Discussion Paper No. 12-083

Minimum Wages and Competition: The Case of the German Roofing Sector

Kornelius Kraft, Christian Rammer,
and Sandra Gottschalk

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

Discussion Paper No. 12-083

Minimum Wages and Competition: The Case of the German Roofing Sector

Kornelius Kraft, Christian Rammer,
and Sandra Gottschalk

Non-technical summary

In 1997, a minimum wage has been introduced in the German roofing sector which has been regularly increased since then. As a result, the share of workers for whom the minimum wage is binding increased steadily. In eastern Germany, this binding rate reached 60% by the mid 2000s, while workers in western Germany were less affected by the minimum wage. Against this background, the present paper investigates the effect of the minimum wage on competition in the roofing sector. Competition is measured by market entry, market exit and profits of firms active in the market. Our analysis is guided by the argument that the minimum wages may by used by established firms to raise rivals' costs and prevent entry by potential competitors. Lower entry rates reduce price competition and may stabilise or even raise profits of established firms.

We analyse the effects of the minimum wage using a difference-in-differences framework, based on a firm panel data set that covers all firms in the roofing sector as well as in the plumbing sector -which serves as reference sector- from 1996 to 2010. Firm-level panel estimations are employed to identify wage effects on profits while panel estimations at the level of regional markets are used to capture likely effects on entries and exits. As the binding rate of the minimum wage is significantly different between eastern and western Germany, all models are estimated separately for the two regions. In addition, firms are separated into two groups, sole traders (i.e. firms not affected by the minimum wage since they do not employ workers) and firms with employees (which do employ workers).

Estimation results reveal that the minimum wage had no effects on competition in the roofing sector in western Germany while some evidence for the theory on raising rivals' cost can be found for eastern Germany. In eastern Germany, both market entries and market exits of firms with employees were reduced by the minimum wage. At the same time, the minimum wage contributed to higher profits of established firms, obviously caused by the lower level of competition due to lower entry and exit rates. Interestingly, the minimum wage clearly favoured market entries by sole traders in eastern Germany, which may point to some type of evasion strategy since almost all newly entering sole traders refrained from employing workers at a later stage.

Das Wichtigste in Kürze

Im Herbst 1997 wurde im deutschen Dachdeckerhandwerk ein bundeseinheitlicher Mindestlohn eingeführt, der seither schrittweise erhöht wurde. Insbesondere in Ostdeutschland nahm der Anteil der gewerblichen Beschäftigten, die vom Mindestlohn betroffen sind, über die Zeit deutlich zu und erreichte ab Mitte der 2000er Jahre Werte von etwa 60 %. Vor diesem Hintergrund untersucht das Papier den Einfluss, den der Mindestlohn auf den Wettbewerb im Dachdeckergewerbe ausübt. Wettbewerb wird über Markteintritte, Marktaustritte sowie die Gewinne der im Markt aktiven Unternehmen abgebildet. Es wird die Hypothese untersucht, dass der Mindestlohn von den im Markt etablierten Unternehmen als ein Instrument genutzt wird, um die Kosten von potenziellen Markteintretern zu erhöhen und damit den Wettbewerb abzuschwächen. Dadurch kann der Mindestlohn zu einer Stabilisierung oder gar Erhöhung ihrer Gewinne beitragen.

Die Untersuchung beruht auf einer Differenz-in-Differenzen-Schätzung der Mindestlohneffekte auf die drei Wettbewerbsgrößen. Datengrundlage bildet ein Paneldatensatz, der alle wirtschaftsaktiven Dachdeckerunternehmen sowie Installationsunternehmen (die als Kontrollbranchen dienen) in Deutschland für den Zeitraum 1996 (d.h. ein Jahr vor Mindestlohneinführung) bis 2010 umfasst. Effekte des Mindestlohns werden auf Unternehmensebene in Bezug auf Unternehmensgewinne und auf Ebene von regionalen Absatzmärkten in Bezug auf Marktein- und -austritte geschätzt. Aufgrund der unterschiedlichen Mindestlohnbetroffenheit werden mögliche Effekte getrennt für West- und für Ostdeutschland untersucht. Außerdem wird zwischen Einpersonenunternehmen (Selbstständigen) und Mehrpersonenunternehmen (die dem Mindestlohn unterworfen sind, da sie abhängig Beschäftigte haben) unterschieden.

Die Schätzergebnisse zeigen für Westdeutschland keine Effekte des Mindestlohns auf dem Wettbewerb im Dachdeckerhandwerk. Für Ostdeutschland liegt dagegen Evidenz vor, dass der Mindestlohn sowohl zu einer geringeren Zahl an Markteintritten als auch einer geringeren Zahl von Marktaustritten von Mehrpersonenunternehmen geführt hat. Gleichzeitig trug der Mindestlohn zu einer Erhöhung der Gewinne von Mehrpersonenunternehmen im Osten bei. Im Gegenzug stiegen aufgrund des Mindestlohns die Markteintritte von Einpersonenunternehmen in Ostdeutschland, was möglicherweise eine Ausweichstrategie widerspiegelt. Insgesamt bestätigt sich die Hypothese, dass der Mindestlohn zu einer Verringerung der Wettbewerbsintensität unter den im Markt bereits etablierten Unternehmen beigetragen hat.

Minimum Wages and Competition: The Case of the German Roofing Sector

Kornelius Kraft*, Christian Rammer** and Sandra Gottschalk**

Abstract

This paper analyses the effects of minimum wages on competition in the German roofing sector. The case is particularly interesting since this sector is faced with a uniform minimum wage despite significant regional disparities in productivity and wages. As a control industry we take the plumbing sector, which shows a similar market structure and demand trend but is not subject to a minimum wage. Employing a comprehensive firm panel data and using a difference-in-difference approach, we estimate the impacts of minimum wages on market entries and exits and firms' profitability. We find significant effects for East Germany which point to a substantial shift in industry structure. Minimum wages decreased both market entries and exits for roofing firms while they increased entries of sole traders. A decreasing number of non-sole traders lowered competition for this group of firms and helped them to increase profitability. The increasing share of sole traders may indicate some type of evasion strategy in eastern Germany, particularly since wages for skilled roofers declined towards the minimum wage. In the western part of the country minimum wages had no impact on competition.

Keywords: Minimum Wage, Competition, Firm Performance, Labour Market Policy, Evasion Strategy, Sole Traders

JEL-Classification: D04, J21, J38, L11, L22, L74

Acknowledgements: We are grateful to Bodo Aretz, Melanie Arntz and Terry Gregory for preparing regional data on the share of workers with binding minimum wage and minimum wage gaps, to Nina Leheyda for estimating models on price impacts of minimum wages, and Melanie Arntz, Jürgen Egeln, Helmut Schröder and Holger Schütz for sharing information collected in interviews with industry representatives and firms

Note: This paper rests on research that was undertaken as part of an evaluation study of the effects of the minimum wage in the German roofing sector which was financed by the German Federal Ministry of Labour and Social Affairs (BMAS). The authors are responsible for all results and conclusions derived in this study. They do not necessarily reflect the views of the BMAS.

* TU Dortmund
Faculty of Business, Economics and
Social Sciences
Vogelpothsweg 87
44227 Dortmund
Germany
E-mail: kornelius.kraft@tu-dortmund.de

** Centre for European Economic Research (ZEW)
Dept. of Industrial Economics and
International Management
L 7, 1
68161 Mannheim
Germany
E-Mail: rammer@zew.de; gottschalk@zew.de

1 Introduction

Most theoretical and empirical papers on the consequences of minimum wages consider employment effects. This is understandable, but introducing or raising minimum wages may also have quite different implications. As legislative intervention affects production costs, the competitiveness of firms may be also altered. If the frequently supposed negative effects really are prevalent, less efficient firms may be forced to leave the market and a larger part of the market may be served by foreign suppliers. This scenario need not necessarily become true if the companies in question make reasonable profits before the minimum wage has been introduced and the competitive pressure is not too tough. But even then it is quite possible that profits are reduced and employers suffer from this legislative action. It might be the case that the introduction of minimum wages implies winners and losers and it appears to be worthwhile investigating how producers are affected and whether they really are the losers if mandatory minimum wages are introduced.

The discussion about possible effects of minimum wages on employment and firm competitiveness is quite controversial. Basically there are two views. On the one hand, a standard supply and demand model with competitive market structure is applied and increasing labour costs will in this scenario reduce employment. Profits will also be negatively affected. On the other hand, there are many reasons why labour markets are not frictionless and workers are immobile. Information on job alternatives is imperfect, moving involves costs, workers have specific preferences for a job or an employer and finally workers are frequently quite specialized and cannot immediately find alternative employment opportunities.

If a labour market can be described by monopsony, oligopsony or monopsonistic competition, an increase in the minimum wage may induce more employment rather than less. However, the effects on profits would still be negative. Hence the effects of minimum wages on employment and competitiveness may not go in the same direction and therefore a welfare-theoretic evaluation of minimum wages should also take into account the impact on capital owners.

We like to add a third view concerning the possible effects of minimum wages on competition. The literature on the incentives to raise rivals' costs emphasises (among other strategies) the advantages for some established firms of reaching an agreement with unions on generally binding wages in an industry. This may even be in their interest if their own wage costs rise, but the competitors are hit more intensively. The establishment of minimum wages by the legislator may just work in the same direction. Hence it is possible that the introduction of minimum wages benefits some firms but proves to be a disadvantage to others.

Of course, the performance of companies, industries or the whole economy is not an insignificant aspect of minimum wages. On the one hand, minimum wages might have opposing effects for workers and employers, and then the redistributive effects should at least be identified before any legislative action takes place. On the other hand, if profitability is affected, the long-term effect of minimum wages on employment might differ from the short-term impact. The loss of competitiveness may well over time lead to the exit of the less efficient firms. Employment would then be reduced in the long run. Moreover, if the domestic industry is covered by a minimum wage but foreign firms are not, imports might rise (if the good is tradable) and the domestically produced goods would be substituted by the imported ones. Analysing the relation between minimum wages and competition is of value in itself, but is also - especially if long-term impacts are considered – relevant to employment.

Increasing rivals' costs through minimum wages can be particularly important if incumbents want to prevent market entries and thus reduce the degree of competition. Newly established firms often enter markets below the minimum efficiency size because of financial constraints (Audretsch 1995, Mata et al. 1995). As newcomers, they also suffer from certain liabilities of newness such as low level of reputation vis-à-vis potential customers and low attractiveness for skilled workers. Young firms typically try to compensate for these competitive disadvantages by operating at lower variable costs than incumbents do, including lower wages. Minimum wages can undermine this strategy and prevent potential entrants from market entry (Göddeke et al. 2011, Haucap et al. 2001).

The role of minimum wages as an instrument to avoid competition has been discussed recently for the case of postal services in Germany. Heitzler and Wey (2010) argued that the introduction of a minimum wage in this sector at the end of 2007, shortly before a further deregulation step in the postal market in Germany, caused many firms to exit the market and deterred market entry. They stress that the minimum wage has been particularly effective in reducing competition because it increased not only marginal costs of labour, but also fixed costs, which has deterred the entry of firms that were more efficient than the incumbent.

The case of postal services is certainly a specific one owing to the particular market regulation and the existence of a large incumbent which was a formerly a state-owned company and is believed to provide services below an efficiency level that would appear under full competition. The objective of this paper is to investigate the role of minimum wages on competition in a market that is characterised by many small firms that act under monopolistic competition and where a minimum wage increases marginal costs of labour only. Competition is measured through four indicators, the level of firm profitability, market entries, market exits and change in the stock of firms. In contrast to the case of postal services, we look at the long-term co impact of minimum wages on competition rather than the short-term effects of the introduction of a minimum wage.

