Volkswirtschaftliches Institut für Mittelstand
und Handwerk an der Universität Göttingen

ifh Working Papers

No. 2

A replication of
'Entry regulation and entrepreneurship:
a natural experiment in German craftsmanship'

Petrik Runst*
Jörg Thomä
Katarzyna Haverkamp
Klaus Müller

Göttingen, 2017

Updated version published on 31.07.2017 first version published on 10.08.2016

Institute for Small Business Economics (ifh Göttingen)
Heinrich-Düker-Weg 6
37073 Göttingen, Germany
Department of Economic Policy
University of Goettingen

*petrik.runst@wiwi.uni-goettingen.de

Die in diesem Papier vertretenen Auffassungen liegen ausschließlich in der Verantwortung der Autoren und nicht in der des ifh Göttingen.

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the position of the ifh Göttingen.

IMPRESSUM

Heinrich-Düker-Weg 6
37073 Göttingen

Tel. +49 (551) 39 174882
Fax +49 (551) 39 174893
E-Mail: info@ifh.wiwi.uni-goettingen.de
Internet: www.ifh.wiwi.uni-goettingen.de

GÖTTINGEN • 2017

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

DHKT DEUTSCHER HANDWERKSKAMMERTAG

sowie die
Wirtschaftsministerien
der Bundesländer

Die Diskussionspapiere können kostenfrei von der Webseite des ifh Göttingen heruntergeladen werden:
www.ifh.wiwi.uni-goettingen.de

A replication of 'Entry regulation and entrepreneurship: a natural experiment in German craftsmanship'.

Petrik Runst*
Jörg Thomä
Katarzyna Haverkamp
Klaus Müller

Institute for Small Business Economics (ifh)
University of Göttingen
*petrik.runst@wiwi.uni-goettingen.de

Abstract

Rostam-Afschar (2014) analyzes the impact of the deregulation of the German Trade and Crafts Code of 2004 on entrepreneurial activity, using German microcensus (MC) data. He finds a positive effect on market entry and self-employment and no change in exit probabilities. As these results partially conflict with company registry data, we re-examine the causal effects. Most importantly, we generate a novel classification scheme that aims to achieve an improved identification of crafts trades. Non-craftsmen need to be removed from the analysis as the policy change exclusively pertains to the crafts sector. In contrast to Rostam-Afschar's findings, the increase in self-employment and entry is more pronounced in the completely deregulated B-trades rather than the partially deregulated A-trades. In addition, exit probabilities do not remain constant but rather increase. Our results are in line with company registry data.

Updated version published on 31.07.2017 first version published on 10.08.2016

Keywords Entrepreneurship, Regulation, Firm entry, Craftsmanship, Replication

JEL Classification L51, J24, I28, M13

1. Introduction

In Germany, 93 trades belong to what is legally defined as the crafts sector. They are governed by a set of laws, the so-called Trade and Crafts Code (TCC, *Handwerksordnung*). Until 2004, the law required the head of a crafts company to hold a Meister-degree, i.e. an advanced vocational training certificate. The regulation has subsequently changed, whereby 52 so-called B-trades such as brewers, interior decorators and musical instrument makers are now fully deregulated and no longer subject to any educational requirements (HwO §7.1). Some trades such as bakers, butchers and car mechanics have been partially deregulated (A-trades hereafter), meaning that experienced employees without a Meister-degree may be permitted to start a business (HwO §7b, *Altgesellenregel*). Finally, six trades (AC hereafter) remain fully regulated.

Using German microcensus data, Rostam-Afschar (2014, RA hereafter) finds that the reform led to an increase in both market entry and self-employment in all deregulated occupations, regardless of the extent to which they were deregulated. According to the author, exit probabilities remain unchanged. In section 2 of this paper, it will be shown that these results differ from those obtained from company registry data, according to which the increase in entry probabilities is more pronounced in the fully deregulated B-trades and less pronounced in the partially deregulated A-trades. Company registry data also shows a marked increase in exit probabilities in case of B-trades.

In section 3, we re-examine the impact of the 2004 deregulation on self-employment, entry and exit probabilities by using the microcensus data set. Our replication study tests whether RA's results are robust and not driven by some peculiarities of the data or the choice of model specification. As the company registry data suggests (and contrary to RA), we find a more pronounced increase in entry probabilities in B-trades rather than A-trades. There is also a marked increase in exit probabilities for fully deregulated B-trades. It seems that the discrepancy between RA and company registry data is mainly driven by the inclusion of building cleaners, as a very large B-trade. We argue that there are certain shortcomings with microcensus data in correctly identifying this craft occupation.

2. Company Registry Data

There is a discrepancy between RA's results and descriptive statistics based on company registration data. In this section, we discuss this data source in further detail and present relevant statistics.

According to the TCC, companies operating in the crafts sector are liable to public registration. This administrative data – including information on entry and exit – is gathered and maintained by local crafts chambers and subsequently aggregated at the national level by the German Confederation of Skilled Crafts (Zentralverband des Deutschen Handwerks, ZDH). The national data set is subsequently used by the German Federal Statistical Office (Statistisches Bundesamt) to compile its official statistics (Feuerhake, 2012). ZDH data is subject to stringent data protection policies and it is only available in an aggregated format, i.e. without individual company observations. While information on the total number of firms is provided online[1], information on exits can only be obtained by researchers upon request.

The development of the number of crafts companies (base year = 2004) is depicted in figure 1. The company registration data clearly points to a sharp increase in market entry in the fully deregulated B-trades, whereby the total number of companies in these trades almost doubled between 2004 and 2009. The large B-trade of building cleaners experienced a particular expansion, with the total number of registered firms more than quadrupling between 2004 and 2009. A-trades and AC-trades did not display any significant changes between 2004 and 2009.

The development of the number of exits (base year = 2004) is shown in figure 2, highlighting a distinct increase in exits in the fully deregulated B-trades after 2004. The trade of cleaners displays a particularly strong rise in exit probabilities. The increase in exits is more pronounced than the increase in the total number of firms. By contrast, an increase in exits in A-trades cannot be established.[2]

3. A replication of the original analysis using microcensus data

3.1. Points of Departure

We proceed by re-examining the microcensus data set used by RA (2014). As with the original paper, we rely on linear difference-in-differences regressions.

