ARTICLE

Minimum wages in German industries—what does the evidence tell us so far?

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Abstract Since the effects of a minimum wage on wages and employment are depending on a bunch of factors and are by no means determined theoretically in an unambiguous way, empirical analysis is required. German studies on the effects of minimum wages in the past often did not meet international methodological standards. International minimum wage research today is typically based on micro data analysis. Hereby the development of economic variables before and after the introduction of a minimum wage for a treatment group is compared to that of a control group (difference-in-difference approach). A corresponding method is applied in a series of recent German studies aiming at the evaluation of the introduction of the minimum wage in a number of industrial branches. Through these studies minimum wage research in Germany has made substantial progress and caught up to standards of the international literature. However, there are still open methodological questions that are discussed in this article. A central finding from the existing minimum wage studies in Germany is that disemployment effects are hard to find. By contrast, wage effects can be identified in most studies, especially in the eastern part of Germany.

Keywords Minimum wages · Employment · Germany · Difference-in-difference approach

JEL Classification J31 · J38 · J41

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Branchenspezifische Mindestlöhne in Deutschland – Was sagt uns die empirische Forschung?

Zusammenfassung Die Auswirkungen eines Mindestlohns auf Löhne und Beschäftigung hängen von einer Vielzahl von Faktoren ab und lassen sich theoretisch keineswegs eindeutig bestimmen. Hierzu bedarf es einer empirischen Analyse. Deutsche Untersuchungen über Mindestlohneffekte entsprachen in der Vergangenheit oft nicht den internationalen methodischen Standards. Mittlerweile beruhen die Analysen der internationalen Mindestlohnforschung auf Mikrodaten. Dabei wird die Entwicklung von ökonomischen Variablen vor und nach Einführung eines Mindestlohns für eine Gruppe von Betroffenen mit der einer Kontrollgruppe verglichen (Differenz-von-Differenzen-Ansatz). Diese Methode wurde in einer Reihe von neueren deutschen Studien verwendet, die sich der Evaluation der Mindestlohneinführung widmen. Die Mindestlohnforschung in Deutschland hat damit große Fortschritte gemacht und Anschluss an die internationalen Standards gefunden. Der wissenschaftliche Diskurs sollte hier anknüpfen. Allerdings bleiben einige methodische Fragen, die in diesem Beitrag diskutiert werden. Als wesentliches Ergebnis aus den bisher vorliegenden Mindestlohnstudien für Deutschland ist festzuhalten: Beschäftigungsverluste durch einen Mindestlohn sind weitgehend ausgeblieben. Insbesondere in Ostdeutschland lassen sich hingegen deutliche Effekte der Lohnuntergrenze auf die Lohnverteilung nachweisen.

1 Introduction

Germany is one of the few countries in Europe that has not introduced a general statutory minimum wage. Up to now, minimum wages have only been implemented in a dozen

branches or occupations. However, there is an on going highly controversial debate on whether or not to impose a general wage floor in the country. This debate is reflected in an academic controversy. On the one side are those who believe that although the neoclassical paradigm perhaps does not describe the labor market perfectly, it is nevertheless adequate. In this setting, the market is at, or at least close to, a competitive equilibrium and workers are paid according to their marginal productivity. A wage floor artificially drives up the remuneration of workers. As a consequence, employment falls when firms are moving upwards along the labor demand curve. Hence minimum wages are detrimental insofar as low-productivity workers lose their jobs. If the real wage elasticity of labor demand is low, it is possible that the total wage bill increases—which could be a desirable effect. However, given that low-skilled workers count for the majority of low-paid workers and the unemployment rate of this group is still at an unacceptable level, disemployment effects of a minimum wage have to be considered as highly undesirable. This, and the fact that under the conditions of a competitive labor market minimum wages squeeze the firms' profits, might explain the strong resistance of a considerable fraction of German economists to the minimum wage.

On the other side are those who point to the fact that the labor market is highly imperfect and the neoclassical paradigm is not suitable, even as approximation to reality. If employers exert market power in some way or other, the competitive equilibrium view becomes obsolete. Under limited competition on the labor market, it may well be that workers are paid below the value of their marginal productivity. The firm has an incentive to keep employment below the market clearing level when it is possible to force workers down to the labor supply curve. In such a situation, a government intervention is able—at least within a certain range—to increase both wages and employment at the same time. Of course, a pure monopsony environment as in the classical case of a company town is not a realistic description of a modern economy where workers are mobile and can escape the narrow confines of a local labor market. However, new approaches of monopsonistic competition as outlined, for instance, by Manning (2003a, 2003b), show that a corresponding situation can arise in a realistic labor market setting. The reasons why a firm might exert some monopsonistic power range from asymmetric information between employers and employees to the specific circumstances, restrictions or preferences of an individual worker. Take, for instance, the case of a single mother when a child care facility happens to be around the corner from the firm: she would then tend to accept a wage offer somewhat lower than she would be typically willing to accept under other circumstances.