We use the German roofing sector as a case for which these characteristics apply. This sector is particularly interesting for various reasons. First, it has a long history of a minimum wage which was introduced in 1997 and has since then increased gradually. Secondly, in 2003 a uniform minimum wage across all regions was implemented despite significant differences in productivity and wages at a regional level, particularly between western and eastern Germany. Thirdly, the roofing sector is only one of a few sectors in construction services that are subject to a minimum wage while other construction services that are faced with similar market developments and show a similar industry structure have no minimum wage. This provides us with a fortunate situation of having a proper control group against which we can evaluate minimum wage effects. Finally, supply in the roofing business is dominated by a large number of very small firms, including many sole traders. This allows an analysis of minimum wage effects on firms with and without wage labour.

Another interesting aspect is the geographical disparity of the share of workers for whom the minimum wage is actually binding. In the centre of our analysis is the effect of minimum wages on the economic situation of the affected firms and the impact on market structure. Though the minimum wage in the roofing sector applies to all roofing firms in Germany, regional economic conditions are quite dissimilar. In particular, there are significant differences between the performance of the roofing business in eastern Germany and the roofing business in western Germany . As a consequence, wages also differ quite widely between the two regions, and therefore the effect of the minimum wage varies greatly between eastern and western Germany. Roofing firms predominantly employ qualified workers. In the western part, qualified workers usually earn more than the minimum wage, resulting in a negligible impact of the minimum wage in western Germany. The situation is very different in eastern Germany where most qualified workers receive a wage close to or at the level of the minimum wage. This regional variation offers an opportunity to examine the impact of a minimum wage within the same industry.

The empirical analysis rests on a difference-in-difference estimation approach, i.e. we observe competition in the roofing sector prior to and following the introduction of a minimum wage and use the plumbing sector as a control group. Using the Mannheim Enterprise Panel, we construct a unique panel data set for firms from both sectors containing annual data on profitability, entries and exits for a period that runs from years prior to the minimum wage introduction in 1997 to 2010. The sample covers almost the entire firm population in both sectors. We analyse profitability at the level of individual firms and aggregate firm data to regional markets in order to analyse effects on entry, exit and the stock of firms. Due to data limitation, we have to refrain from a detailed analysis of minimum wage effects on prices but we do report some general findings on price effects that can be attributed to the minimum wage.

The paper continues with some theoretical considerations on the link between minimum wages, prices, profitability and market entry and exit (Section 2), followed by a review of relevant empirical studies (Section 3). Section 4 provides background information on market structure and competition in the German roofing sector and Section 5 presents

the empirical strategy of our analysis. The data are described in Section 6 and the empirical results are presented in Section 7. Section 8 concludes.

2 Theoretical Considerations on Minimum Wage and Competition

The Competitive Market Theory

In the standard model of a competitive market firms are small, earn no economic profits and have no impact on the market-determined wage rate. Paying a higher wage would drive a company out of business and if it attempts to pay less than the market wage rate, vacancies could not be filled and the already employed workers would quit.

In such a situation, the introduction of a binding minimum wage would affect all firms in the same way and lead to cost increases, higher prices and lower demand, and consequently also to lower output. In the presence of fixed costs or efficiency differences (not implied by the standard model of a competitive market), some suppliers have to leave the market. Entry will be reduced.

However, the negative impact of minimum wages on employment may be counteracted by some factors. Higher wages might lead to efficiency wage effects by stimulating employee motivation and then productivity would increase. Moreover firms may provide additional training and as the workers who are affected by the minimum wage are in most cases the unqualified ones, such initiatives will be quite valuable for their employment prospects, but also probably for productivity and firm performance. In addition the higher wages that have to be paid to any workers in the presence of a minimum wage may induce substitution effects. The employers may now look for better qualified and more experienced workers, who offer a better return for the increased wage in comparison to the ones employed prior to the introduction of the minimum wage. With a better qualified workforce product strategy might also be affected. The firms might now aim at products with higher quality.

It is unclear whether the described counterstrategies are able to balance the cost increase, but they probably contribute to a mitigation of the effects. Still, some or most firms will suffer from the less favourable production conditions. If the industry has made high profits before, the minimum wage may simply lead to redistributive effects

without affecting the number of employees and the number of firms. However, if the competitive situation was tough before the minimum wage was imposed, its negative effects might be stronger. Passing on the cost increases to custumers may be difficult in the presence of intense competition and substitution possibilities for the customers. Furthermore, foreign producers might increase imports (in the case of tradable goods) if they now have a relative cost advantage. Then the less efficient firms in the industry in question may have to leave the market. In such a (negative) scenario we would observe reduced profitability, more exits and relatively few entries by domestic firms.

The Monopsonistic Model

The competitive model predicts lower employment if a minimum wage is imposed or raised and therefore also lower output is expected. Increased wage costs and lower output imply in turn higher prices. Under monopsonistic competition, however, employment will rise or at least remain constant if the minimum wage is not set too high. This is because in a monopsonistic situation the marginal costs of hiring a worker are not equal to the wage rate. If the minimum wage is fixed at a level above the monopsonistic level, but below marginal costs of employing additional workers by a monopsonist, the now relevant marginal costs are below the former level. For some level of employment marginal costs remain constant and this leads to higher employment. As labour input and output are correlated, firms produce more. Then prices will fall in response to minimum wage changes. Hence the predictions of the two models are not only in conflict with respect to the employment effects but also with respect to output and prices.

However, regardless of whether monopsony, oligopsony or monopsonistic competition is the relevant case on the labour market, producers suffer from the cost increases which are related to the introduction of minimum wages. If the product market is very competitive the less productive firms may be forced to leave the market and the remaining firms will realize lower profits.

The Raising Rivals' Costs Theory

The competitive market and the monopsonistic models are usually the theoretic foundation of (the few) contributions on the impact of minimum wages on competitiveness. However, the effect could well go in the opposite direction.

Markets differ and so do competitive strategies. In some markets price is the strategic variable and low cost producers try to gain market share by underbidding other producers. This will probably be of relevance for entrants into a market with standardized products and availability of (low skilled) employees, who are prepared to work for a low wage.

The literature concerning the strategies of "raising rivals' costs" does not explicitly consider minimum wages introduced by the legislator (with the exception of Heitzler and Wey 2010) but they do deal with a very similar issue, namely the imposition of wage rates which are generally binding for all firms active in an industry. Williamson (1968) discusses a court decision on an alleged conspiracy of a union with a group of employers with the aim of raising wage costs in competing firms to the level relevant for the allegedly conspiring firms. In his model firms produce with differing capital-labour intensities. Clearly, after the imposition of binding and relatively high wages, the labour intensive producers are disadvantaged. Williamson (1968) uses a standard limit pricing model to show that these firms cannot enter.

Haucap, Pauly and Wey (1999) consider the case of domestic firms with different productivities. Haucap, Pauly and Wey (2001) analyse the interest of employers' associations and unions in generally binding wage agreements. Both the union and the employers' association may have an incentive to increase the wage rate. This is because it may help to increase rivals' costs, therefore limiting competitive pressure. However, the employers' association may even prefer a higher wage than the union does and the union may enhance efficiency by limiting wage increases.

The effect of the introduction of a generally binding minimum wage was investigated by Heitzler and Wey (2010). In contrast to Haucap et Al. (2001), they consider fixed rather than variable costs. Furthermore, they allow for efficiency advantages of potential entrants. They theoretically analyse the case where labour costs mainly comprise fixed operating costs and apply this scenario to mail delivery networks. A mail delivery service can only effectively enter a market if it offers full coverage of the relevant area by a network. This network is associated with fixed costs which are independent of the overall mail volume. This scenario is applied to the case of the Deutsche Post and the

introduction of minimum wages in postal services which may serve as a barrier to entry, even if the potential entrant is more efficient.

Petrakis and Vlassis (2004) regard internationally integrated markets with productivity asymmetries. High productivity firms pay higher wages and still have lower unit costs than their inefficient rivals. Efficient firms have an incentive to opt for a wage floor high enough to raise their relative unit cost advantage and to increase their market share. In the Petrakis and Vlassis (2004) model unit costs are strategic complements and raising rivals' costs has a feedback effect to their own costs. However, the efficient firms gain more by reducing competition than they lose from the increase to their own costs. This strategy could also be applied to force the low performance producers to leave the industry and to discourage entry.

In such a situation, minimum wages create a lower bound for labour costs and therefore limit the room for manoeuvre for firms which follow a low price strategy. The high-wage suppliers may regard the introduction of a minimum wage as being "fair" because underbidding strategies are no longer possible[1]. The minimum wage works as a "raising rivals' costs" strategy, but is induced by the legislator and not by incumbents. The possible advantages of firms with a low wage (low cost) strategy will no longer prevail. Some of these firms are no longer competitive and are forced to leave the market. In addition, the minimum wage may discourage entry by challengers, who in the absence of minimum wages intended to underbid the incumbents. Less entry will further reduce competitive pressure and help to raise prices, therefore benefiting high-wage firms.

To put it differently: Minimum wages lead to a convergence of production costs and therefore limit the opportunity for price competition based on production cost advantages. Since price competition will affect profits of all firms in an industry negatively, minimum wages can help established firms to sustain a higher level of profits. Under a minimum wage regime, competition may rather shift towards quality differentiation, which is probably to the advantage of established high-wage firms.

[1] See Manz (2012) for statements of practitioners supporting this view.

Summarising, the three theories lead to the following hypotheses on the impact of minimum wages on competition (Table 1). The competitive market and the raising rivals' cost theories suggest that firms will attempt to use price adjustments in order to pass on the cost increases to customers. If the competitive theory applies, it depends on the intensity of competition in how far this is possible. The raising rivals' costs theory in contrast implies less competitive pressure following the introduction of a minimum wage and price increases are then more easily realized than before. Only the monopsonistic model predicts lower prices as a reaction to the introduction or increase of minimum wages.

Table 1: Hypotheses on the impact of minimum wages on competition

	Competitive Market Theory	Monopsony Theory	Raising Rivals' Costs Theory
Profitability	-	-	+ (high wage firms) - (low wage firms)
Exits	+	+	+
Entry	-	-	-
Prices	+	-	+

3 Review of Empirical Results

Not surprisingly research on the effects of minimum wages predominantly focuses on employment effects. Beside employment, prices are perhaps investigated most frequently. Card and Krueger (1994, 1995) consider the fast-food industry but could not reach firm conclusions. Aaronsen (2001) considers price variation in the fast-food industry across U.S. states and finds an effect of minimum wages on prices with an elasticity of about one. Aaronsen, French and MacDonald (2008) use establishment prices in the same industry and also find that cost increases are passed on to consumers. The latter study discusses extensively the differing implications of the competitive and the monopsonistic model. This comparison is also pursued in Aaaronson and French (2007).

For the UK some studies on price effects can also be found. Bullock, Hughes and Wilkinson (2001) use questionnaire data from a survey concerning the possible effects of minimum wages and identify the likely consequences of it. 38 percent of all participat-

ing firms report that price increases are a consequence of minimum wages. Based on data from an industry with many low paid employees before the national minimum wage was introduced, Machin, Manning and Rahman (2003) find no price effect in the care home industry. Draca, Machin and van Reenen (2005) also consider take-away food, restaurants and canteens and do not find much evidence in favour of price changes. Wadsworth (2008) uses the Labour Force Survey (LFS) and the Annual Survey of Hours and Earnings (ASHE) to estimate the wage bill shares of minimum wages in each industrial sector for the UK. This data is matched with sector-level data on retail prices and Wadsworth (2008) then looks at price changes. He finds some evidence that firms which employ minimum-wage workers could have passed on parts of the higher labour costs to customers by increasing prices.

Draca, Machin and van Reenen (2006) consider the impact of minimum wages on firm performance. They find evidence that firm profitability was significantly reduced by minimum wage introduction. However, no increased exit rates are estimated. They conclude that minimum wages simply redistribute quasi-rents towards low wage employees. Galindo-Rueda and Pereira (2004) find lower growth rates in employment and business creation if firms are exposed to minimum wages. Bullock, Hughes and Wilkinson (2001) report that as a result of the introduction of minimum wages 27 percent of all firms participating in their survey realize lower profits.