[1] www.zdh-statistik.de

[2] The reader may notice that we do not distinguish between A- and AC-trades in figure 2, which is because the regression analysis of exit probabilities in the MC data set also combines the two groups. The MC data contains few exits in the category of AC-trades and thus it should not be used as the control group.

$$Exit_i = \alpha + \beta B_i + \gamma Post_i + \sigma B_i Post_i + \pi X_i + \varepsilon_i$$

Self-employment, entry and exist probabilities serve as dependent variables (see appendix B). The interaction of the post-2004 dummy and a treatment group dummy (e.g. indicating a fully deregulated B-trade or partially deregulated A-trade) denotes the treatment effect. The control variables contained in the vector X are those described in RA[3] (2004, 1083). As discussed below, education variables for secondary as well as post-secondary schooling are not simply treated as controls but are shown to be mediating variables (see 3.2.ii)[4]. Errors are clustered by occupation. Our methodology departs from the original paper in three respects:

(i) Most importantly, when assessing the implications of a particular policy change in the crafts sector, it is paramount that the sample entirely comprises individuals within this sector. It must not contain individuals in the agricultural, industrial or any other sector of the economy, all of which were not directly affected by the 2004 reform of the Trades and Crafts Code. Given that the MC dataset does not contain a crafts indicator, it is necessary to make a decision about how to classify the observations.

In his study, RA (2014, 2010) developed a classification procedure based on occupation codes in the microcensus (KldB1992). The author kindly provided us with his list of occupation codes, which can be found in appendix A[5]. We analyzed this list in detail, because it constitutes an important attempt to make the microcensus data utilizable for studies focusing on the German crafts sector. The thorough examination enabled us to conclude that the demarcation chosen by RA is most probably too broad: while it certainly includes many of the occupations that German craftsmen would practice, it also very likely contains a large proportion of non-crafts individuals who are unaffected by the policy reform.

Therefore, in our replication study, we decided to develop a new classification system that is still based on the occupation codes of the microcensus (KldB1992) yet also uses additional information, allowing us to exclude a number of non-craft workers. Details of the procedure are provided in appendix A. Comparing the sample based on RA's original

[3] Age, age squared, female, East Germany dummy, nationality dummies for being German, European or other, professional qualification dummies, school degree dummies, dummies indicating the number of children in the household, dummies for marital status, years, branch, occupation and city size.

[4] 'Realschule', as opposed to 'Hauptschule', is the most important secondary schooling degree for craftsmen as there are very few individuals with 'Abitur', which enables access to tertiary education. In terms of post-secondary education, most craftsmen have either completed vocational training ('Geselle') or the more advanced 'Meister' degree.

[5] We are reproducing the list of occupations in the RA classification scheme with the permission of the author in appendix A.

demarcation with our sample, we observe that around 97,000 (43%) of RA's observations are not included in our study.[6]

(ii) There are two channels in which the reform may have increased exit probabilities. First, the reform *directly* affects exit probabilities by increasing the level of competition, deliberate temporary self-employment, etc. We expect the interaction term coefficient to be positive from a theoretical perspective and due to the empirical findings emerging from company registry data (see section 2).

Second, the reform also *indirectly* affects exit probabilities by lowering the level of education of market entrants after 2004 (especially in the fully deregulated B-trades). It can be hypothesized that entrepreneurs with little training are more likely to exit compared with those with advanced vocational training. In other words, the reform effect is partially mediated by the education variables in our model (see Baron and Kenny, 1986; MacKinnon et al., 2007; Judd and Kenny, 1981; also see Heckman and Pinto, 2015; Imai et al., 2010).

Following Judd and Kenny (1981), Table 2 presents exit probabilities results both with and without education controls. Our main result of increased exit probabilities holds regardless of whether we control for education or not. A more detailed discussion of mediation can be found in appendix C.

(iii) Finally, we also adapted the definition of the treatment groups. The original paper distinguished between A1- and A2-trades, referring to the so-called easy-job rule, which eliminates the master qualification standard for a limited set of tasks that can be learned within three months. However, the easy-job rule actually applies indiscriminately to A1- and A2-trades (see Müller, 2006), meaning that there is no reason to differentiate between them.

3.2. Results

3.2.1. Self-employment levels and entry

Table 1 displays the regression coefficients for the dependent variables self-employment and entry. The interaction term for both treatment groups (A and B) positively affects self-employment. However, in contrast to RA, we note distinct effect sizes for the two groups. While self-employment increases by almost 6 percentage points in the completely deregulated B-trades (specification 7), the effect is notably smaller for A-trades (1.6

[6] RA (2014) states that he uses alternative classifications in which unclear cases are omitted from the analysis. According to the author, these robustness checks do not affect his main results. For example, the author states in FN8: "the results do not change if all occupational codes associated with more than one group, e.g., a B1-occupation and a B2-occupation, are excluded from the sample." By contrast, our sample based on a refined classification of occupations produces different results.

percentage points), which are only partially deregulated. This difference in effect sizes is in line with company registry data (see section 2).

Specification 9 in table 1 presents results for the case whereby the B-trade variable only comprises cleaners. While the descriptive ZDH data (figure 1) strongly suggests a rapid expansion of self-employment, the LPM coefficient indicates an increase by only 1.3 percentage points. This peculiar result increases our suspicions about this occupation code (see appendix A) and our decision to remove it from the sample.

Regardless of which entry variable we use (see appendix B for details), the reform appears to have caused a wave of new entrepreneurship for B-trades. Depending on the specification (1-4), effect sizes range from 1.0 to 1.8 percentage points. Given that the average probability of entry equals 0.81% in the overall sample, the reform's impact must be interpreted as large. In contrast to RA, we do not find a corresponding increase of entry probabilities for A-trades. In specification 1 and 2, the coefficient is positive but not statistically significant at conventional levels. Finally, there is no evidence of increased entry for cleaners (specification 5). Again, this increases our suspicions about this occupation code (see appendix A) and contributes to our decision to remove it from the sample.

