-level random terms was significant (unstructured covariance). This was not the case. For this reason we decided to specify an independent covariance structure, although our findings are the same with unstructured covariance.

robustness of our results we also estimated models for the self-employed only. In these analyses we found a significant and positive effect of being regulated by the Trade and Crafts code, which confirms the results from our multilevel models. These results are available upon request.

4. Data

For our analyses we use the German Microcensus of 2006.[6] The Microcensus is the official statistical survey that is exercised by the Federal Statistical Office, and provides data on the German population and labor market. The Microcensus is a 1% random sample of the German population, which is about 380,000 households and 820,000 individuals. There is a legal obligation to participate in the Microcensus, which results in an extremely high response rate (about 95%), and makes it the most representative micro data in Germany. We analyze the anonymized Scientific Use File, a random sample of 70% of the original Microcensus. Although the sample size is smaller, it still provides more than enough cases to nest individuals in a highly detailed occupational classification (see Section 4.2). Our analyses are restricted to respondents who are currently (self-)employed, between the ages of 25 and 65, and indicated that their reported income is primarily derived from employment. We want to compare occupations in the skilled trades that are regulated versus unregulated occupations in the skilled trades. In order to define which occupations are skilled trades and which are not, we use the overview provided by the Federal Institute for Vocational Education and Training (Tiemann et al., 2008, pp. 30–37). In this overview all skilled trades are mapped on the occupational classification used by the Microcensus (‘‘Klassifizierung der Berufe’’), which makes it easy to select our sample. Our final analytical sample consists of 61,831 individuals nested in 171 skilled trades occupations.

4.1. Individual level variables

Our dependent variable in all analyses is the natural logarithm of monthly income. Since we are interested in income from labor (earnings), we selected only those respondents who reported that labor earnings are the primary source of their income. Monthly income is measured in 24 categories, which we all assign midpoints. In our analyses the variable is treated as a linear dependent variable.

Our main independent variable is self-employment. This binary variable indicates if the respondent is an employee (0) or self-employed (1). We furthermore include binary individual level demographic covariates for gender (female = 1) and marital status (married = 1). In order to make sure that our occupation-level effects are not due to unmeasured human capital at the individual level, we include a series of labor market variables: normal working hours per week, a binary indicator for part-time employment (part-time = 1), highest level of educational attainment, work experience, and work experience squared. Work experience is a constructed variable and takes the time between leaving formal education and the date of the interview.[7] Highest level of educational attainment is measured by using the CASMIN scale (Brauns et al., 2003), which differentiates between level and focus (vocational versus general) of the educational program. In order to fit the individual level equation better, and take gender differences into account, we estimate the interactions between gender and all individual level variables. Descriptive statistics for all individual level variables can be found in Table 1.

4.2. Occupation level variables

We nest individuals in occupations, and the occupational classification we use is the three-digit version of the ‘‘Klassifizierung der Berufe’’ 1992 (KldB-1992), the official German coding scheme with 369 categories. In the KldB-92 occupations are classified on the basis of occupational activities. We only analyze the 171 occupational categories which belong to the skilled trades and have an accredited apprenticeship program (cf. Tiemann et al., 2008, see also Prantl and Spitz-Oener (2009) for a similar approach).

Our main independent variable at the occupation level is a binary indicator for being regulated by the Trade and Crafts code. The regulated occupations, as listed in Annex A of the code, are mapped on the KldB-92. In our data 35 of the 171 occupational categories in the KldB-92 are coded as being regulated. The number of regulated occupational categories (35) is lower than the number of regulated occupations (41) for two reasons. First, although the KldB-92 is very detailed, some regulated occupations are classified in the same occupational category (e.g., surgical instrument makers, precision engineers and gunsmiths are all classified as ‘‘precision mechanics’’). Second, three regulated occupations only constitute a very small part of the occupational category in which all other occupations are not regulated (e.g., well sinkers in ‘‘other civil engineering works’’), which are for this reason not being coded as regulated.[8]

At the occupation level we control for the composition of each occupation and the skill-requirements for each occupation. These control variables can give further evidence that the effect of occupational regulation on earnings is not caused by the

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[6] We use the data of 2006 rather than more recent data, since it corresponds with the time our occupational data was gathered.