4 Market Structure and Competition in the German Roofing Sector[2]

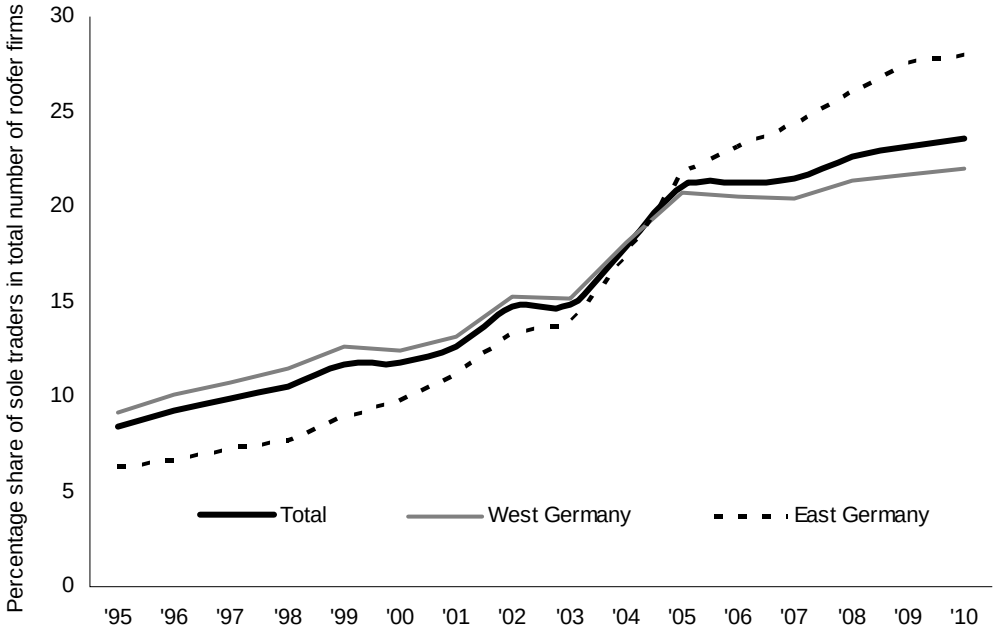
The roofing business in Germany is highly regulated. As a general rule, a master craftsman's diploma and registration in the local official register of handicrafts is required before a firm can offer roofing services, though there are exceptions for journeymen with sufficient business experience who may conduct the business as an itinerant trade ("sole traders"). In addition, other construction service firms may offer roofing services as an "insignificant auxiliary operation", but this said to be a rare case. Substitutability

[2] Information in this section rests on publicly available statistics, sector reports and a telephone survey of a random sample of 249 roofing firms as well as on a number of interviews conducted with roofing firms as well as with representatives of employer's associations and unions, see Aretz et al. (2011) for more details and literature.

of roofing services by other suppliers is thus very limited. Since roofing services require special skills and equipment there is also little room for substitution through do-it-yourself. Most roofing firms are engaged only in the roofing business, though some do offer related services such as construction plumbing or the de-humidification of buildings.

In 2010, according to VAT statistics almost 14,000 firms were active in the German roofing sector. Most of them are small firms led by a master craftsman and typically employ a few people, but rarely more than 10 (including apprentices). In 2010, there were only 60 roofing firms in Germany with more than 50 employees, and just 7 with more than 100 (and not a single one with more than 200). An increasing number of roofing firms are sole traders. Over the past 15 years, their share has increased from 8.4 percent in 1995 to 23.6 percent in 2010 (see Figure 1). The rise was particularly noticeable in East Germany. The increasing share of sole traders contributed to a substantial growth in the total number of roofing firms which grew from 1995 to 2010 at an annual rate of 8.3 percent.

Figure 1: Share of sole traders in the German roofing sector, 1995 to 2010



Source: LAK

Production in the roofing sector is labour intensive. Opportunities for labour-saving technical progress are limited and mainly driven by producers of equipment (particu-

larly material transport equipment) and roofing materials. Capital expenditure of roofing firms are low, resulting in a low share of depreciation in total costs of just about 1 percent. Since roofing firms typically organise roofing materials for their clients, the share of material costs tends to be high (60 percent). Labour costs represent about a third of total costs. Most employees - about 70 percent - are craftsmen or other skilled workers, and only a few percent are unskilled workers. In traditional trades, apprenticeship is very common, and apprentices represent up to ten percent of the workforce. Since roofing services have to be provided outdoors, production depends on weather conditions and often rests during winter time (December to March).

Demand in the roofing market includes four main segments:

- Roofs for new buildings for private clients, including loft conversion and similar construction work: this market is mostly served by local roofers. Price competition tends to take place through the quality of roofing materials used rather than through labour costs. While demand for new private housing has been declining since 2000, there has been an increase in roof conversion activities.

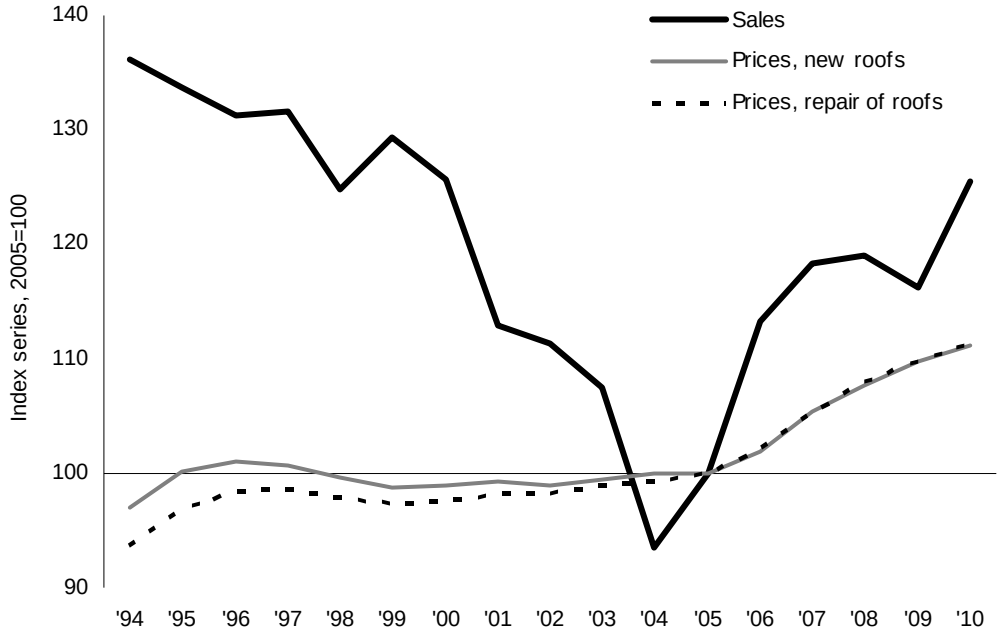
- Roofs for new buildings for corporate or public clients: this market is mostly served by large roofing companies that act as subcontractors of construction companies. The market is highly competitive, and market volumes have been gradually declining since 1995 owing to falling investment in housing and industrial buildings in Germany.

- Repairs to roofs, including energy-efficient upgrades: this market is mostly served by local roofers and by sole traders. It is a fairly stable business, and demand has tended to increase in recent years since an increasing number of houses built after WWII require substantial repair. Public subsidies for upgrading energy-efficiency of buildings have further added to a growing demand for the modernisation of roofs and heating equipment in residential buildings.

- Installation of solar collectors: this is an increasingly important market with high growth since 2005 due to generous public subsidies for the installation of solar collectors. Roofers often serve as subcontractors or partners of electricians or plumbers.

Market development in the German roofing sector was characterised by a sharp decline in sales volumes during the second half of the 1990s and until 2004 (Figure 2). Sales fell from 1994 to 2004 by 31 percent. The East German roofing business was hit harder (-53 percent) than the West German one business (-22 percent). From 2005, demand recovered substantially, with significantly higher rates in the western part of the country. Along with falling demand, nominal prices remained almost stable from 1995 to 2005 and have markedly increased since. Roofing prices for new buildings and for repairs show a similar development.

Figure 2: Sales volume and prices in the German roofing sector, 1994 to 2010



Source: Federal Statistical Office

Competition in the roofing sector largely takes place within local markets between a limited number of firms. A telephone survey of a random sample of roofing firms revealed that 66 percent do not have more than 10 competitors, suggesting fragmented and localised markets. Interviews with firms confirmed that most roofers act within the boundaries of local markets, often demarcated by the region of the regional guild. 77 percent of the roofing firms surveyed report that quality is more important than price in their business, though price competition has recently been reinforced by the introduction of online tender databases. Competition by foreign suppliers is not relevant, except for a few border regions. Private customers, who represent roughly 60 percent of total

market volume, often enter into long-term business relations with local roofers. Price elasticity of private demand (with respect to the price for roofing labour) tends to be low since roofing services cannot be substituted by other related services nor can house owners dispense with building and maintaining a roof. Price elasticity tends to be higher with respect to roofing materials, which are a transitory cost item for roofing firms, however.

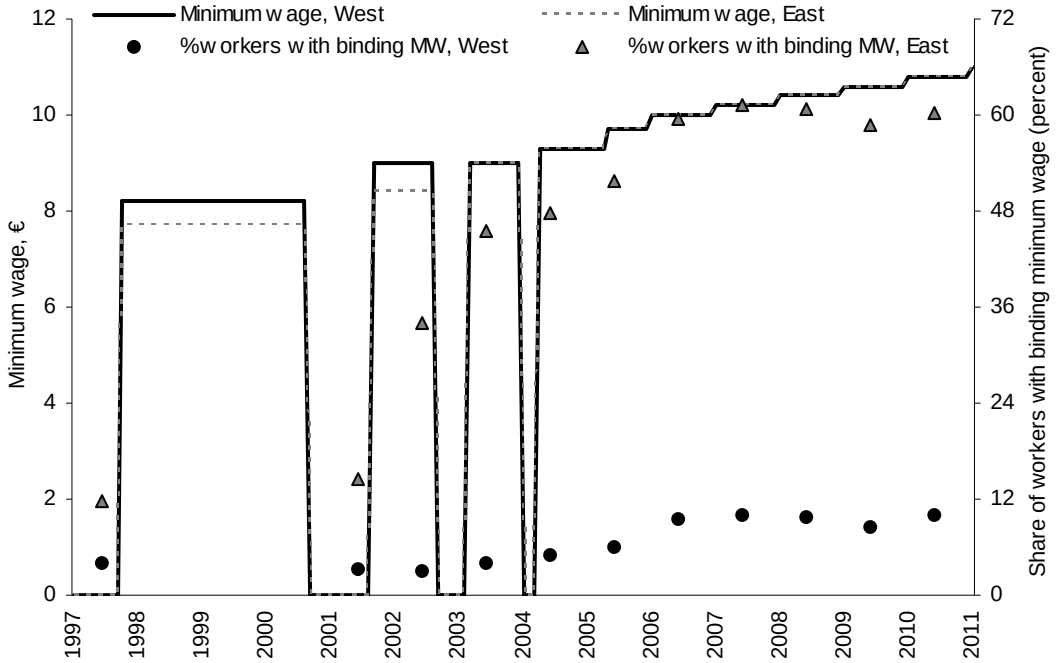
In October 1997, a minimum wage for workers[3] was introduced in the roofing sector in Germany, in a situation of declining demand and overcapacities following a multiannual boom in the German construction industry after reunification in 1990. Minimum wage introduction in the roofing business was part of a wider activity to introduce minimum wages in the construction industry which started in January 1997 with a minimum wage for the main construction trade. The minimum wage in the roofing sector initially applied different rates for West and East Germany, reflecting the diverging levels of productivity and average wages (Figure 3). In 2003, a uniform minimum wage level for the entire country was introduced based on the previous West German level. There were three short periods between 1997 and 2004 when the minimum wage did not apply because of delays in negotiations between employer associations and unions over the future level of the minimum wage. Continuation of the minimum wage was not challenged at any time during these interruption periods, however, meaning that behavioural adjustments of firms are very unlikely. From 2004 onwards, the minimum wage was steadily increased. Since 2007, minimum wages increase by 20 ct. steps per year, which is equivalent to an annual increase of about 2 percent, which is equal to the average inflation in Germany during this time.