3.2.2. Exit probabilities

In our estimation of exit probabilities, we cannot safely rely on the control group AC because the number of identifiable exits per year within this category is quite small. Instead, we compare the development of exits in B with the aggregate of A- and AC-trades. As opposed to RA, we find an increase in exit probabilities by between 2.0 and 2.5 percentage points (specification 1 and 2). As the mean exit probabilities per year in our data set are below four percent, this change represents a considerable increase in exits for the fully deregulated part of the crafts sector. Our result again mirrors the conclusions based on company registry data discussed above (figure 2).

Given that education can be expected to reduce the likelihood of exiting the market, if a number of entrepreneurs with little training enter the market, we hypothesize exit probabilities to rise. For a more detailed discussion of education as a mediating variable, see appendix C. Regardless of whether education is controlled for or not, the interaction term coefficient (treatment group B and post-2004) remains positive and statistically significant (specification 1 and 2). However, once the cleaner category is included (specification 3 and 4), the interaction term is no longer positive and significant. If the B-trade variable only comprises cleaners (specification 5), the interaction is negative and statistically significant. This result sharply contrasts the company registry data discussed in section 2. It appears

that the inclusion of cleaners is the main reason for the difference between our results and those in RA (2014).

3.2.3. Sensitivity tests and a discussion of causality

We re-run the exit probability regression to assess the causal interpretability of our results (appendix D).

While the reform of occupational licensing was put into practice on January 1, 2004, the interviews for the microcensus were conducted in April of the same year. In specification 2, table 7, we recode the year 2004 as being part of the post-policy period. Specification 1 drops all observations for that year, whereby the interaction term coefficient remains positive and significant in both specifications. Interestingly, the effect size is slightly larger than before. Our first "placebo" specification (3) reduces the sample by keeping the years 2002, 2003 and 2004, in addition to treating the last year as the post-policy period. Again, the interaction term coefficient is positive and significant. The results in columns 1 to 3 suggest that the reform already increased exit rates in 2004.

The suitability of DID regressions requires that factors unrelated to the reform itself have not selectively affected the control or treatment group. We now address the most likely candidates.

Our second "placebo" specification (4) reduces the sample to 2002 and 2003, pretending that the latter belongs to the post-policy period. The interaction term coefficient is statistically insignificant and close to zero. It can be stated that prior to 2004, no other factor appears to have selectively acted upon the groups.

One particular concern relates to the economic crisis of 2008/09 (Müller, 2016). Specification (5) drops all observations for 2009, the only year in which the German economy experienced a reduced GDP growth rate. The coefficient of interest remains statistically significant and positive. Similarly, the gradual introduction of minimum wages in the construction trades may have influenced our results. As stated by Aretz et al. (2013), the roofing trade experienced the most important wage increase in the period under consideration. However, dropping this occupational code also does not change the results. Müller (2016) stated a possible impact of "adolescents' changing preferences concerning vocational training" (p.2). However, it is unlikely that a slow process such as preference change – which spans over decades – will bias our results. Finally, table 8 reports the results of a regression in which interaction terms between the treatment group B and each year after 2002 are included. With the exception of 2006 (positive but insignificant) and 2009, all post-policy coefficients are positive and significant.

While the existence of cofounding factors can never be falsified conclusively, the above discussion suggests that the DID results estimate the positive causal effect of the reform on exit probabilities.

4. Conclusion

This study re-examines the impact of the reform of the German TCC in 2004 on the likelihood of self-employment, market entry and exit. The reform lowered entry barriers for potential entrepreneurs by removing educational licensing requirements in certain skilled crafts trades but not in others. The alleviation of these entry barriers can be seen as a new attempt to strike a balance between consumer protection and self-employment opportunities. Strict licensing rules constitute an ex-ante selection mechanism, through which only highly skilled craftsmen are permitted to enter the market. Less restrictive licensing allows for increased market competition and an ex-post selection of unsuccessful firms.

Using microcensus data, RA (2014) finds a uniformly positive effect of the reform on market entry and self-employment and no change in exit probabilities. We have identified a discrepancy between these findings and descriptive company registry statistics, pointing to a more pronounced increase in entry in the fully deregulated trades compared to partially deregulated trades. In addition, company registry data shows a marked increase in exit probabilities for fully deregulated B-trades. After replicating the original study, we have shown that the identified discrepancies are driven by differences in sample selection. The occupational classification chosen by RA is most probably too broad: while it certainly includes many of the occupations that German craftsmen would practice, it also very likely contains a large proportion of non-crafts individuals. However, when assessing the implications of a particular policy change in the crafts sector, it is paramount that the sample entirely comprises individuals within this sector.

Our analysis of the microcensus data suggests that the reform has had a larger impact on entries in fully deregulated trades rather than partially deregulated trades. Moreover, there is evidence of an increase in exit probabilities in fully deregulated B-trades. Both results correspond to official company registry data. It is shown that the discrepancy between RA's analysis and official data is mainly driven by difficulties in correctly identifying the large B-trade of building cleaners based upon microcensus data.

Our study also sheds some light on the appropriate use of microcensus data. Even if there is no clear-cut crafts indicator in this data set, it is nevertheless suitable for analyzing the skilled crafts sector if some care is taken regarding the classification of occupations. We provide one such classification scheme and a discussion of the underlying methodology in appendix A.

References

Aretz, Bodo; Arntz, Melanie; Gregory, Terry (2013) The minimum wage affects them all: evidence of employment spillovers in the roofing sector, *German Economic Review*, 14(3): 282-315.

Baron, Reuben M; Kenny, David A. (1986) The moderator-mediator mariabledistinction in social psychological research: Conceptual, strategic, and statistical considerations*, Journal of Personality and Social Psychology*, 51(6): 1173-1182.