[7] Unfortunately no better indicator of work experience was available. The constructed measure assumes continuous employment strategies, making it less suitable as a measure for women than men. Although we cannot overcome this problem, we do fit interactions between sex and experience to allow for heterogeneous effects of experience on earnings between men and women.

[8] Including the small occupations such as well-sinkers in the analysis did not affect our findings. The data for the variable of regulation by the Trade and Crafts code are available from the author.

Table 1
Descriptive statistics of individual level variables. *Source:* Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006, own calculations. *N* [individuals] = 61,831.

	Mean	S.D.	Range
Self-employed	0.102	0.303	0–1
Female	0.414	0.493	0–1
Married	0.631	0.483	0–1
Normal working hours per week	37.350	10.479	1–90
Part-time	0.196	0.397	0–1
Experience	21.246	10.869	0–49
Experience squared	569.528	487.908	0–2401
Highest level of education			
Casmin 1abc	0.356	0.479	0–1
Casmin 2ab	0.441	0.496	0–1
Casmin 2c	0.125	0.331	0–1
Casmin 3a	0.036	0.187	0–1
Casmin 3b	0.042	0.201	0–1
Monthly earnings	1593.145	1113.787	75–22000
ln monthly earnings	7.219	0.565	4.317–9.999

Table 2
Descriptive statistics of occupation level variables. *Source:* Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006, own calculations. *N* [occupations] = 171.

	Mean	S.D.	Range
Registered by Trade and Crafts code	0.193	0.396	0–1
% Females ($\times$100)	0.302	0.298	0–0.990
Physical skill demands	0.298	0.566	−0.950 to 1.280
Complex processing skills	−0.021	0.405	−1.624 to 1.090
Technical skills	0.359	0.513	−0.826 to 1.147

occupational skill demands for regulated occupations, or because there are important differences in the demographic composition of unregulated and regulated occupations. Following a large literature that shows that female-dominated occupations have a net effect on earnings (e.g., Tomaskovic-Devey, 1993; England et al., 2007), we add the proportion of females in each occupation (aggregate of the Microcensus 2006).

The most important controls on the occupation-level are the indicators of occupational skill requirements. If regulation by the Trade and Crafts code affects earnings net of occupational skill requirements, this provides strong evidence that this effect is indeed attributable to processes of occupational closure instead of unmeasured skill requirements. To measure occupational skill requirements we use the BIBB–BAuA Workforce survey,[9] which is a representative survey of 20,000 employed people in Germany, conducted by the Federal Institute for Vocational Education and Training (“BIBB”) and the Federal Institute for Occupational Safety and Health (“BAuA”). An important part of the survey focuses on questions about the workplace (core job tasks, working conditions). In our analyses we add three skill controls for (a) physical abilities, (b) technical skills, and (c) complex mental processing skills required within each detailed occupational category. These three occupational skill controls are based on several items of the BIBB–BAuA Workforce survey. First we performed principal factor analysis over a series of items that are closely related to each of these three types of occupational skills. We then calculated the factor score for each of these different items, which we aggregated to the occupation level.[10] These aggregates indicate to what extent occupations are physically challenging, demand complex processing skills, or demand technical skills. More information about the different items and details on the factor analysis can be found in Bol and Weeden (2013) and in Appendix B. An overview of all occupation level variables can be found in Table 2.

5. Results

Before we discuss the results of our multilevel models, we will briefly discuss the composition of skilled trades occupations that are regulated by the Trade and Crafts code, and skilled trades occupations that are not. In Table 3 the mean values for some key variables are shown for both groups of occupations.

When we look at earnings, we see that the average monthly earnings are slightly higher for occupations that are regulated by the Trade and Crafts code (€1668 versus €1579). The differences are more pronounced with respect to the educational composition, as individuals in regulated occupations tend to be lower educated than individuals in unregulated occupations.

[9] More information on this survey can be found at http://www.bibb.de/dokumente/pdf/BIBB_BAuA_2006_Data_Manual.pdf, accessed on April 23, 2013.
[10] Our findings are robust for other specifications of the skill variables, for example first aggregating items to the occupation level and then taking the factor scores.

Table 3
Composition of workers in regulated and unregulated occupations. *Source:* Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006, own calculations. *N* [individuals] = 52,219 for unregulated and 9612 for regulated occupations.