The minimum wage has been of limited relevance for West German roofing firms since most workers receive wages clearly above the minimum wage level. The share of workers for whom the minimum was binding at the time of introduction was 3.9 percent. When comparing the labour cost increase due to the minimum wage with the total labour costs of all West German roofing firms in 1997, minimum wage introduction

[3] The minimum wage only applies for industrial workers and excludes salary earners and apprentices as well as self-employed persons.

caused higher labour costs of 0.15 percent. Over time, the significance of minimum wages in West Germany increased only slowly. In 2010, about 10 percent of workers in West German roofing firms received a wage level below or at the level of the next year's (2011) minimum wage. The total labour cost increase in the West German roofing business due to the minimum wage did not exceed 0.35 percent in any year.

Figure 3: Minimum wage levels and share of workers bound by the minimum wage in the German roofing sector, 1997 to 2010



Note that the share of workers with binding minimum wages (MW) is calculated for June in each year. From September 2000 to August 2001, from September 2002 to February 2003, and from January to March 2004, no minimum wage applied.

Source: LAK data.

The situation is substantially different in East Germany. At the time of introduction, 12 percent of workers in the East German roofing business received a wage below or at the minimum wage level. This share of workers with a binding minimum wage increased to more than 60 percent in 2007. The annual increase in total labour costs of East German roofing firms due to the introduction and gradual increase of the minimum wage was between 1.0 and 2.0 percent for most years since a uniform minimum wage is applied.

Firms reacted upon the minimum wage through different strategies. Increasing prices was the preferred option both for West and East German firms, though it was more often used in the East (Table 2). Increasing productivity, reducing material costs and mak-

ing more use of seasonal labour (which need not be employed during the colder season due to fewer orders) were further options used more frequently. The high share of firms that increased prices in response to higher labour costs caused by the minimum wage reveals that roofing firms have at least some room for passing on cost increases to customers, which is most likely due to a low price elasticity of (private) demand and limited competition in local markets.

Table 2: Strategies of German roofing firms to respond to minimum wages

Percent of all firms that were affected by the minimum wage	West	East
Increasing prices	33	55
Increasing productivity	17	18
Reducing material costs	17	6
Using more seasonal labour	17	6
Reducing overtime premiums	4	11
Subcontracting to other firms	4	10
Reduction of staff	0	12
Increasing marginal employment	4	4
Unpaid extra work	0	6
Reducing hardship allowance	0	4
Reducing costs for higher paid workers	0	2
No response	4	0

Multiple answers allowed.
Source: Own survey (n=249).

One should bear in mind, however, that annual cost increases due to the minimum wage are rather low even for firms that have a very high share of workers with a binding wage. The highest annual increase of the minimum wage was 4.7 percent in 2003 for East German firms when the East German minimum wage level was raised to the West German level, and about 2 percent in most other years. Since labour costs for workers represent only about a quarter of total costs of roofing services when material costs are included, total cost increase due to the minimum wage was limited. In addition, in the largest market segment of roofing services, roofs for new buildings, roofers supply only a sub-product of the entire product (the building), and costs for building the roof are only a minor part of total costs. More important, however, is the accumulative effect of the minimum wage if the minimum wage is constantly higher than the productivity of workers with a binding minimum wage. If productivity or workers cannot be increased accordingly, firms will face an increasing gap between labour costs and labour produc-

tivity, which can be particularly harmful for newly founded firms with a low initial level of productivity due to inefficient firm size and lack of experience.

5 Empirical Strategy: Difference-in-Differences

In line with many other empirical studies we apply a difference-in-differences methodology to identify the causal effects of the minimum wage on competition in the German roofing sector. This requires the availability of panel data as the basic idea of difference-in-differences for the identification of any effect is a before-after comparison. It is necessary to have information available on firms which are affected by the policy change (treatment group) and a comparison set of firms for which the policy measure has no impact (control group).

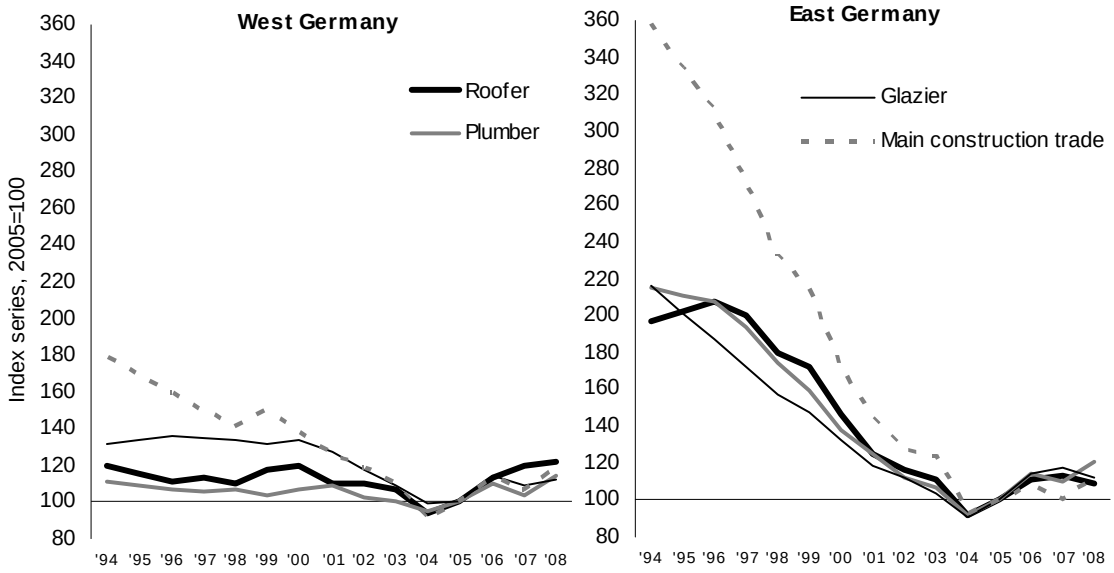
The treatment group consists of firms in the roofing sector. Since roofing firms may be treated by the minimum wage to different extents, depending on the share of workers for which the minimum wage is binding, we use indicators on the degree to which a roofing firm is affected by the minimum wage to control for treatment heterogeneity.

The control group has to consist of firms from an industry which is not covered by a minimum wage and which shares key features with the roofing business. In principle the control group should be as similar as possible to the treatment group, expect for the treatment (Meyer 1995). Obviously this requirement is difficult to fulfil since there are no two identical sectors. A somewhat weaker assumption is that in the absence of treatment the difference between the two groups would remain constant over time or, put differently, without treatment the time trends are parallel for both groups. This would require that the control group shows similar market structure and demand conditions. Furthermore the composition of the two groups should not change during the pre-treatment period in a way that the outcome variables were affected[4] (e.g. firms anticipating the introduction of minimum wages react by increasing skill requirement for workers, dismissing the workers with the lowest productivity or by leaving the region or the industry altogether).

[4] Cf. for example Blundell et al. (2004).

As the roofing sector is part of the construction service industry, other construction services are obvious candidates for serving as a control group. Luckily for our investigation, two construction service sectors in Germany do not apply minimum wages, namely the plumbing sector (plumbing, heating and air-conditioning installation) and the glazing sector. Analysing structural characteristics or production (capital intensity, wage level, share of labour costs, average firm size, labour productivity) and demand (change in sector sales prior to October 1997, market size per firm, average number of competitors) reveals that the plumbing and the roofing sectors are much alike in all features while glazing firms differ considerably (see Aretz et al. 2011 for more detail).

Figure 4: Sales in the German roofing sector, 1994 to 2008, compared to the plumbing and glazing sectors and main construction trade



Source: Federal Statistical Office.

Both in the roofing and the plumbing sector, competition takes place within rather narrowly confined regional markets, and both require a master craftsman's diploma to supply services. In addition, the plumbing sector shares some peculiar market trends with roofers, particularly with respect to the role of solar collector installation as a driver of demand in recent years. Since most solar collectors on private houses are used for water heating, plumbers and roofers often work hand in hand for the same clients. The development of sales ran quite similarly in both sectors prior to the first full year of the minimum wage (1998), except for 1994/95 in East Germany while glaziers showed a significantly different development of demand, as did the main construction trade (Figure

4). At the same time, the essential assumption of an absence of control group contamination (i.e. that there are no indirect effects of the minimum wage in the roofing sector on the plumbing sector) holds since both services are not substitutable and there are virtually no firms that offer both services.

We evaluate the impact of the minimum wage on competition in the roofing sector by both comparing the situation prior to minimum wage introduction in October 1997 to the situation afterwards and comparing the development in the treatment group, i.e. the roofing sector with the development in the control group, i.e. the plumbing sector. In the standard difference-in-difference approach, the before-after comparison is made twice, and the outcome variable *y* is compared as a difference between the two groups:

$$\delta = (\bar{y}_T^{time=2} - \bar{y}_T^{time=1}) - (\bar{y}_C^{time=2} - \bar{y}_C^{time=1}) \quad (1)$$

The sample averages $\bar{y}_i$ for the variable of interest y of the two groups, *treatment* T and *control* C, are identified and then differences with respect to the variable of interest are computed. The difference-in-differences method removes permanent differences between groups and at the same time common trends.

In practice the difference-in-differences estimator is frequently realised by applying a simple regression:

$$y_{it} = \alpha + \beta_0 d_t + \beta_1 B_{it} + \delta d_t * B_{it} + \boldsymbol{\beta}_2 \mathbf{Z}_{it} + \varepsilon_{it} \quad (2)$$

The outcome variable for observation i in year t is again denoted by y, the dummy variable B takes unit value if an observation is part of the treatment group (roofing sector), and d identifies the event of the policy change (introduction and increase of the minimum wage, respectively). The coefficient α captures possible differences between the treatment and the control group before the policy change. The coefficient β_0 captures time effects relevant to the period after the policy change has been implemented and β_1 captures structural differences between the treatment and the control group independent from the policy measure. The coefficient δ is the key variable of interest since

it captures the effect of the policy measure on the outcome variable. Vector **Z** represents a set of control variables that may affect *y*.

An essential issue of evaluating the impacts of the minimum wage on competition in the roofing sector is to go beyond the mere effects of the minimum wage introduction in 1997. Following the raising rivals' cost hypotheses, a minimum wage would not only affect profitability, entry and exit at the time of introduction, but also in consecutive periods. This is particularly true if the minimum wage increases over time and grows faster than labour productivity. In such a case, potential negative impacts of the minimum wage on less competitive firms and potential entrants will increase over time, and so will the impact on competition. In addition, the treatment effects of the minimum wage will vary among firms according to their wage level prior to minimum wage introduction and prior to a further increase of the minimum wage.