BAA (2014) Methodenbericht – Spezifische Berufsaggregate auf Grundlage der Klassifikation der Berufe 2010. Bundesagentur für Arbeit. http://statistik.arbeitsagentur.de/

BiBB (2012) Zuordnungsliste von dualen Ausbildungsberufen nach BBiG/HwO ggf. inklusive Vorgänger und den zugeordneten Erhebungsberufen der Berufsbildungsstatistik

Feuerhake, Jörg (2012) Handwerkszählung 2008, Wirtschaft und Statistik, 1: 51-62.

Heckman, James; Pinto, Rodrigo (2015) Econometric mediation analyses: Identifying the sources of treatment effects from ecperiementally estimated production technologies with unmeasured and mismeasured inputs, *Economic Review*, 34(1-2): 6-31.

Imai, Kosuke; Keele, Luke; Yamamoto, Teppel (2010) Identification, inference and sensitivity analysis for causal mediation effects. *Statistical Science*, 25(1): 51-71.

Judd, Charles M.; Kenny, David A. (1981) Process Analysis: Estimating mediation in treatment evaluations, *Evaluation Review*, 5(5): 602-619.

MacKinnon, David P; Fairchild, Amanda J.; Fritz, Matthew S. (2007) Mediation analysis. *Annual Review of Psychology*, 58(1): 593-614.

Müller, Klaus (2016): Economic effects of deregulation: Using the example of the revised Trade and Crafts Code 2004, ifh Working Papers No. 5, Institute for Small Business Economics (ifh), University of Göttingen.

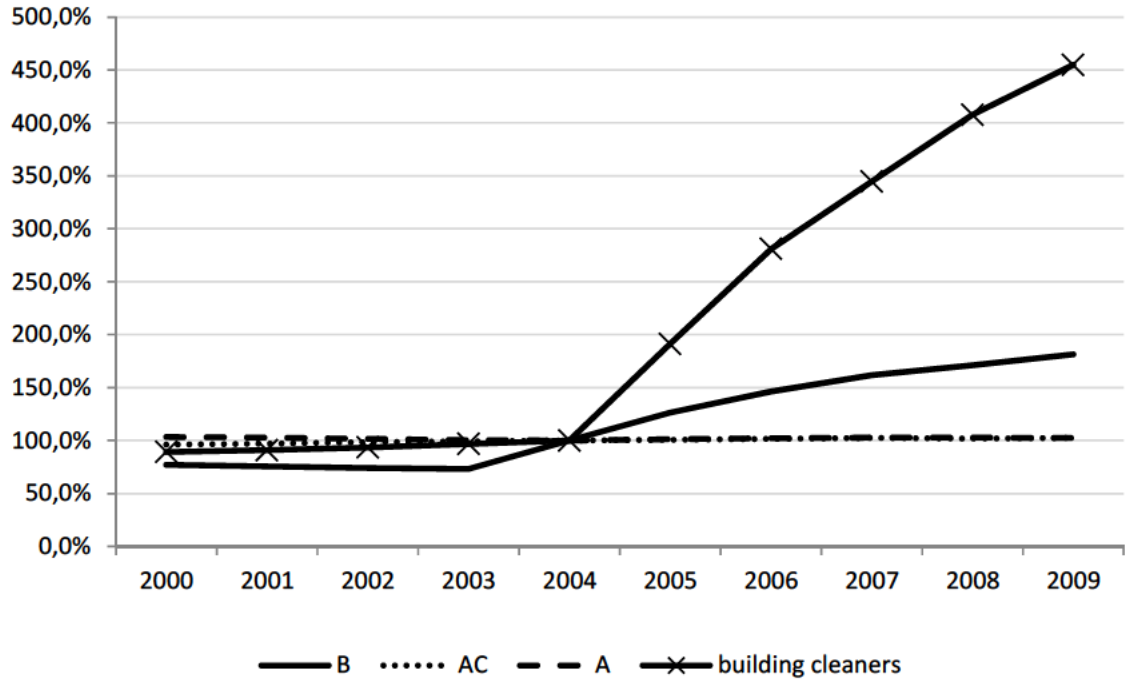
Müller, Klaus (2014) *Stabilität und Ausbildungsbereitschaft von Existenzgründungen im Handwerk* (Ed. Kilian Bizer). Göttinger Handwerkswirtschaftliche Studien, 94, Duderstadt.

Müller, Klaus (2006) *Erste Auswirkungen der Novellierung der Handwerksordnung von 2004* (Ed. Kilian Bizer). Göttinger Handwerkswirtschaftliche Studien, 74, Duderstadt.

Rostam-Afschar, Davud (2014) Entry regulation and entrepreneurship: a natural experiment in German craftsmanship, *Empir Econ*, 47: 1067-1101.

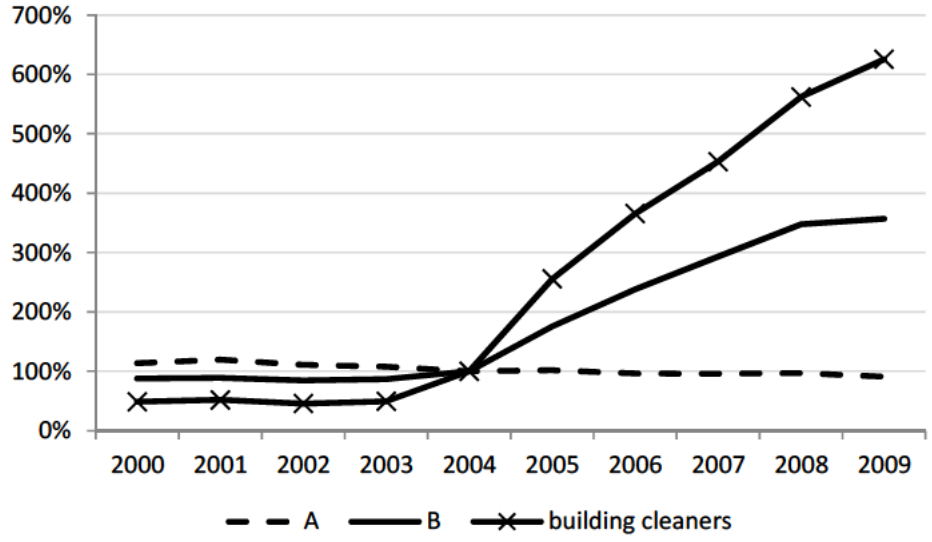
Rostam-Afschar, Davud (2010) Entry regulation and entrepreneurship. Empirical evidence from a German natural experiment. DIW Discussion Papers, 1065.