	Unregulated	Regulated
Monthly income (euro)	1579	1668
Highest level of education		
Casmin 1abc	0.330	0.494
Casmin 2ab	0.447	0.408
Casmin 2c	0.134	0.078
Casmin 3a	0.041	0.012
Casmin 3b	0.048	0.009
Female	0.469	0.117
Self-employed	0.086	0.188

Notes: The table shows the mean scores for all listed variables. All scores except the mean income can be interpreted as proportions.

In regulated occupations half of the individuals has a degree from secondary school or lower (CASMIN 1abc), whereas this is only 33% in unregulated occupations. In both unregulated and regulated occupations the intermediate vocational degree (CASMIN 2a) is well-represented (45% and 41%). Individuals with tertiary degrees (CASMIN 3a and 3b) only make up a small fraction of all workers in regulated occupations (2%), while this number is much higher in unregulated occupations (9%). The different educational composition of regulated and unregulated occupations might be driven by some unregulated occupations in sales and administration, that inhibit relatively little low educated individuals but are unregulated (e.g., bank workers, office staff).

The most striking difference between both types of occupations is found when we look at the gender composition. Occupations that are regulated by the Trade and Crafts code employ much less women (12%) than occupations that are not regulated (47%). This reflects the historical roots of the Trade and Crafts code, as it consists of predominantly male-dominated occupations that used to be organized as guilds. In only four regulated occupations the majority of workers are female (dental technicians, dispensing opticians, pastry-cooks, and hairdressers).

Finally, the proportion of self-employed is much higher in regulated occupations (19%) than in unregulated occupations (9%). One conclusion could be that regulation increases self-employment, but such a causal claim is rejected by Prantl and Spitz-Oener (2009). Using longitudinal data they show that entry into self-employment decreased when entry restrictions were formulated in Germany. Although our descriptive statistics indicate that the level of self-employment is higher in regulated than in unregulated occupations, according to their findings, self-employment would be even higher in the counterfactual situation where there were no entry regulations at all (Prantl and Spitz-Oener, 2009).

While Table 3 shows clear differences in the workers composition between regulated and unregulated occupations, we are mainly interested in whether regulation in the form of the Trade and Crafts code results in an earnings premium for incumbents of regulated occupations. In Table 4 we investigate if being regulated by the Trade and Crafts code has a main effect on mean occupational earnings. In Table 5 we investigate if self-employment has a differential effect on labor market returns in regulated and unregulated occupations. For reasons of clarity Tables 4 and 5 do not present all individual level coefficients (see Appendices C.1 and C.2 for these coefficients[11]).

In Model 1 we only fit our individual level variables. We find that self-employed men do not significantly earn more or less than employed men. However, the negative interaction between gender and self-employment indicates that self-employed females earn less than employed females. One explanation for this negative interaction might be found in the work-family balance, as female self-employed work much less hours than self-employed men, and use self-employment more often to combine work and family duties (Lechmann and Schnabel, 2012).

In Model 2 we fit the main effect of the Trade and Crafts regulation. As the code only lays restrictions on the supply of self-employed, we do not expect a main effect of being regulated on the average occupational wage. Our estimates show that mean occupational wages are 6% (exp[0.059]) lower in occupations that are regulated by the Trade and Crafts code. However, the results in Model 2 are not yet controlled for other occupation level factors that affect occupational wages.

Model 3 adds our occupation level control variables. In line with previous literature we find a negative main effect of the proportion of females in the occupation. Of the three occupational skill characteristics only the physical skill demands and the complex processing skills have an effect of mean occupational wages. Occupations with high physical demands tend to pay less, while occupations that demand complex processing skills on average pay higher wages. After adding our occupation level control variables the point estimate of regulation by the Trade and Crafts code shrinks to −0.030 and loses significance. The negative effect of regulation in Model 2 is thus explained by the shared compositional characteristics and occupational skill demands of regulated occupations, rather than by the regulation itself.

[11] The individual level covariates point in the direction one would expect from earlier research. We find strong effect for education and working part-time. Marital status also shows strong effects: married men have higher earnings, whereas the opposite is true for married women. This is likely caused by the male-breadwinner model, as married men generate the primary income for the family, whereas married women are likely to earn less than unmarried women.