We make account for dynamic and firm-specific effects of the minimum wage by altering (2) by introducing an observation- and time-specific measure of policy change, *x*:

$$y_{it} = \beta_0 + \delta_0 d_t + \beta_1 B_{it} + \delta_1 x_{it}(d_t)*B_{it} + \boldsymbol{\beta}_2 \mathbf{Z}_{it} + \varepsilon_{it} \qquad (2a)$$

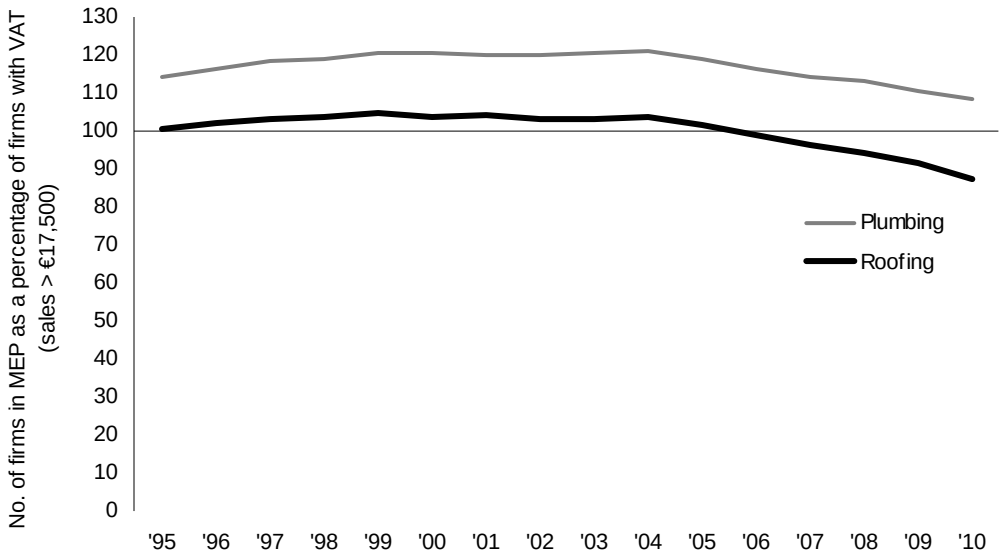
In our empirical study we use two different definitions for observation *i*. For the outcome variable profitability, observation *i* represents an individual firm while the outcome variables market entry, market exit and stock of firms are analysed for regional markets, i.e. observation *i* represents a region. Regional markets are used because both the roofing and the plumbing market are regionally segmented, and competition takes place within spatially limited areas, which is most often the area of the regional guild. The boundaries of both roofing and plumbing guilds are identical.

6 Data

For estimating (2a), we need data on our outcome variables on competition (firm profitability, market entry, market exit, stock of firms), the extent to which a firm or region is affected by the minimum wage, and control variables that may influence outcome variables and are independent of the minimum wage for both sectors over a time period that runs from before the minimum wage introduction to the most recent year available. We combine different data sources to measure our model variables.

Outcome variables on competition are taken from the Mannheim Enterprise Panel (MEP), which is a firm panel database produced by the Centre for European Economic Research based on information from *Creditreform*, Germany's largest credit rating agency. The MEP covers virtually all firms in Germany that are commercially active, which means that firms show some level of production or sales activity, including sole traders. The MEP contains, among other things, annual information on the number of employees and the credit rating of firms. In addition, industry codes, a text description of a firm's commercial activity and the formal skill level of firm founders are known as well as the date of the firm's foundation and its location. In addition, both voluntary and forced firm closure can be identified. MEP data are used to establish an annual panel data set of roofing and plumbing firms in Germany that spans the time from 1995 to 2010. Roofing and plumbing firms are identified by industry codes (NACE rev. 2.0 sub-class 43.91.1 for roofers, 43.22.0 for plumbers). Comparing the number of active firms per year in our panel with VAT data (number of firms that pay VAT, which excludes firms with sales of less than €17,500) shows that the MEP covers 100 to 105 percent of VAT-registered roofing firms and of 114 to 121 for VAT-registered plumbing firms until the year 2004, and that coverage rates have been falling ever since (Figure 5).

Figure 5: Coverage of VAT-registered firms in the MEP in the roofing and plumbing sectors, 1995 to 2010



Source: MEP, Federal Statistical Office (VAT statistics).

A coverage rate of more than 100 percent indicates that the MEP contains a number of sole traders that report very small sales figures of less than €17,500 per year to the tax office and are thus not covered in VAT statistics. There are obviously more such firms in the plumbing than in the roofing sector. The falling coverage rates from 2005 on reflect a time lag in recording newly founded firms, particularly sole traders, by *Creditreform*. This time lag applies to all sectors equally, and there is no reason why this time lag should differ between the roofing and the plumbing sector. The slightly increasing coverage rates from 1995 to 1999 are due to slightly incomplete coverage of firms founded before 1989 and closed between 1995 and 1998 due to incomplete data transmission at this time, which again concerns all sectors equally and is not biased between the two sectors considered.

The firm panel data set is used for estimating minimum wage effects on profitability. Profitability is measured by the credit rating given by *Creditreform* for each firm. *Creditreform* uses different information for its ratings, including financial and liquidity risks and structural risks such as industry classification, firm age, firm size and productivity, along with "soft factors" such as payment history, volume of orders, firm development or management quality (see Czarnitzki and Kraft 2007). On the basis of these individual facts *Creditreform* calculates a rating index ranging from 100 points to a maximum of 600 points. The worst firms receive 600 points and the best ones have 100 points. We transfer this rating into an ordinal variable with nine classes so that the number of observations by class is similar in size. The credit rating basically provides information about the short-term solvency of a firm, which is highly correlated to its current profitability situation. Czarnitzki and Kraft (2004, 2007) demonstrated that credit ratings are valuable information with respect to a firm's financial performance.

The firm panel data set is further used to calculate our other three competition variables, the number of market entries (this is the number of roofing and plumbing firms that were founded in a certain year), and market exits (this is the number of firms that were closed in a certain year) as well as the number of active firms (this is the number of firms that offered roofing or plumbing services during a certain year, including firms founded and closed during the same year). All three variables are measured for regional markets. We use administrative districts (*Landkreise* and *kreisfreie Städte*) to define

regional markets. Districts often match one to one with the area of regional guilds, though in some Federal States guilds cover more than one district. There are 413 different districts, compared to 319 different regional guilds in Germany. The average number of roofing firms (excluding sole traders) per district is 26, which is somewhat more than the mean of the number of competitors as reported by roofing firms (17), which indicates that districts may either be too large in some cases to represent actual regional markets or that there is some type of market segmentation among roofing firms within regional markets (e.g. between firms that specialise in new buildings and roof conversion and others that are engaged in repair only).

The extent to which a firm or region is affected by the minimum wage is measured by the 'binding ratio'. The binding ratio in year t gives the proportion of workers at time t-1 that are paid less than the minimum wage at time t:

$$BIN_{it} = \Sigma_j L_{jit-1}(W_{jit-1} <= W_{jt}^{min}) / \Sigma_j L_{jit-1} \quad (3)$$

with L_{jit-1} being the number of workers j in observation i at time $t-1$, W_{jit-1} wage of worker j in observation i at time $t-1$ and W_{jt}^{min} the minimum wage for the relevant worker j at time t.

We also considered an alternative measure of the significance of the minimum wage for a firm, the so-called wage gap. This indicator measures the change in total wage costs due to the minimum wage introduction or increase. Though the financial burden is expected to determine the extent of a firm's reaction, if many or even all workers initially paid less than the minimum wage are dismissed, the wage gap would be zero, but obviously the minimum wage has had a strong effect. In addition, the wage gap does not represent accumulative effects of the minimum wage on costs which can be particularly important for competition impacts. In contrast, the binding rate is always defined in relation to the situation before the minimum wage was introduced for the first time, when the binding rate was zero. Hence the effect of an increase of the minimum wage is not measured just in comparison to the situation in the previous period since workers paid below the minimum wage during the period before the minimum wage was introduced would still earn less than the minimum wage in later periods, especially in cases where the minimum wage is increased. We prefer the binding ratio over the wage gap as

minimum wage indicator since it represents the total burden of the existence of a minimum wage for a firm. This is probably the more appropriate measure if profitability, exit and entry are considered.

Data on the binding rate are taken from the central pay office of the roofing sector (*Lohnausgleichskasse*, LAK). This database contains all roofing firms that employ blue-collar workers. Data protection regulation impedes a merge of this data with MEP data, however. We therefore follow the approach by Stewart (2003) as well as Galindo-Rueda and Pereira (2004) and make use of the regional variation and size class variation in the exposure to the minimum wage. We calculate the average of all firms in a regional market and a certain size class (up to 5, 6 to 10, 11 to 20 and more than 20 employees) and merge this indicator with firm data based on a firm's location and size. This approach ensures that minimum wage indicators are also assigned to sole traders and other firms in the roofing sector without blue-collar workers (for whom the minimum wage applies) which is a prerequisite to analyse minimum wage effects on this group of firms. For details on the calculation of the binding ratio and the wage gap, see Aretz et al. (2011).

In addition, we use a number of control variables that may have an influence on our competition variables. These include firm characteristics, input prices, demand characteristics and market structure characteristics. We use four variables to control for firm heterogeneity: size, age, legal status and qualification of firm owners. Size is measured by the number of persons working in a firm, including both employed and firm owners (thus size equals 1 for sole traders). Age is the number of years since firm foundation. Both age and size have been found to have a significant effect on the survival of entrants (Geroski 1995). Size and age way also affect profitability positively (Czarnitzki and Kraft (2004). Legal status is measured as a dummy variable that equals 1 if the firm owners assume full liability. Qualification of firm owners refers to the highest qualification level in terms of university degree, master craftsman's diploma or journeyman's certificate and is measured through three dummy variables. All firm-specific variables are taken from the MEP.

The development of input prices can affect profitability as well as market exit if prices for materials change considerably and unexpectedly, and challenge initial calculation bases. Since all material inputs used by roofing and plumbing firms are procured from

other sectors than the roofing sector, no minimum wage effects on material input prices can occur. Input price development is taken from the statistics on producer prices for building materials which is published by the Federal Statistical Office (FSO). We use the average index for six main roofing and plumbing inputs, respectively (weighted by the approximate input share of each material).

Demand for roofing and plumbing services is approximated by three indicators, the number of new building permits for both private and commercial buildings, the average age of buildings and the square meters of newly installed solar panels on roofs. Demand variables are standard explanatory variables in models explaining profitability (Martin 2003, Ch. 6). Entry rates are also affected by market growth (Siegfried and Evans 1994). All three demand variables are measured at the level of regional markets, i.e. districts. The number of new building permits is taken from building statistics of the FSO and is used to represent the demand segment for new roofs. We relate this figure to the production capacity in the region to control for the size of the region. Production capacity is approximated by the employment in the roofing and plumbing sector, respectively, including self-employed persons and is calculated from MEP data. The average age of buildings is a proxy for the repair and energy-efficient upgrade demand segment since older buildings are more likely to need repair and upgrade. The data come from a special tabulation of the Micro Census of the FSO for two years (1998 and 2006). Since building age is available for four age classes only, we calculate an index that weighs buildings erected prior to 1949 with 2, buildings erected between 1949 and 1978 with 1, buildings erected between 1979 and 1990 with 0.5 and buildings erected 1991 or later with 0.25 to represent the varying demand for repair. Values for all other years than 1998 and 2006 are interpolated or extrapolated. Data on newly installed solar panels on roofs were provided by the Research Center for Energy Economics (FFE). The square meters of installed solar panels are adjusted for the size of the region by relating the figure to the production capacity in the region. All demand variables enter the model as rates of change since we assume it is the change in demand that affects competition, rather than the level.