Although the neoclassical and the monopsonistic approach represent fundamentally different views of the labor market, it should be stressed that both lead to the same predictions in two specific situations: (i) in the trivial one, where the minimum wage is so low that it is not binding and (ii) in the case where the minimum wage is beyond the equilibrium level of a competitive market. Whereas in the former case, no effects can be expected, both approaches would predict the same negative employment response of the labor market in the latter. The discrepancy between the neoclassical and the monopsony view is in the question of whether the minimum wage could be binding even below the competitive market clearing level.

Similar to the theoretical academic controversy, the empirical evidence on the disemployment effects of a wage floor is ambiguous as well (see Neumark and Wascher 2008; Manning 2011). Whereas, from the neoclassical point of view, the effect of a binding minimum wage is always detrimental, an advantage of the monopsony approach might be seen in the fact that it is flexible enough to explain opposite employment effects depending on the specific circumstances. The crucial point in the debate, therefore, is whether or not there is an area of freedom where a binding minimum wage has no negative employment effects. If so, then an intelligent minimum wage strategy can be used to pursue not only social aims, i.e. to improve the situation of workers at the very low tail of the wage distribution, but also to improve the functioning of the labor market because the number of vacancies is reduced.

In general, empirical minimum wage research in Germany has lagged behind standards in international literature for quite a long time. Before several studies were initiated by the German Ministry of Labor in 2010, most contributions aimed at analyzing the effects of a minimum wage simply used inadequate methods. In the next section we first describe two of these deficient approaches before turning to a more state-of-the-art analysis.

2 Differing concepts of minimum wage analysis in Germany

2.1 Minimum wage analysis in the neoclassical spirit

Several minimum wage studies in Germany are *a priori* based on the neoclassical presumption. Assuming that the labor market is close to being a perfect market, and hence the initial situation is a competitive equilibrium, the introduction of a wage floor implies a movement along the labor demand curve. It goes without saying that this approach inevitably leads to employment losses if the minimum wage is binding, i.e. above the competitive market equilibrium. In this case the enforced wage level exceeds the marginal productivity evaluated at market prices. As a consequence, employment shrinks until the equilibrium relation between wages and productivity of the marginal worker is re-established. Empirical estimates of the employment ef-

fect of minimum wages are then straightforward. All that is needed to calculate the disemployment effect is information on the low tail of the wage distribution and an estimate of the (real) wage elasticity of labor demand.

For instance, if there are 100,000 workers earning 5 € before the introduction of a wage floor and the minimum wage is set to 7 € or 40 percent higher, then, with a wage elasticity of −0.8, one ends up with employment losses of roughly one third (32,000). The calculations can be refined if more precise information on the distribution of low-wage workers is used or group-specific estimates for the wage elasticity of labor demand are taken into account.

However, the approach as described above, is subject to critique not so much because estimates of the wage elasticity of labor demand are typically not very precise. The main problem is that the *a priori* assumption of a perfectly competitive labor and goods market cannot be tested. As a consequence, the approach does not lead to a fair empirical investigation. The employment effect of a minimum wage has to be negative *by construction*. Put differently, the trial is prejudiced; the delinquent is given no chance.

International evidence shows that calculations based on the pure neoclassical approach typically lead to completely unreliable disemployment effects of a minimum wage. For example, Minford and Haldenby (1999) made predictions of huge employment losses in Britain as a consequence of the introduction of the national minimum wage in 1999. These calculations turned out to be fundamentally wrong. According to numerous studies thereafter there were, if any, no significant job losses in the aftermath of the introduction of a national minimum wage. In the face of this experience, calculations of the disemployment effects of a minimum wage for Germany based on a comparable approach, as in Ragnitz and Thum (2007, 2008), simply lack credibility. From an academic viewpoint, they do not present the state-of-the-art in empirical minimum wage research.