Table 4
Effects of the Trade and Craft regulation on the natural logarithm of monthly earnings. Selected estimates from multilevel regressions. *Source:* Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006, own calculations. *N* [occupations] = 171; *N* [individuals] = 61,831.

	Model 1	Model 2	Model 3
Fixed effects			
Constant	6.736**	6.748**	6.868**
	(0.021)	(0.021)	(0.027)
Individual level variables			
Self-employment	−0.030	−0.030	−0.031
	(0.019)	(0.019)	(0.019)
Female * Self-employment	−0.094**	−0.094**	−0.095**
	(0.016)	(0.016)	(0.016)
Occupation level variables			
Trade and Crafts regulation		−0.059*	−0.030
		(0.028)	(0.021)
% Female (×100)			−0.209**
			(0.040)
Physical skills			−0.174**
			(0.017)
Complex processing skills			0.097**
			(0.021)
Technical skills			−0.021
			(0.023)
Random effects			
$\sigma^2 u_0$ (intercept)	0.020**	0.020**	0.009**
	(0.001)	(0.001)	(0.001)
$\sigma^2 u_1$ (self-employment)	0.034**	0.035**	0.035**
	(0.003)	(0.003)	(0.003)
$\sigma^2 e$	0.163**	0.163**	0.163**
	(0.000)	(0.000)	(0.000)
−2 log likelihood	64,112	64,108	63,998

Note: Standard errors are listed in parentheses. All models fit all individual-level effects, see Appendix C.1 for all individual level coefficients.
* $p < 0.05$.
** $p < 0.01$, two-tailed tests.

The results shown in Table 4 do provide support for hypothesis 2, which stated that there would be no main effect of regulation by the Trade and Crafts code on earnings. The regulation does not affect the wages of all occupational incumbents. However, if occupational closure only secures economic rents by restricting the supply of labor, we would expect that only the group that is regulated by the Trade and Crafts code, the self-employed, obtain a rent. The variance term $\sigma^2 u_1$ in Table 4 shows that there is significant variance in the effect of self-employment on earnings across occupations. In Table 5 we will investigate if regulation by the Trade and Crafts code can (partly) explain this heterogeneity.

In Model 4 we add the cross-level interaction between regulation and self-employment, which shows that, net of all individual level characteristics, self-employed workers in regulated skilled trades have 13% (exp[0.126]) higher earnings than self-employed in unregulated skilled trades. This provides evidence for the claim that by laying artificial restriction on the supply, the Trade and Crafts code generates an economic rent for self-employed master craftsmen in regulated occupations. The question is if this finding is not caused by unmeasured skill or compositional characteristics of occupations: self-employment could pay off more in regulated occupations because these occupations have different skill demands. Model 5 therefore fits occupation level control variables and their interactions with self-employment.

The final model shows that returns to self-employment does not structurally vary across occupations with different compositions or skill requirements. Although the main effects of all occupational control variables are significant and in the expected direction, none of the cross-level interactions is significant. Most important for our article is that the main finding of Model 4 persists, as self-employment yields higher returns in skilled trades where self-employment is regulated by the Trade and Crafts code. This confirms hypothesis 1: net of individual-level and occupation-level controls for demographic and human capital characteristics, self-employed earn more in closed skilled trades. Model 5 shows that this premium is 13% (exp[0.118]), meaning that self-employed earn 13% more if they work in a regulated instead of an unregulated occupation.

The findings from Table 5 are consistent with the idea that occupational closure generates economic rents by laying restrictions on the labor supply. In this case the Trade and Crafts code maintains limits on the supply of self-employed workers in regulated skilled trades. Because only master craftsmen can start a business, the Trade and Crafts code causes an artificial shortage of self-employed in regulated occupations, resulting in a rent. This rent can be explained as a monopoly rent; as the entry regulation restricts individuals to respond to demand changes. The 13% earnings premium that self-employed obtain in closed occupations can also be explained as an exploitation rent, as the inability of employees to leave their job and become self-employed enables employers to pay them lower wages than they would pay in the absence of regulation.

Table 5
Effects of the Trade and Craft regulation on the natural logarithm of monthly earnings. Selected estimates from multilevel regressions. *Source:* Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Mikrozensus 2006, own calculations. *N* [occupations] = 171; *N* [individuals] = 61,831.