Market structure may affect profitability as well as market entries and exits. We use a firm's market share to control for likely market power effects on profitability. Market

share plays a very prominent role in empirical research on profitability (Schmalensee 1985, Martin 2002, ch. 6). A high market share may reflect efficiency advantages (efficient firms tend to grow at the expense of their rivals and tend to be more profitable at the same time), but the market share is also a determinant of price-cost margins in oligopoly models (see for examples Motta 2004, ch. 3.3.1.6). Market share is measured by the share of the number of persons working in firm *i* in total regional employment in the respective sector. In the regional models, the average market share of firms is used to control for concentration effects on entry and exit. As mentioned before, the relevant market for roofers is in most cases a geographically narrowly defined area[5]. The distance of a firm to its nearest competitor informs about the significance of monopsonistic competition in the labour market and a likely regional monopoly in the product market. Firm-specific distance to the nearest competitor is calculated based on distances between ZIP areas. If a firm has a competitor in the same ZIP area, distance is zero. In addition, we use lagged entry rates in the regional market for the models on profitability to control for corresponding effects of firm closure on the performance of the remaining firms. However, the literature on entries reports only limited effects on profitability (Geroski 1995). In the entry and exit models, lagged exit and entry rates are used to represent "revolving door" effects (Santarelli and Vivarelli 2007), i.e. the incentive to enter a market and try to capture the former market share of the exiting firm and the increased competition by entries that may increase the probability of market exit among the newly founded or the established firms.

For the estimations at regional level, we use regional averages of firm size, firm age, market share and distance to nearest competitor to control for heterogeneity in the regional firm population and corresponding effects on entry, exit and the change in the stock of firms.

[5] For a general discussion about the relevant market see Motta (2004, ch.3).

Table 3: Definition, data source and descriptive statistics of model variables

Variable	*Definition*	*Source*	***Firm-level data***				***Regional data***			
			Mean	*Std. D.*	*Min.*	*Max.*	*Mean*	*Std. D.*	*Min.*	*Max.*
Profitability	Credit rating, 9 classes (the higher, the better)	MEP	4.86	2.29	0	8	-	-	-	-
Entry rate sole traders	No. of newly founded sole traders per stock of sole trader firms, district level	MEP	-	-	-	-	0.0154	0.026	0	0.5
Entry rate non-sole traders	No. of newly founded non-sole traders per stock of non-sole trader firms, district level	MEP	-	-	-	-	0.0300	0.041	0	1
Exit rate sole traders	No. of sole traders closing per stock of sole trader firms, district level	MEP	-	-	-	-	0.0026	0.010	0	0.33
Exit rate non-sole traders	No. of non-sole traders closing per stock of non-sole trader firms, district level	MEP	-	-	-	-	0.0396	0.044	0	1
Change in stock of sole traders	Change in the no. of active sole trader firms over the previous year, district level	MEP	0.0433	0.165	-1.886	2.109	0.0576	0.249	-1.886	2.109
Change in stock of non-sole traders	Change in the no. of active non-sole trader firms over the previous year, district level	MEP	-0.0183	0.047	-1.099	1.099	-0.009	0.084	-1.098	1.609
Binding rate	Share of workers with a wage below the minimum wage in the following year	LAK	0.0295	0.112	0	1	0.0691	0.145	0	0.845
Firm size	No. of persons employed, logarithm	MEP	0.0775	0.403	-3.99	35.88	6.680	3.442	0	70.51
Firm age	No. of years since foundation, logarithm	MEP	2.420	1.16	-0.69	6.71	2.447	0.380	0	4.06
Unlimited	1 if the firm is a private company, 0 otherwise	MEP	0.674	0.469	0	1	-	-	-	-
Graduate	1 if at least one owner has a university degree, 0 otherwise	MEP	0.040	0.197	0	1	-	-	-	-
Master crafts-man	1 if at least one owner has a master craftsman's diploma but no one a university degree, 0 otherwise	MEP	0.528	0.499	0	1	-	-	-	-
Journeyman	1 if at least one owner has journeyman's certificate but no one has a university degree or a master craftsman's diploma, 0 otherwise	MEP	0.114	0.318	0	1	-	-	-	-
Input prices	Change in price index of roofing/plumbing materials	FSO	0.030	0.040	-0.029	0.137	0.0191	0.0342	-0.030	0.137

Table 3: Continued

Change in building permits	Change in no. of permits for new buildings per production capacity (no. of persons employed in the roofing/plumbing sector), district level	FSO	-0.044	0.174	-3.50	3.57	-0.054	0.255	-1.16	3.75
Building age	Average age of buildings weighted by repair need, district level	FSO	3.183	3.40	0	13.82	-	-	-	-
Change in building age	Year-to-year change in average age of buildings weighted by repair need, district level						0.0040	0.0054	-0.009	0.024
Solar demand	m^2 of newly installed solar panels on roofs per production capacity, logarithm, district level	FFE	0.0012	0.003	-0.008	0.010	-	-	-	-
Change in solar demand	Year-to-year change in m^2 of newly installed solar panels on roofs per production capacity, district level	FFE	-	-	-	-	0.598	1.786	-11.35	12.18
Market share	Share of firm's employment in total roofing/plumbing employment in the district	MEP	0.0120	0.032	0.0001	1	0.1813	0.1624	0.0112	1
Distance to competitor	Distance in km to nearest competitor based on ZIP areas (0 if >0 competitors in the same ZIP area)	MEP	0.1763	1.027	0	43.49	0.781	1.575	0	21.81
Roofing firm	1 if the firm is from the roofing sector, 0 otherwise	MEP	0.188	0.390	0	1	0.5	0.5	0	1

Table 3 summarises the definition of the model variables used and shows descriptive statistics for the firm-specific and regional data.

7 Econometric Estimation and Empirical Results

The type of measurement of our outcome variables requires different econometric approaches. Profitability is measured as an ordinal variable with nine classes which suggests the use of an ordered Probit modelling approach. Entry and exit rates are continuous variables, but for many regions there are zero exits and entries in some years. Across the entire sample of 413 regions and 15 years the share of zero observations is 27.0 percent for entries and 30.5 percent for exits. We employ a Tobit model to capture this data structure. The change of the stock of firms is a continuous and normally distributed variable and makes an OLS the model of choice.

Both the firm-level and the regional models are clustered by 97 planning regions which tend to represent labour market regions as well as the largest geographical reach that may be served by roofing and plumbing firms, though many firms confine their supply to more narrow regional markets. By introducing regional dummies, we try to control for likely spatial autocorrelation effects of demand, market structure in product markets and labour markets of bordering regions. In addition, all models include time dummies that capture, among others, business cycle effects as well as effects of varying coverage of entries, exits and the stock of firms by year in the sample we use.

All models are estimated separately for East and West Germany and for sole traders and non-sole traders. Separate models for East and West are used since the significance of the minimum wage differs widely between the two regions and is likely to exert quite different impacts. Differentiating between sole traders and non-sole traders (i.e. firms with wage labour) is essential since sole traders are not directly affected by the minimum wage and may thus show very different effects than firms for which the minimum wage may be binding. Sole traders are defined as firms with the firm owner being the only person engaged in the organisation, all others are non-sole traders. Among the latter, there might be firms that consist of two firm owners and no wage labour, though this is most uncommon in a trade.

In section 6, we suggested two measures for the significance of the minimum wage, the binding rate and the wage gap. While the former is an indicator for the accumulative effect of the minimum wage since the share of workers with a binding minimum wage tends to increase along with increased minimum wage levels, the wage gap captures short-term cost effects of the introduction and increase of minimum wages. We focus on the results for the binding rate, since for competition the accumulative effect of the minimum wage as an instrument to raise rivals' costs is more significant than a short-term cost increase. Results of the wage gap yield similar though less robust and significant results.

Table 4 shows the estimation results of ordered probit models on firm profitability. The binding has a negative though statistically insignificant effect on the profitability of West German roofing firms but shows a positive and significant effect for East German roofing firms. The effect of the binding rate on profitability of sole traders is insignificant in both regions. While an insignificant effect for non-sole traders in the West is to be expected given the limited significance of the minimum wage in this region, the positive effect in East Germany suggests that there might indeed be a negative causal impact of the minimum wage on the degree of competition in the East German roofing sector - as compared to the control group of the plumbing sector - which gives room for higher profitability than in the absence of a minimum wage.

Most of our control variables show the expected result and are statistically significant. Larger and older firms generate higher profitability as do unlimited companies and firms with higher qualification levels of firm owners. Material prices have a negative impact on profitability for non-sole traders but are insignificant for sole traders, which is reasonable since the latter rarely do trade in roofing materials. Demand-side variables show different results. The average age of buildings exerts a positive impact on profitability which is in line with the significance of repair work as the main business line for most roofing and plumbing firms. Since the need for repair work often comes unexpectedly for the clients and calls for urgent response, firms tend to be in a favourable negotiation position and are able to enforce higher prices for their services. The change in the number of building permits in the regional market has no significant effect on firm profitability. This result may indicate that the market segment for new roofs is of lim-

ited significance for many small firms, and if they engage in this market segment, price competition is more severe since roofing and plumbing firms are typically subcontractors of larger construction firms which may exert buyer power. Demand for solar collector installation has a positive effect on the profitability of non-sole traders in East Germany, but no effect in the West.

Table 4: Results of ordered probit models[a)] on firm profitability in the roofing and plumbing sector in Germany, 1996 to 2010

Dependent variable:	*West Germany*		*East Germany*	
Profitability (credit rating)	*Non-sole traders*	*Sole traders*	*Non-sole traders*	*Sole traders*
Binding rate	-0.107	-0.0120	0.110**	0.109
	(0.0765)	(0.180)	(0.0443)	(0.111)
Firm size	0.304***		0.299***	
	(0.00650)		(0.0113)	
Firm age	0.269***	0.289***	0.292***	0.252***
	(0.00454)	(0.00914)	(0.00847)	(0.0139)
Unlimited company	0.546***	0.436***	0.443***	0.470***
	(0.00908)	(0.0199)	(0.0157)	(0.0334)
Graduate	0.0214	0.109*	0.0736***	-0.0221
	(0.0209)	(0.0585)	(0.0260)	(0.0564)
Master craftsman	0.0804***	0.0346**	0.0720***	0.0142
	(0.00941)	(0.0170)	(0.0158)	(0.0240)
Journeyman	-0.0764***	-0.116***	-0.0426*	-0.0882**
	(0.0133)	(0.0245)	(0.0221)	(0.0379)
Material prices	-0.392***	-0.302	-0.277	0.429
	(0.106)	(0.240)	(0.169)	(0.315)
Change in building permits	-0.00411	-0.0132	0.00486	0.0340
	(0.0100)	(0.0175)	(0.0169)	(0.0303)
Building age	0.293***	0.349***	0.611***	2.253***
	(0.0519)	(0.107)	(0.138)	(0.248)
Solar demand	0.667	-6.318	15.23***	17.32*
	(3.949)	(7.856)	(5.038)	(10.34)
Market share	-0.0945	-1.708	0.747*	-4.335
	(0.142)	(1.224)	(0.391)	(4.761)
Distance to competitor	0.00845**	0.0140*	-0.0142**	-0.0138
	(0.00372)	(0.00736)	(0.00677)	(0.0129)
Change in stock of firms[b)]	0.0588	-0.00202	0.128*	0.0651
	(0.0397)	(0.0291)	(0.0651)	(0.0484)
Roofing firm	-0.123***	-0.214***	-0.169***	-0.219***
	(0.0138)	(0.0368)	(0.0268)	(0.0725)
No. of observations	376,844	106,978	119,724	44,622

a): Parameter estimates (standard errors in parentheses). - b): Change in stock of firms refers to non-sole traders only for the models for non-sole traders, and to sole traders only for the models for sole traders. - All models include 14 time dummies, 97 dummies for labour market regions and 8 constants for the categories of the ordered dependent variable.
*. **, ***: significant at the 0.1, 0.05, 0.01 level, respectively.

Market structure variables mostly show the expected effects. A firm's market share positively affects profitability for non-sole traders in East Germany but is not significant for the other three groups of firms. Firms with a greater distance to their nearest competitor can yield higher profitability in West Germany. The lagged entry rate negatively affects profitability of non-sole traders in West Germany, confirming that new firms increase competition and reduce profitability of established firms. Note that the entry rate in the model for non-sole traders only includes entries by non-sole traders.