Figure 1: Total number of firms (by year and treatment category, 2004=100)



Source: ZDH data (company registry data), own calculations.
B-trades include cleaners.

Figure 2: Total number of exits (by year and treatment category, 2004=100)



Source: ZDH data (company registry data), own calculations

Table 1: Estimation results of self-employment state and transition probabilities (linear probability models)

	entry 1		**entry 2**			**self-employment**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
dB x dPost	0.018	0.01	0.01	0.01	0.00	0.042	0.059	0.03	0.013
	(0.00)	*(0.01)*	*(0.015)*	*(0.016)*	*(0.761)*	*(0.078)*	*(0.09)*	*(0.1)*	*(0.023)*
dA x dPost	0.008	0.01	-	0.00	0.00	-	0.016	0.2	0.016
	(0.178)	*(0.18)*	-	*(0.365)*	*(0.374)*	-	*(0.067)*	*(0.07)*	*(0.05)*
dEU x dPost	0.01	0.01	0.001	0.01	0.004	0.055	0.056	0.05	0.043
	(0.00)	*(0.00)*	*(0.336)*	*(0.339)*	*(0.163)*	*(0.10)*	*(0.10)*	*(0.12)*	*(0.078)*
dB	0.012	0	0.003	0.001	-0.003	0.15	0.16	0	-0.24
	(0.006)	*(0.5)*	*(0.033)*	*(0.00)*	*(0.022)*	*(0.00)*	*(0.00)*	*(0.99)*	*(0.00)*
dA	-0.005	-0.01	-	0.004	0.00	-	0.013	-0.07	-0.07
	((0.175)	*(0.09)*	-	*(0.001)*	*(0.677)*	-	*(0.72)*	*(0.07)*	*(0.002)*
dEU	-0.001	0	0.003	0.003	0.001	0.011	0.01	0.03	0.020
	(0.667)	*(0.98)*	*(0.076)*	*(0.079)*	*(0.36)*	*(0.58)*	*(0.58)*	*(0.11)*	*(0.214)*
cleaners	no	*yes*	*no*	*no*	*B=only cleaners*	*no*	*no*	yes	B=only cleaners
R2	*2.11%*	*2%*	*<1%*	*<1%*	*<1%*	*23.7%*	*23.7%*	23.88%	25.76%
N	*123,417*	*153,221*	*166,437*	*166,437*	*174.01*	*165,965*	*165,956*	*204,137*	*192,643*

German Microcensus data for the years 2002 – 2009 has been used.
P-values are displayed in parentheses.
dEU is equal to one if a foreigner was born in an EU country.
'Entry 1' is constructed as described by RA. 'Entry 2' is constructed as described in appendix B.
The following control variables are used: Secondary education (POS, Realschule, Fach-Abitur, Abitur), tertiary education (dual vocational training, school-based vocational training, master craftsmen, university for applied sciences, university degree, Ph.D.), age, age squared and cubed, gender, citizenship, state dummies, city size dummies, marital status, no. of children, year dummies, branch and occupation controls.

Table 2: Estimation results of exit probabilities (linear probability models)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
dB x dPost	0.025	0.020	-0.001	-0.004	-0.13
	(0.018)	*(0.04)*	*(0.95)*	*(0.84)*	*(0.00)*
dB	-0.04	-0.05	0.01	-0.007	0.27
	(0.0)	*(0.0)*	*(0.84)*	*(0.87)*	*(0.00)*
dEU x dPost	-0.03	-0.03	-0.03	-0.02	-0.04
	(0.56)	*(0.43)*	*(0.445)*	*(0.53)*	*(0.34)*
dEU	0.03	-0.021	-0.06	-0.05	-0.07
	(0.511)	*(0.62)*	*(0.24)*	*(0.30)*	*(0.23)*
controls	*no edu*	*all*	*no edu*	*all*	*no edu*
cleaners	*no*	*no*	*yes*	*yes*	*B = only cleaners*
R2	*15.65 %*	*17.4 %*	*15.95 %*	*18.12 %*	*17.65 %*
N	*14,400*	*14,400*	*14,900*	*14,900*	*12,500*

German Microcensus data for the years 2002 – 2009 has been used.
P-values are displayed in parentheses.
dEU is equal to one if a foreigner was born in an EU country.
The variable 'exit' is constructed as described by RA.
The following control variables are used: Secondary education (POS, Realschule, Fach-Abitur, Abitur), tertiary education (dual vocational training, school-based vocational training, master craftsmen, university for applied sciences, university degree, Ph.D.), age, age squared and cubed, gender, citizenship, state dummies, city size dummies, marital status, no. of children, year dummies, branch and occupation controls.

Appendix A: Classification of crafts trades

The following procedure was used to identify individuals working in the crafts sector by using the microcensus occupation codes (KldB1992). In a first step, we gathered information on all *training occupations* and their classification codes (KldB 1992). *Training occupations* are different from occupations but are nevertheless associated with a particular crafts trade. This was achieved by consulting the official classifications of the ZDH and the Federal Institute for Vocational Education and Training and including present as well as predecessor occupations (Bundesinstitut für Berufsbildung, BiBB, 2012).

In a second step, we used data provided online by BiBB concerning the information about how many apprentices within one occupational field are trained within either crafts companies or non-crafts (mainly industrial) companies.[7] We subsequently computed a proportion of crafts apprentices within each occupational code. To exclude occupation codes with a high proportion of non-crafts workers, we used the information on the proportion of crafts trainees and dropped codes if this proportion was less than 60%. Lowering or increasing this cut-off point by up to 20% hardly affects the classification as most occupations contain either a very low or a high proportion of craftsmen. We also removed observations if occupations could not be clearly marked as either an A or B occupation.