	Model 4	Model 5
Fixed effects		
Constant	6.749**	6.869**
	(0.021)	(0.027)
Individual level variables		
Self-employment	−0.064**	−0.052
	(0.021)	(0.046)
Female∗Self-employment	−0.091**	−0.092**
	(0.016)	(0.016)
Occupation level variables		
Trade and Crafts regulation	−0.064*	−0.034
	(0.028)	(0.021)
% Female (×100)		−0.207**
		(0.040)
Physical skills		−0.174**
		(0.017)
Complex processing skills		0.099**
		(0.021)
Technical skills		−0.021
		(0.023)
Cross-level interactions		
Self-employment * Regulation	0.126**	0.118**
	(0.040)	(0.045)
Self-employment * % Female (×100)		−0.028
		(0.088)
Self-employment * Physical skills		0.008
		(0.036)
Self-employment * Complex processing		−0.093
		(0.051)
Self-employment * Technical skills		−0.002
		(0.052)
Random effects		
$\sigma^2 u_0$ (intercept)	0.019**	0.009**
	(0.001)	(0.001)
$\sigma^2 u_1$ (self-employment)	0.030**	0.030**
	(0.003)	(0.003)
$\sigma^2 e$	0.163**	0.163**
	(0.000)	(0.000)
−2 log likelihood	64,099	63,985

Note: Standard errors are listed in parentheses. All models fit all individual-level effects, see Appendix C.2 for all individual level coefficients.
* $p < 0.05$.
** $p < 0.01$, two-tailed test.

The central finding of our empirical analyses is that self-employed workers with comparable levels of human capital and demographic characteristics, who work in occupations that are comparable with respect to composition and skill requirements, earn structurally more in closed occupations. The legal restrictions in the Trade and Crafts code monopolize self-employment in some of the skilled trades and generate income above what would be obtained in a perfect market.

6. Conclusion

In this article we investigated occupational closure in the German skilled trades by looking at the German Trade and Crafts code, which legally restricts access to self-employment in 41 skilled trades to those who have obtained a master craftsman's certificate. The Trade and Crafts code is an institutional barrier that regulates access to occupations and thus a form of occupational closure. Following earlier research on occupational closure, we argued that the German Trade and Crafts code generates an economic rent by laying artificial restrictions on the supply of the self-employed, thereby increasing economic returns to self-employment in regulated skilled trades.

To investigate these two mechanisms we combined micro data from the German Microcensus of 2006 with occupation-level data on the Trade and Crafts code, as well as indicators on the occupational composition and skill requirements. The empirical analyses showed that there is no main effect of being regulated by the Trade and Crafts code on mean occupational wages. Not all occupational incumbents benefit from regulation. Our analyses did show that self-employment pays off more in regulated occupations, thereby providing support for the idea that closure generates rents by restricting supply. The Trade and Crafts code restricts entry into self-employment, which keeps the supply of self-employed artificially low and restricts individuals to directly respond to changes in demand. Hereby the code allows self-employed in closed occupations to obtain an economic rent. We argue that this rent can both be explained by the monopolization of labor tasks to master craftsmen (monopoly rent) and the ability of employers in regulated occupations to pay their employees lower wages, as they are not able to start leave their employer and start their own business. Self-employed craftsman acquire more labor returns, which are either paid for by the consumers (monopoly rent) or their employees (exploitation rent).

The results from this article contribute to existing literature in three ways. First, while the majority of research on occupational closure focuses on the United States, we show that occupational closure is a viable explanation for occupational wage differentials in the German context as well. Second, our article focused exclusively on the skilled trades, a segment in the labor market that is rarely empirically investigated in the closure literature. While a large number of studies concentrates on closure in the professional occupations (e.g., lawyers, doctors, architects), our study shows that occupational closure theory provides an explanation for wage inequality in the lower segments of the labor market as well.

Third, our study offers an important nuance to the role of vocational education and training in the labor market. Earlier studies portray the German dual apprenticeship system as a "skills machine" (Culpepper and Finegold, 1999), and argue that individuals with vocational education accrue labor market returns solely because of their highly occupation-specific skills (Witte and Kalleberg, 1995; OECD, 2010). Our results show that besides providing individuals with skills, the German apprenticeship system is partly a system of occupational closure, as it restricts entry into self-employment in the regulated skilled trades and crafts. We do not argue that skills are unimportant for wages, or that individuals do not accumulate skills in the vocational system, we merely argue that the economic returns to vocational education are at least partly explained by the levels of occupational closure.