The level of profitability of roofing firms is significantly lower than that of plumbing firms, as revealed by the negative coefficient for the roofing firm dummy.

Estimation results of the models on entry and exit are shown in Table 5 and confirm the results of the model on profitability with respect to minimum wage effects. The binding rate shows a highly significant negative effect on market entry of non-sole traders in the East German roofing sector and a highly positive effect on entry of sole traders in the same region. For West Germany, we find no significant effects. Market exit is hardly affected by the minimum wage, though we find a weakly significant negative effect on the exit rate of non-sole traders in the East. This finding is not very robust, however, as the significance level falls below the 10 percent threshold for slightly different model specifications. In addition, we do not find a significant negative effect of the minimum wage for a firm's likelihood of exiting the market when running hazard rate models on market exit based on the firm-level data set.

Entry rates in regional markets tend to be lower if average firm size and age of existing firms is low and prices for materials go up. Exit rates are also lower if a region's firm population is young. Increasing prices for materials tend to increase the probability of sole traders exiting the market both in East and West Germany. Effects of demand variables on entry rates are mostly insignificant except for the average age of buildings which tends to spur entry of sole traders in the East at the expense of entries by non-sole traders. A decrease in new building permits raises market exits of non-sole traders in the West while there is a negative impact on the change of repair demand on market exits of non-sole traders in the East. For some reason, sole traders in the East show higher exit rates when repair demand increases.

Table 5: Results of Tobit models[a] on firm entry and exit in the roofing and plumbing sector in Germany, 1996 to 2010

	Dependent variable: ***Entry rate***				*Dependent variable:* ***Exit rate***			
	West Germany		*East Germany*		*West Germany*		*East Germany*	
	Non-sole traders	*Sole traders*	*Non-sole traders*	*Sole traders*	*Non-sole traders*	*Sole traders*	*Non-sole traders*	*Sole traders*
Binding rate	-0.0339	0.0297	-0.0402***	0.0248***	0.0298	-0.0278	-0.0145*	-0.00247
	(0.0274)	(0.0221)	(0.00776)	(0.00663)	(0.0237)	(0.0238)	(0.00837)	(0.00757)
Average firm size	-0.0000024	-0.00226***	-0.00219***	-0.00227***	0.000875***	-0.000477	-0.000302	-0.00104
	(0.000559)	(0.000643)	(0.000776)	(0.000628)	(0.000283)	(0.000624)	(0.000530)	(0.000655)
Average firm age	-0.0141***	-0.00907**	-0.0148***	-0.00621	-0.0144***	-0.0159***	-0.0266***	-0.0103***
	(0.00313)	(0.00375)	(0.00427)	(0.00498)	(0.00363)	(0.00394)	(0.00464)	(0.00370)
Input prices	-0.0789*	-0.114***	-0.0636	-0.199***	0.0102	0.0723*	0.0873	0.184***
	(0.0405)	(0.0411)	(0.0535)	(0.0581)	(0.0437)	(0.0431)	(0.0683)	(0.0554)
Change in building permits	-0.000778	-0.000452	0.00379	0.00626*	-0.00677**	-0.00141	0.00157	0.000334
	(0.00284)	(0.00249)	(0.00299)	(0.00343)	(0.00269)	(0.00226)	(0.00561)	(0.00408)
Change in building age	-0.210	0.0477	-0.494*	0.299**	-0.197	-0.115	-0.421*	0.276***
	(0.194)	(0.259)	(0.253)	(0.141)	(0.202)	(0.258)	(0.233)	(0.0901)
Change in solar demand	-0.000108	0.000396	0.000433	0.000635	-0.000572	-0.000285	-0.000194	-0.000610**
	(0.000397)	(0.000275)	(0.000336)	(0.000566)	(0.000445)	(0.000487)	(0.000690)	(0.000284)
Average market share	-0.0452***	-0.00555	-0.0121	-0.00615	-0.0468***	-0.0281***	0.00954	-0.0366***
	(0.0126)	(0.0100)	(0.0134)	(0.0120)	(0.00893)	(0.0103)	(0.0128)	(0.0112)
Average distance to competitor	-0.00278***	-0.00178**	0.00165	-0.00712	-0.00459***	-0.00223*	-0.00693***	-0.0106***
	(0.00101)	(0.000756)	(0.00231)	(0.00445)	(0.00107)	(0.00114)	(0.00222)	(0.00271)
Exit rate (lagged)[b]	0.0858***		0.0578					
	(0.0273)		(0.0389)					
Entry rate (lagged)[b]					0.0438		-0.0842***	
					(0.0267)		(0.0308)	
Roofing firm	0.00703***	-0.0245***	0.0283***	-0.0220***	-0.00230	-0.0161***	0.0163***	-0.000941
	(0.00258)	(0.00298)	(0.00332)	(0.00413)	(0.00272)	(0.00316)	(0.00386)	(0.00430)
Constant	0.0382***	0.0355***	0.0404***	0.0234*	0.0720***	0.0272***	0.0985***	0.0221***
	(0.00857)	(0.0100)	(0.0118)	(0.0131)	(0.0104)	(0.0105)	(0.0115)	(0.00835)
No. of observations	9,112	9,112	2,436	2,436	9,106	9,106	2,436	2,436

a): Parameter estimates (standard errors in parentheses). - b): Entry and exit rates refer to entries and exits of non-sole traders only for the models for non-sole traders and to sole traders only for the models for sole traders. - All models include 14 time dummies and are clustered for labour market regions.
*. **, ***: significant at the 0.1, 0.05, 0.01 level, respectively.

A low average market share of firms in a regional market tends to increase exit rates for both sole and non-sole traders in the West and for sole traders in the East. There is also a negative impact of average market share on entry rates of non-sole traders in the West. If firms in a region are located further apart from each other, exit rates are lower, but in the West this situation also leads to lower entry rates. A high exit rate of non-sole traders in the previous years spurs market entries of non-sole traders in West Germany, while for the East we find a negative impact of lagged entry rate on market exits of non-sole traders. Both results support the existence of some sort of "revolving door" effects in the roofing and plumbing business.

Table 6: Results of OLS models[a)] on change in stock of firms in the roofing and plumbing sector in Germany, 1996 to 2010

Dependent variable:	*West Germany*		*East Germany*	
Change in stock of firms	*Non-sole traders*	*Sole traders*	*Non-sole traders*	*Sole traders*
Binding rate	-0.000355	0.0427	-0.0211	0.167***
	(0.0282)	(0.0757)	(0.0152)	(0.0422)
Average firm size	-0.000937*	-0.00214	0.000259	-0.00292
	(0.000521)	(0.00146)	(0.000955)	(0.00431)
Average firm age	-0.00818	0.0136*	-0.00435	0.0649***
	(0.00553)	(0.00806)	(0.0101)	(0.0178)
Material prices	-0.127*	-0.159	-0.0821	0.0387
	(0.0726)	(0.185)	(0.0731)	(0.330)
Change in building permits	-0.000900	-0.00234	0.00806	0.00167
	(0.00400)	(0.0125)	(0.00819)	(0.0276)
Change in building age	0.0561	-0.00929	0.118	-0.789
	(0.151)	(0.398)	(0.233)	(0.686)
Change in solar demand	-0.000195	0.00201	-0.000104	-0.00313
	(0.000587)	(0.00200)	(0.00109)	(0.00270)
Average market share	0.0110	-0.0317	-0.0705***	-0.0722
	(0.0175)	(0.0190)	(0.0168)	(0.0429)
Average distance to competitor	-0.00137	-0.00308**	0.00209	0.00390
	(0.00104)	(0.00136)	(0.00514)	(0.0145)
Roofing firm	0.00669**	0.0194**	0.0226**	-0.0317
	(0.00285)	(0.00763)	(0.00832)	(0.0245)
Constant	0.0301**	0.0191	0.00932	-0.174***
	(0.0132)	(0.0214)	(0.0295)	(0.0505)
No. of observations	9,112	9,106	2,436	2,436

a): Parameter estimates (standard errors in parentheses). - All models include 14 time dummies and 97 dummies for labour market regions.
*. **, ***: significant at the 0.1, 0.05, 0.01 level, respectively.

Finally, we look at the impact of minimum wages on changes in the stock of firms (Table 6). The estimation results support the findings of the previous models. In East Germany, the stock of sole traders in a regional roofing market increases the higher the

average binding rate of firms is. For non-sole traders in the East, we find a negative, but not statistically significant effect of the binding rate on the stock of firms. The negative effect of the minimum wage on both the number of entries and the number of exits of sole traders in the East German roofing market go together with a stable stock of firms. Again we do not find any statistically significant effects for West Germany.

Most of our control variables do not work well in the stock-of-firm models and are insignificant, except for the average age of the firm population in a regional market which shows a negative effect. There is a significantly stronger growth of the stock of roofing firms compared to plumbing firms.

The model results show evidence that a strategy of raising rivals' costs through a minimum wage and by that reducing the degree of competition in the market might in fact be at work in the German roofing sector as far as East Germany is concerned. In this region, the minimum wage contributed to lower entry rates and a lower stock of firms than in the absence of this policy instrument. Lower competition helped the firms to reach a level of profitability they otherwise would not have been able to realise. A precondition for higher profitability is the ability of firms to increase prices to compensate for higher costs of the minimum wage. Our survey of roofing firms clearly showed that most East German firms indeed reacted upon the minimum wage by increasing prices which is a clear sign that there is room for price pass-through in the roofing market. Unfortunately, there are no regionally differentiated price data for roofing services available in Germany that would allow a statistical test. Analysing the impact of the minimum wage on prices for roofing services in Germany as a whole shows a small positive impact of the average binding rate on the level of prices for roofing services.[6] This result provides further support for price pass-through, particularly as one may only expect small effects if any for Germany in total given the limited significance of the minimum wage as a cost raising component in West Germany.

[6] These results are derived from DiD models that regress the quarterly average binding rate on quarterly price data for four different types of roofing and plumber services while controlling for input price development and demand development; reference period is second quarter 1996 to second quarter 2009. For more details see Aretz et al. (2011).

A major finding of this study is that the minimum wage implies different competition effects for different types of firms. The above-mentioned impacts only hold for firms which employ wage labour. In a trade such as roofing, there is also opportunity for sole traders to offer services and run a business, either by focussing on smaller repair work, by working together with other sole traders or by serving as subcontractor to other (larger) roofing firms. Sole traders are not directly affected by the minimum wage since only wage labour is subject to the regulation while sole traders are self-employed persons. We find evidence that the minimum wage contributed to a growth in the number of sole traders in the East German roofing sector, particularly by stimulating market entries. It is difficult to assess whether these market entries represent an evasion strategy of established firms. One could also argue that market entries of sole traders are a reaction of more skilled workers in East German roofing firms who are faced with stagnating nominal wages as many East German roofing firms tried to compensate for higher wage costs due to the minimum wage by saving costs on the side of higher qualified workers whose wages were gradually squeezed towards the minimum wage level (see Aretz et al. 2012). While we have no data at hand to directly evaluate the presence of an evasion strategy, shifts in the qualification level of sole traders as well as the persistence of remaining a sole trader in the business (and not starting to employ workers) may give some hints. The share of roofing journeymen who started a sole trade was very low in the first years after the introduction of the minimum wage and increased since then both in the West and the East though most recently the share has been higher in East Germany (Table 7) which may indicate a reaction to deteriorating wages for skilled workers.

The descriptive statistics show that in the West the survival rate has decreased over time in comparison to the period 1994-1997. In East Germany, in contrast, the survival rate of sole traders has strongly increased from 58 percent for those who started up during the years 1994-1997 to 88 percent in 2006 and is now higher than in the western part of Germany. Perhaps in the first few years following reunification the sole traders in East Germany were unfamiliar with processes taking place in a market economy, but the founders of sole-trade firms have learned to survive and apparently are also highly interested in remaining self-employed.