This method is not error-proof as it assumes that the proportion of crafts *trainees* strongly correlates with the proportion of crafts *employees*. However, this method allows us to remove some of the occupation codes from the analysis that most probably contain very low proportions of crafts workers. For example, while the KldB code 141 ("Chemiebetriebswerker", chemical plant employee) may seem a good proxy for the B-trade of "Wachszieher" (candle maker, see RA classification), according to our results less than 1% of individuals in the occupation of chemical plant employee are actually craftsmen. Our classification scheme implies that most of the individuals in that occupation are industrial workers such as chemical production specialists, chemical technicians or pharmaceutical technicians.

In a final step, we scrutinized the occupation of building cleaners (KldB code: 934). The occupation comprises about 45% of all individuals in the deregulated B-trades in the microcensus dataset. Owing to its large size, it potentially biases any general conclusions about B-trades.

After a thorough inspection, we are doubtful that the occupational group of cleaners in the microcensus data reasonably captures the TCC trade of cleaners. While official company registration data points to a sharp increase in market entry in that trade after 2004, no such trend can be established in the microcensus data. The proportion of self-employed cleaners

[7] https://www.bibb.de/de/berufeinfo.php

in microcensus only increases from 1.6% (2004) to 2.3% (2011). Upon request, employees of the Research Data Centers of the German States confirmed our suspicion and suggested several other classification codes under which cleaners might be found, none of which can be identified as crafts trades based upon our classification scheme.

According to the documentation for an older occupation classification system (KldB1975), there are about seven activity profiles coded as 933 or 934 (cleaners). The classification scheme in the microcensus (KldB1992) merges these codes into one (934). According to the crafts classification scheme recently developed by the Federal Employment Agency (BAA, 2014[8]), only three of these seven occupations belong to the crafts sector.

Table 3 presents a comparison of the RA and the Runst et al. samples. According to our classification scheme, about 97,000 observations in the RA sample are in fact not crafts occupations or cannot be clearly identified as group A or B and thus must be dropped from the analysis. Furthermore, there are about 45,000 observations that we included but are not part of the RA sample.

Table 3: Comparison of samples based on different crafts classifications

	RA	**Runst et. al**
Number of overall observations	221,951	170,398
Number of self-employed	27,889	25,516
Fraction of self-employed	12.5%	15%
Number of exits in the crafts sector	1,075	562
Female	31.2%	14.5%
Age	40	38.4
Meister	12.6%	14.9%
Geselle	57.2%	62.5%

The samples contain microcensus data from 2002 to 2009.
The Runst et al. sample drops observations if the occupation contains less than 60% craftsmen.
A *Geselle* represents the title for trained craftsmen who do not possess a Meister-degree.

[8] BAA (2014) Methodenbericht – Spezifische Berufsaggregate auf Grundlage der Klassifikation der Berufe 2010. Bundesagentur für Arbeit. http://statistik.arbeitsagentur.de/

Table 4: Classification of crafts occupations, Rostam-Afschar (KldB1992 titles)

AC	A1
Augenoptiker/innen Zahntechniker/innen	Kachelofen- und Luftheizungsbauer/innen Zimmerer
Schornsteinfeger/innen	Dachdecker
Orthopädiemechaniker/innen, Bandagist(en/innen)	Straßenbauer
Schuhmacher/innen (Handwerk)	Isolierer/innen, Abdichter/innen
Radio- und Fernsehtechniker/innen und verwandte Berufe	Sonstige Tiefbauberufe
	Stein-, Edelsteinbearbeiter/innen
	Stukkateur(e/innen)
	Gerüstbauer/innen
	Werkzeugmechaniker/innen (Instrumententechnik), Schneidwerkzeugmechaniker/innen, Metallfeinbauer/innen Dreher/innen
	Kälteanlagenbauer/innen, und -installateur(e/innen)
	Landmaschinenmechaniker/innen, Metallbauer/innen (Landtechnik) Industriemechaniker/innen (Geräte- und Feinwerktechnik), Feinmechaniker/innen Klempner/innen
	Gas-, Wasserinstallateur(e/innen)
	Elektrotechniker/innen
	Elektromaschinenbauer/innen, Elektromaschinen-monteur(e/innen) Tischler/innen
	Holz-, Kunststoffkonstruktions-bauer/innen
	Spuler/innen, Zwirner/innen, Seiler/innen
	Bäcker/innen
	Konditor(en/innen)
	Friseur(e/innen)
	Glaser/innen
	Glashersteller/innen
	Gummihersteller/innen, -verarbeiter/innen, Vulkaniseur(e/innen)

Table 4 cont'd: Classification of crafts occupations by Rostam-Afschar (KldB1992 titles)