We showed that occupational closure generates economic returns in the German skilled trades. These returns can be explained as monopoly rents, the restrictions on the supply that are caused by the German Trade and Crafts code allow employers to ask higher prices for their products or services. The returns to occupational closure could also be explained by a process of exploitation, as the inability of employees to start their own business allows employers to obtain a larger share of firm profit.

Occupational closure is present in different types of labor markets and different segments of the labor market. Institutionalized forms of closure may take diverse forms in these different contexts; whereas licensure is dominant in the professional occupations, skilled trades occupations have apprenticeships and vocational credentials to regulate access. This study provides further evidence that occupational closure affects the wage distribution, as in occupations that have a monopoly over the labor tasks, occupational incumbents obtain an economic rent.

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Appendix A

The occupations regulated by the Trade and Crafts code (Annex A).

1. Bricklayer and Concretor
2. Stove and Air Heating Mechanic
3. Carpenter
4. Roofer
5. Road Construction Worker
6. Thermal and Acoustic Insulation Fitter
7. Well Sinker
8. Stonemason
9. Plasterer
10. Painter and Lacquerer
11. Scaffolder
12. Chimney Sweep
13. Metal Worker
14. Surgical Instrument Maker
15. Coachbuilder
16. Precision Engineer
22. Gunsmith
23. Plumber
24. Installer and Heating Fitter
25. Electrics Technician
26. Electrical Machine Engineer
27. Joiner
28. Boat Builder
29. Rope Maker
30. Baker
31. Pastry-cook
32. Butcher
33. Dispensing Optician
34. Hearing Aid Acoustician
35. Orthotic Technician
36. Orthopedic Shoemaker
37. Dental Technician

17. Motorbike and Bicycle Mechanic
18. Refrigeration Mechanic
19. Communication Technician
20. Automotive Mechatronics Technician
21. Mechanic for Agricultural and Construction Machinery
38. Hairdresser
39. Glazier
40. Glass Blower and Glass Apparatus Maker
41. Mechanic for Tires and Vulcanization

Appendix B. Construction of the occupational skill requirements measures

In constructing the variables for occupational skill requirements we rely on earlier work done by Bol and Weeden (2013). They use the O*NET classification of occupational skill requirements in order to construct scales of different skill demands. For all three indicators of skill demands we performed a principal factor analysis over a number of items, and saved the factor loadings as regression scores. The individual scores of all individuals are then aggregated to the occupational level, thereby obtaining the occupational skill demands. Below we describe which items are used for each of the indicators, and how well the factor analysis worked.

B.1. Physical skill demands

This indicator is a combination of three items, that are all responses to the question "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 20 kg (men), 10 kg (women), and (3) working crouched down, kneed, reclined, overarm. All items loaded on one factor, which has an eigenvalue of 1.33. The reliability, expressed in Cronbach's alpha, is 0.75.

B.2. Technical skills

This indicator is a combination of three items. Two items are responses to the question "Do you require the following skills in your job? (0 = no, 1 = basic skills, 2 = specialized skills)": (1) manual/craft skills, and (2) technical skills. The final item is a response to the question "How often does the following task appear in your job? (0 = never, 1 = sometimes, 2 = often)": (3) operating, controlling machines. All items loaded on one factor, which has an eigenvalue of 1.20. The reliability, expressed in Cronbach's alpha, is 0.70.

B.3. Complex processing skills

This indicator is a combination of six items. Four items are responses to the question "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 have not learned yet or are not proficient in, and (4) there are diverse processes and job tasks which you have to keep an eye on simultaneously. The final two items are a response to the question "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, and (6) recognizing and closing own knowledge gaps. All items loaded on one factor, which has an eigenvalue of 2.34. The reliability, expressed in Cronbach's alpha, is 0.77.

Appendix C

C.1. Individual level effects for the analyses shown in Table 4.