The share of surviving sole traders that remain as such and do not hire additional employees is lower nowadays in western Germany than it was before the introduction of the minimum wage. 30 percent of businesses that started as sole traders in 2006 grew to be non-sole traders in 2010 (i.e. they employed other workers). In contrast, the share of sole traders who were still sole traders in the fifth year of market presence increased in the eastern part of Germany and has been higher than the respective share in West Germany every year since the introduction of the minimum wage. For the most recent usable year (2006) the difference between West and East Germany is significant. This may indicate a higher relevance of the strategy in Eastern Germany of permanently remaining a sole trader . The diverging trends in the two parts of Germany may reflect different motives for becoming sole traders. In the West it is most unlikely to be the result of evasion as the share of workers covered by the minimum wage is below the share of sole traders. In the East, however, evasion may well be the case and the data is at least not inconsistent with such an interpretation.

Table 7: Qualification level and market survival of sole traders in the German roofing sector, 1994-2009

Period of business start-up	Share of sole traders with journeyman's certificate in the roofing business		Share of sole traders staying in the market 5 years after entry		Share of surviving sole traders that are still sole traders 5 years after entry	
	West	East	West	East	West	East
'94-'97	9.4	23.0	85.5	57.9	77.1	72.4
'98-'01	7.2	4.0	75.7	71.3	58.1	62.7
'02-'05	16.1	11.7	76.4	81.5	61.6	67.5
'06-'09*	14.6	16.6	82.9	87.7	69.8	81.0

2006 only for the share of sole traders exiting market 5 years after entry and for the share of surviving sole traders that are still sole traders 5 years after entry.

Source: MUP

8 Conclusions

This paper analysed the impact of a minimum wage on competition in a particular sector of the German construction business, the roofing sector. A minimum wage for blue-collar workers was introduced in this sector in 1997 and has been raised gradually since then. The minimum wage is of high significance in eastern Germany, where the regulation is binding for up to 60 percent of all workers while the policy instrument is of lim-

ited relevance in the western part of the country where only about 10 percent of workers are affected.

Our aim was to contribute to the small amount of literature investigating the effects of minimum wages for competition. Our study benefited from a broad coverage of firms operating in a specific industry and a large diversity of the binding nature of the minimum wage. As required for consistency we only find effects for eastern Germany where, in contrast to western Germany, a large proportion of all workers are affected by minimum wages. A main advantage and perhaps an innovative element of the present study is the use of several control variables on firm characteristics, input costs, development of demand and market structure. These variables have a firm foundation in the literature and are standard in the analysis of competition.

We investigated the impact of the minimum wage on four competition indicators: firm profitability, market entry, market exit, and stock of firms. We analysed the development of the industry over time, which is probably of high relevance for economic welfare. The time period covered by our study is long enough to observe market adjustment by exit and entry, which in many cases will only slowly react to changes in market conditions. We focus on the accumulative effect by using the binding rate, that is the share of workers for which the minimum wage is binding. If a minimum wage exists for a long time and is increased gradually, cost-raising effects of the minimum wage as compared to a situation without a minimum wage tend to increase over time. Such a cost increase may particularly hurt potential entrants since in a trade such as roofing newly founded firms are typically less productive than established firms owing to a lack of scale economies and market experience. In addition, they may suffer from lack of reputation. In many industries, entrants try to compensate for the disadvantage of newness by offering lower prices for their services, based on lower production costs, including lower wages than established firms. A minimum wage may undermine this strategy. From the point of view of established firms, a minimum wage raises rivals' costs, can prevent market entry and reduce the degree of competition.

Employing a difference-in-difference approach with the plumbing sector as a control group and using a 15 year firm panel data set that almost fully covers the firm population in both sectors in Germany we find evidence for a competition-reducing effect in

the eastern part of the country. Minimum wages contributed to lower entry rates of non-sole traders (i.e. firms with employees) and a lower number of non-sole traders operating in the East German roofing market as compared to the hypothetical situation of no minimum wage. Exit rates of non-sole traders in East Germany may also be lowered, but the robustness of this finding is weak. Minimum wages also led to higher profitability for East German non-sole traders than one would have found in the absence of a minimum wage. Higher profitability may be associated with lower competition as well as the ability of firms to pass through higher costs to customers. The latter may result from low price elasticity of demand owing to the fact that roofing services cannot be substituted by suppliers from other industries and that customers cannot simply refrain from repairing a damaged roof while for new buildings, labour costs of roofers are a negligible part of total building costs.

Another important finding is that the minimum wage spurred the growth of sole traders in the East German roofing market. A shift form non-sole to sole traders may indicate some type of evasion behaviour since sole traders are not subject to minimum wage regulation and often serve as subcontractors for other roofing firms, though many may manage to run an independent business based on repair work and co-operation with other construction services, e.g. for installing solar collectors. The growing number of sole traders in East Germany may also reflect less attractive working conditions for the more qualified workers. Aretz et al. (2012) found that the minimum wage not only affected the employment probability of workers with a binding minimum wage negatively, but also of workers paid above the minimum wage level. In addition, the wage distribution in East Germany was compressed towards the minimum wage level over time, resulting in less opportunity for qualified workers to earn significantly above the minimum wage. Some of these qualified workers may have opted to start their own business to increase their earnings, particularly since moving out of their region (e.g. to move to West Germany, where wage levels for qualified roofing workers are much higher) is often seen as no option due to family obligations and ties to property. Throughout our analysis we did not find any competition effects of the minimum wage for West Germany.

As with any study, our analysis has a number of limitations that should be pointed out. Unfortunately we were not able to identify the share of workers with a binding minimum wage at the firm level. Instead we use the regional and size class variation in coverage of workers by the minimum wage as indication concerning the relevance of this regulation. While we find a rising share of sole traders, we know little about the nature of this trend. In particular, we cannot determine whether newly founded sole traders in East Germany are the result of an evasion strategy or just induced by the dismissals of the non-sole roofing firms. To clarify this, more detailed analysis would be needed, including interviews with sole traders about their business strategy.

Another shortcoming of the study is the neglect of potential spillovers from other construction industries with minimum wages. Most importantly, the main construction trade is also subject to a minimum wage which was introduced in January 1997, a few months before the roofing minimum wage came effective. Demand for roofing services may be affected by changes in prices for buildings that are due to the minimum wage in the main construction business, particularly for the market segment of new buildings, since roofs are a sub-product of buildings and demand for erecting new roofs is simply a derivative of the demand for new buildings.

9 References

Aaronsen, D. (2001), Price Pass-Through and the Minimum Wage, Review of Economics and Statistics, vol. 83, 158-169.

Aaronsen, D. and French, E. (2007), Product Market Evidence on the Employment Effects of the Minimum Wage, Journal of Labor Economics, vol. 25, 167-200.

Aaronsen, D., French, E. and MacDonald, J. (2008), The Minimum Wage, Restaurant Prices, and Labor Market Structure, Journal of Human Resources, vol. 48, 688-720.

Aretz, B., Arntz, M., Gottschalk, S., Gregory, T., Leheyda, N., Niefert, M., Rammer, C., Schröder, H. and Schütz, H. (2011), ZEW-Studie zu den Wirkungen eines Mindestlohns in der Dachdeckerwirtschaft, Research report for the Federal Ministry of Labour and Social Affairs, Mannheim.

Aretz, B., Arntz, M. and Gregory, T. (2012), The Minimum Wage Affects Them All: Evidence on Employment Spillovers in the Roofing Sector, ZEW Discussion Paper, Mannheim.

Audretsch, D.B. (1995), Innovation, Growth and Survival, International Journal of Industrial Organization, vol. 13, 441-457.

Blundell, R., Costa Dias, M., Meghir, C. and van Reenen, J. (2004), Evaluating the Employment Impact of a Mandatory Job Search Program, Journal of the European Economic Association, vol. 2, 569-606.

Bullock, A., Hughes, A. and Wilkinson, F. (2001), The Impact of the National Minimum Wage on Small and Medium Sized Businesses in the Cleaning and Security Sectors, Report Prepared for the Low Pay Commission.

Czarnitzki, D. and Kraft, K. (2004), Innovation indicators and corporate credit ratings: evidence from German firms, Economics Letters, vol. 82, 377-384.

Czarnitzki, D. and Kraft, K. (2007), Are Credit Ratings Valuable Information?, Applied Financial Economics, vol. 17, 1061-1070.

Draca, M., Machin, S. and van Reenen, J. (2005), The Impact of the National Minimum Wage on Profits and Prices: Report for the Low Pay Commission.

Draca, M., Machin, S. and van Reenen, J. (2006), Minimum Wages and Firm Profitability, Center for Economic Performance, CEP Discussion Paper No. 715.

Galindo-Rueda, F. and Pereira, S. (2004), The Impact of the National Minimum Wage on British Firms, Final Report for the Low Pay Commission on the Econometric Evidence from the Annual Respondents Database.

Geroski, P.A. (1995), What Do We know about Entry?, International Journal of Industrial Economics, vol. 13, 421-440.

Göddeke, A., Haucap, J., Herr, A. and Wey, C. (2011), Stabilität und Wandel von Arbeitsmarktinstitutionen aus wettbewerbsökonomischer Sicht, DICE ordnungspolitische Perspektiven, No. 10.

Haucap, J., Pauly, U. and Wey, C. (1999), The Incentives of Employers' Assocations to Raise Rivals' Costs in the Presence of Collective Bargaining, Discussion Paper FS IV 99-6, Wissenschaftszentrum Berlin.

Haucap, J., Pauly, U. and Wey, C. (2001), Collective Wage Setting When Wages are Generally Binding: An Antitrust Perspective, International Review of Law and Economics, vol. 21, 287-307.

Heitzler, S. and Wey, C. (2010), Raising Rivals‘ Fixed (Labor) Costs: The Deutsche Post Case, DIW Discussion Paper No. 1008, Berlin.

Machin, S., Manning, A. and Rahmann, L. (2003), Where the Minimum Wage Bites Hard: Introduction of Minimum Wages to a Low Wage Sector, Journal of the European Economic Association, vol. 1, 154-180.

Manz, K. (2012), Keine Angst vor dem Mindestlohn, handwerk magazin, vol. 2/12, 20-23.

Martin, S. (2002), Advanced Industrial Economics, second edition, Blackwell, Oxford, UK.

Mata, J., Portugal, P. and Guimares, P. (1995), The Survival of New Plants: Start-Up Conditions and Post-Entry Evolution, International Journal of Industrial Organization, vol. 13, 459-481.

Meyer, B.D. (1995), Natural and Quasi-Experiments in Economics, Journal of Business and Economic Statistics, vol. 13, 151-161.

Motta, M. (2004), Competition Policy – Theory and Practice, Cambridge University Press:

Petrakis, E. and Vlassis, M. (2004), The Political Economy of the “Minimum Wage Institution" in an Internationally Integrated Market, Review of International Economics, vol. 12, 27-40.

Santarelli, E. and Vivarelli, M. (2007), Entrepreneurship and the process of firms’ entry, survival and growth, Industrial and Corporate Change, vol. 16, 455-488.

Schmalensee R.C. (1985), Do Markets Differ Much?, American Economic Review, vol. 75, 341-351.

Siegfried, J.J. and Evans, L.B. (1994), Empirical Studies of Entry and Exit: A Survey of the Evidence, Review of Industrial Organization, vol. 9, 121-155.

Stewart, M.B. (2002), Estimating the Impact of the Minimum Wage Using Geographical Wage Variation, Oxford Bulletin of Economics and Statistics, vol. 64, Supplement, 583-605.

Wadsworth, J. (2008), Did the UK Minimum Wage Affect Prices?, Research Report for the Low Pay Commission.

Williamson, O.E. (1968), Wage Rates as a Barrier to Entry: The Pennington Case in Perspective, Quarterly Journal of Economics, vol. 82, 85-116.