A2	B
Maurer, Feuerungs- und Schornsteinbauer, Beton- und Stahlbauer/innen	Fliesen-, Platten-, Mosaikleger/innen
Maler/innen und Lackierer/innen (o.n.A., Ausbau)	Formstein-, Beton(stein)hersteller/innen
Metallbauer/innen (Metallgestaltung) und Schmied(e/innen) (Handwerk)	Estrich-, Terrazzoleger/innen
Karosserie-, Fahrzeugbauer/innen	Anlagenmechaniker/innen (Apparatetechnik)
Kraftfahrzeug-, Zweiradmechaniker/innen	Uhrmacher/innen
Kommunikations-, Büroinformationselektroniker/innen	Graveur(e/innen) und verwandte Berufe
Kraftfahrzeug-, Zweiradmechaniker/innen	Industriemechaniker/innen (Geräte- und Feinwerktechnik), Feinmechaniker/innen, Graveur(e/innen) und verwandte Berufe, Edelmetallschmied(e/innen)
Fleischer/innen	Galvaniseur(e/innen), Metallfärber/innen
	Gießereimechaniker und andere Formgießerberufe
	Werkzeugmechaniker/innen (Instrumententechnik), Schneidwerkzeug-mechaniker/innen, Metallfeinbauer/innen Edelmetallschmied(e/innen)
	Raumausstatter/innen, Parkettleger/innen
	Sonstige Metallbau- und verwandte Berufe
	Modellbauberufe
	Berufe in der Holz-, Flechtwarenherstellung und in verwandten Bereichen Holz-, Kunststoffkonstruktions-bauer/innen
	Berufe in der Holz-, Flechtwarenherstellung und in verwandten Bereichen Oberbekleidungsschneider/innen
	Sonstige Textilverarbeiter/innen
	Bekleidungszubehörfertiger/innen
	Weber/innen
	Textilnäher/innen
	Fellverarbeiter/innen
	Schuhmacher/innen (Handwerk)
	Sattler/innen, Täschner/innen
	Raumausstatter/innen, Parkettleger/innen
	Sonstige Berufe in der Lebensmittelherstellung
	Brauer/innen und Mälzer/innen
	Sonstige Getränke-hersteller/innen, Koster/innen
	Textilreiniger/innen, -pfleger/innen
	Chemiebetriebswerker/innen
	Gebäudereiniger/innen, Raumpfleger/innen
	Glasbearbeiter/innen, Glasveredler/innen
	Glas-, Keramik-, Porzellanmaler/innen
	Stein-, Edelsteinbearbeiter/innen, Graveur(e/innen) und verwandte Berufe, Edelmetallschmied(e/innen)
	Fotograf(en/innen), Kameraleute
	Buchbinder/innen
	Schriftsetzer/innen, Drucker/innen (Hoch-, Flach-, Tiefdruck)
	Spezialdrucker, Siebdrucker
	Druckformhersteller/innen
	Keramiker/innen (Grob-, Feinkeramik)
	Musikinstrumentenbauer/innen
	Warenmaler/innen, Warenlackierer/innen und verwandte Berufe
	Schilder-, und Lichtreklamehersteller/innen

Table 5: Classification of crafts occupations by Runst et al. (KldB1992 titles)

AC			**A**		
TCC trade title	**KldB code**	**fraction of crafts trainees**	**TCC trade title**	**KldB code**	**fraction of crafts trainees**
Augenoptiker	304	100.00%	Feinwerkmechaniker	221	10.00%
Zahntechniker	303	100.00%	Büchsenmacher (also contains Feinwerkmechaniker)	300	100.00%
Schornsteinfeger	804	100.00%			
Orthopädietechniker	307	100.00%	Dachdecker	488	100.00%
			Elektrotechniker	310	100.00%
Orthopädieschuhmacher (also contains very few individuals from B occupation Schumacher)	372	100.00%	Elektrotechniker	312	100.00%
			Friseure	901	100.00%
			Glaser	485	100.00%
Hörgeräteakustiker (also contains very few individuals from occupation Radio- und Fernsehtechn ker)	315	100.00%	Kälteanlagenbauer	266	100.00%
			Klempner	261	100.00%
			Konditoren	392	100.00%
			Maler und Lackierer	510/ 511	100.00%
			Ofen- und Luftheizungsbauer	484/ 441	100.00%
			Seiler	332	100.00%
			Tischler	501	100.00%
			Vulkaniseure und Reifenmechaniker	145	100.00%
			Stukkateure	481	99.53%
			Installateur und Heizungsbauer	264/ 267/ 268	99.36%
			Bäcker	391	99.33%
			Steinmetzen und Steinbildhauer	101	99.09%
			Karosserie- und Fahrzeugbauer	287	98.51%
			Wärme-, Kälte- und Schallschutzisolierer	482	98.45%
			Landmaschinenmechaniker	282	95.34%
			Kraftfahrzeugtechniker, Zweiradmechaniker	281	95.01%
			Boots- und Schiffbauer	506	94.71%
			Metallbauer	254	92.92%
			Gerüstbauer	443	92.24%
			Fleischer	401	91.81%
			Zimmerer	487	88.83%
			Maurer und Betonbauer	441	84.79%
			Elektrotechniker	311	80.36%
			Kraftfahrzeugtechniker	318	77.90%
			Elektromaschinenbauer	313	74.93%
			Maler und Lackierer	512	70.85%
			Chirurgiemechaniker (dropped, cannot be separated from Schneidewerkzeugmacher, 295)	295	70.50%
			Brunnenbauer	466	67.36%
			Straßenbauer	461	54.06%
			Informationstechniker	317	47.20%
			Maurer und Betonbauer	442	38.82%
			Glasbläser und Glasapparatebauer	131	22.07%
			Elektrotechniker	316	8.79%

Table 5 cont'd: Classification of crafts occupations by Runst et al. (KldB1992 titles)

B			B continued		
TCC trade title	**KldB code**	**fraction of crafts trainees**	**TCC trade title**	**KldB code**	**fraction of crafts trainees**
Bogenmacher	305	100.00%	Galvaniseure	234	34.93%
Fotografen	837	100.00%	Siebdrucker	175	26.73%
Gebäudereiniger (see appendix A for more details)	934	100%	Brauer und Mälzer	421	20.19%
Geigenbauer	305	100.00%	Behälter- und Apparatebauer	252	17.29%
Graveure	294	100.00%	Betonstein- und Terrazzohersteller	112	16.43%
Rolladen- und Jalousiebauer	259	100.00%	Sticker, Weber	341	9.43%
Schilder- und Lichtreklamehersteller	839	100.00%	Instrumentenmacher	305	74.47%
Wachszieher	141	0,3%	Flexografen	173	12.98%
(This is a small crafts trade. Has been deleted bc of overlap with the industrial occupation of chemical production specialist)			Buchdrucker: Schriftsetzer; Drucker	174	8,51%
Parkettleger, Raumausstatter	491	99.65%	Glasveredler, Feinoptiker	135	7,36%
Estrichleger	486	98.75%	Weinküfer	423	6.10%
Sticker	359	96.55%	Müller	435	5.08%
Fliesen-, Platten- und Mosaikleger	483	93.42%	Metall- und Glockengießer	201	4.46%
Kürschner	378	93.27%	Buchdrucker: Schriftsetzer; Drucker	171	1.18%
Gold- und Silberschmiede, Edelmetallschmied(e/innen)	302	90.47%			
Orgel- und Harmoniumbauer	305	90.71%			
Modisten	354	87.75%			
Sattler und Feintäschner	374	82.47%			
Korbmacher, Drechsler, Holzbildhauer, Holzspielzeugmacher	185	71.61%			
Damen- und Herrenschneider	351	80.56%			
Uhrmacher	308	80.08%			
Schneidwerkzeugmechaniker (dropped, cannot be separated from Chirurgiemechaniker, 295)	295	70.50%			
Keramiker	121	69.61%			
Textilreiniger	931	58.10%			
Modellbauer	502	55.54%			
Glas- und Porzellanmaler	514	54.38%			
Klavier- und Cembalobauer	305	50.00%			
Segelmacher	358	41.47%			
Buchbinder	178	35.38%			