	Model 1	Model 2	Model 3
Female	−0.603**	−0.604**	−0.605**
	(0.027)	(0.027)	(0.027)
Married	0.206**	0.206**	0.206**
	(0.005)	(0.005)	(0.005)
Normal working hours per week	0.011**	0.011**	0.011**
	(0.000)	(0.000)	(0.000)
Part-time	−0.269**	−0.269**	−0.270**
	(0.014)	(0.014)	(0.014)
Experience	0.014**	0.014**	0.014**

(continued on next page)

Individual level effects for the analyses shown in Table 4. (*continued*)

	Model 1	Model 2	Model 3
	(0.001)	(0.001)	(0.001)
Experience squared	−0.000**	−0.000**	−0.000**
	(0.000)	(0.000)	(0.000)
Highest level of education			
Casmin 1abc	Ref.	Ref.	Ref.
Casmin 2ab	−0.098**	−0.098**	−0.099**
	(0.005)	(0.005)	(0.005)
Casmin 2c	0.012	0.011	0.010
	(0.008)	(0.008)	(0.008)
Casmin 3a	0.077**	0.077**	0.075**
	(0.012)	(0.012)	(0.012)
Casmin 3b	0.143**	0.143**	0.141**
	(0.012)	(0.012)	(0.012)
Interactions			
Female * Married	−0.393**	−0.393**	−0.393**
	(0.007)	(0.007)	(0.007)
Female * working hours per week	0.011**	0.011**	0.011**
	(0.001)	(0.001)	(0.001)
Female * Part-time	0.243**	0.243**	0.244**
	(0.017)	(0.017)	(0.017)
Female * Experience	−0.001	−0.001	−0.001
	(0.001)	(0.001)	(0.001)
Female * Experience squared	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)
Female * Highest level of education			
Female * Casmin 1abc	Ref.	Ref.	Ref.
Female * Casmin 2ab	0.080**	0.080**	0.080**
	(0.008)	(0.008)	(0.008)
Female * Casmin 2c	0.060**	0.060**	0.060**
	(0.012)	(0.012)	(0.012)
Female * Casmin 3a	0.076**	0.076**	0.076**
	(0.019)	(0.019)	(0.019)
Female * Casmin 3b	0.053**	0.053**	0.053**
	(0.018)	(0.018)	(0.018)

Note: Standard errors are listed in parentheses.
* $p < 0.05$.
** $p < 0.01$, two-tailed tests.

C.2. Individual level effects for the analyses shown in Table 5.

	Model 4	Model 5
Female	−0.604**	−0.605**
	(0.027)	(0.027)
Married	0.206**	0.206**
	(0.005)	(0.005)
Normal working hours per week	0.011**	0.011**
	(0.000)	(0.000)
Part-time	−0.269**	−0.270**
	(0.014)	(0.014)
Experience	0.014**	0.014**
	(0.001)	(0.001)

Individual level effects for the analyses shown in Table 5. (*continued*)

	Model 4	Model 5
Experience squared	−0.000**	−0.000**
	(0.000)	(0.000)
Highest level of education		
Casmin 1abc	Ref.	Ref.
Casmin 2ab	−0.098**	−0.099**
	(0.005)	(0.005)
Casmin 2c	0.011	0.010
	(0.008)	(0.008)
Casmin 3a	0.077**	0.075**
	(0.012)	(0.012)
Casmin 3b	0.143**	0.142**
	(0.012)	(0.012)
Interactions		
Female * Married	−0.393**	−0.393**
	(0.007)	(0.007)
Female * working hours per week	0.011**	0.011**
	(0.001)	(0.001)
Female * Part-time	0.243**	0.244**
	(0.017)	(0.017)
Female * Experience	−0.001	−0.001
	(0.001)	(0.001)
Female * Experience squared	0.000**	0.000**
	(0.000)	(0.000)
Female * Highest level of education		
Female * Casmin 1abc	Ref.	Ref.
Female * Casmin 2ab	0.081**	0.080**
	(0.008)	(0.008)
Female * Casmin 2c	0.060**	0.060**
	(0.012)	(0.012)
Female * Casmin 3a	0.076**	0.076**
	(0.019)	(0.019)
Female * Casmin 3b	0.053**	0.053**
	(0.018)	(0.018)

Note: Standard errors are listed in parentheses.
* $p < 0.05$.
** $p < 0.01$, two-tailed tests.

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