Appendix B: Construction of entry and exit variables

There are two possible approaches to constructing dummies that indicate market entry. RA uses a 45% sub-sample of the microcensus, whereby he compares the employment status of the previous year and the year of the survey. However, given that previous employment information is not part of the mandatory microcensus section, there is a possible answer selection bias. Alternatively, one may rely on information about the start of current employment, which is part of the mandatory section of the questionnaire. If the starting date for self-employment coincides with the year of the survey, it is coded as a market entry. As the questionnaire is completed around March of each year, market entry during the summer, fall and winter is not recorded in this way. We report the regression results for both of these variables.

The exit variable is constructed as described by RA (2014), based on the non-mandatory question about the employment status in the previous year.

Appendix C: Mediating variables

Mediation refers to a causal chain when a variable A affects the mediating variable B, which in turn affects variable C. At the same time, A can also cause C directly. The concept was developed in psychology (Baron and Kenny, 1986; Judd and Kenny, 1981; MacKinnon et. al, 2007) but has recently also been applied to econometric analyses (see Heckman and Pinto, 2015).

In the context of our paper, the reform (A) lowers the educational credentials of market entrants (B), which in turn increases the exit probabilities in the market (C). At the same time, the reform is hypothesized to directly increase exit as the level of competition is higher than prior to 2004.

In order to explore mediation pathways, Baron and Kenny (1986) suggest performing four regressions in which each component of the causal chain is examined separately. The first regression does not include mediation variables (education), i.e. the direct channel from reform to exit probability. The second and third regressions follow the mediation channel (reform to education, education to exit probability). Finally, if the first three regressions have established significant relationships, the fourth model uses all variables.

The regression results without education controls can be found in table 2, while the regression results for steps two and four can be found in table 6. There is evidence of the existence of a mediation channel. The relationship between the reform and education is

negative. Education and exit probabilities are also negatively related. The negative reform effect on exit probabilities holds regardless of whether we control for education or not.

Table 6: Testing for Mediation

	Meister (advanced vocational training)	**Realschule** *(secondary schooling degree)*
Effects of Reform on Education	-0.014 (0.06)	-0.014 (0.03)
Effects of Education on Exits	-0.058 (0.00)	-0.013 ((0.05)

German Microcensus data for the years 2002-2009 has been used.
'Meister' translates as master craftsmen.
'Realschule' is a secondary schooling degree which enables students to enter vocational training, but not tertiary education.
The regressions contain control variables, although these coefficients are not reported in the table.
P-values are displayed in parentheses.

Appendix D: Sensitivity analysis

Table 7: Timing Sensitivity

	(1) Exit Probability *2004 dropped* (2002-2009)	(2) Exit Probability *2004 as post-policy* (2002-2009)	(3) Exit Probability *Placebo reform 2004* (2002-2004)	(4) Exit Probability *Placebo reform 2003* (2002-2003)	(5) Exit Probability *2009 dropped* (2002-2008)
dB x dPost	0.035	0.035	0.043	-0.001	0.023
	(0.00)	*(0.00)*	*(0.014)*	*(0.949)*	*(0.017)*
dB	-0.063	-0.063	-0.067	-0.064	-0.041
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
dEU x dPost	-0.042	-0.043	-	-	-0.031
	(0.34)	*(0.331)*	-	-	*(0.481)*
dEU	-0.006	-0.016	-0.040	0.033	-0.027
	(0.93)	*(0.73)*	*(0.49)*	*(0.56)*	*(0.511)*
controls	all	all	all	all	all
cleaners	no	no	no	cleaner	cleaner
R2	18.25%	17.36%	10.06%	9.5%	9.5%
N	13,605	14,787	3,595	2,413	2,413

German Microcensus data has been used.
P-values are displayed in parentheses.
dEU is equal to one if a foreigner was born in an EU country.
The variable 'exit' is constructed as described by RA.
The following control variables are used: Secondary education (POS, Realschule, Fach-Abitur, Abitur), tertiary education (dual vocational training, school-based vocational training, master craftsmen, university for applied sciences, university degree, Ph.D.), age, age squared and cubed, gender, citizenship, state dummies, city size dummies, marital status, no. of children, year dummies, branch and occupation controls.

Table 8: Robustness

	Exit Probability (2002-2009)
dB x 2003	*-0.000*
	(0.96)
dB x 2004	*0.042*
	(0.011)
dB x 2005	*0.030*
	(0.076)
dB x 2006	0.24
	(0.134)
dB x 2007	0.035
	(0.035)
dB x 2008	0.042
	(0.001)
dB x 2009	0.006
	(0.19)

German Microcensus data for the years 2002 – 2009 has been used.
P-values are displayed in parentheses.
The variable 'exit' is constructed as described by RA.
The following control variables are used: Secondary education (POS, Realschule, Fach-Abitur, Abitur), tertiary education (dual vocational training, school-based vocational training, master craftsmen, university for applied sciences, university degree, Ph.D.), age, age squared and cubed, gender, citizenship, state dummies, city size dummies, marital status, no. of children, year dummies, branch and occupation controls.