2.2 Analyses based on (Keynesian) macroeconomic models

A completely different road to study the possible effect of minimum wages is chosen by Bartsch (2009) which in some aspects is the counterpart of the neoclassical approach. The author takes a macro perspective. Minimum wage effects are calculated on the basis of a traditional macroeconometric model in Keynesian spirit. The simulation assumes an increase in average hourly wages in the low-pay sector from 6 € to 7.50 € as a first stage and to 9 € as a second stage. According to the simulation, 2.4 (4.0) million full-time workers and 3.1 (5.2) million part-time workers and marginally employed would profit from the wage floor at the first stage (second stage, respectively). Since the tax burden for persons with low incomes is low, the effect on disposable

income is high. Due to the Keynesian multiplier/accelerator mechanisms in the model, this leads to higher investment and growth. In the logic of the model, sizable positive employment effects result from the wage floor.

The fundamental problem with the approach, however, is that only the consumption demand, not the cost aspects, of the wage is considered. In the study, the wage elasticity of employment demand is set to zero by assumption. Hence the corresponding labor demand mechanisms as emphasized by the neoclassical approach have no chance to become effective. The disemployment effects of a minimum wage are excluded *a priori*. This is highly problematic since theoretically it is not even clear whether the impact on the total wage bill is positive or negative if labor demand reacts to higher costs.

Leaving aside the possible criticism related to the ability of large-scale macroeconomic models of traditional Keynesian type to capture the structural elements of an economy accurately, this attempt to analyze the effect of institutional changes is still not satisfactory.

2.3 Approaches based on cross-sectional data

Recent studies on minimum wages in the international literature typically rely on micro data. A further approach relies on cross-sectional micro data. The method goes back to Meyer and Wise (1983) and has been improved by Dickens et al. (1998). The basic idea is to estimate a counterfactual wage distribution for industries where a minimum wage has been introduced. Clearly the effect of a binding minimum wage is a thinning out of probability mass in the low tail of the wage distribution. From information on the parts of the wage distribution that are presumably not affected and comparable sectors without a minimum wage regulation as reference cases, the counterfactual is estimated. Inference on the possible disemployment effects can be drawn from the comparison between the actual and the counterfactual distribution. An advantage of the approach might be seen in the fact that only cross-sectional data is required.

However, the construction of the counterfactual relies on more or less "heroic" assumptions. In early applications of the approach, estimates of the counterfactual wage distribution used a parametric form. It has been criticized that the outcome heavily relies on the distributional assumptions. More recently, the approach has been significantly refined through the use of non-parametric techniques (see Müller 2012).

The resulting method is less contestable than the original one. However, the distribution of hourly wages is affected by many factors that can only be controlled for if information in the time dimension is available. For example, there might be a trend in skill upgrading in the sector, leading to a thinning out of probability mass in the low-paid region. Another point

could be that workers in different sectors might be affected differently by the business cycle. Hence it remains unclear to which extent the results depend on the choice of a reference sector. Thus the possibilities of checking the robustness of the results are limited.

Despite these possible criticisms, the results can be taken as first evidence of the effects of a wage floor in specific sectors of the economy. In the study by Müller (2012), the approach is applied to the introduction of minimum wages in the construction sector in the eastern and western parts of Germany. The author uses a more flexible non-parametric approach for estimating the counterfactual. He finds a sizable disemployment effect in the East, but a negligible one in the West.

2.4 Studies based on laboratory experiments

A further possibility of grasping the effect of minimum wage legislation on economic outcomes might be seen in laboratory experiments. In such an experiment, Falk et al. (2006) find a strong relationship between minimum wages and reservation wages. It seems that minimum wages define standards of fairness which are taken as a reference in future expectations of acceptable wages. As an important consequence of this, the effects of introducing or abolishing a minimum wage regime might be quite different. In other words, there might be a hysteresis effect of a minimum wage regime, i.e. a long-term impact of a temporary change.

Although some doubts can be expressed as to the extent to which findings from laboratory experiments carry over into real-world situations, the results point to the fact that in labor relations not only market aspects, like the productivity of a worker, play a crucial role but also inter-subjective behavioral factors such as standards of fairness, social valuation etc. If so, then one would also expect deviations from the pure neoclassical view of the labor market.

2.5 Studies based on quasi-natural experiments

In international literature, recent empirical studies on the effects of minimum wages are typically based on micro panel data (e.g. Abowd et al. 1999; Stewart 2004; Draca et al. 2011) or regionalized industrial data (e.g. Dube et al. 2010). In the tradition of Card and Krueger (1994), these studies rely on the difference-in-difference (DiD) approach and intend to investigate the (causal) impact of a wage floor on economic outcomes. The DiD approach is applicable to a quasi-natural experiment where the outcomes of a treatment group are compared to those of a control group. The method is able to control for a number of influences that possibly contaminate the results of a pure cross-sectional approach. For example, the effect of the business cycle can be neutralized if both—the treatment and control group—are affected the same way. The latter is called the common-trend

assumption (CTA). Although the DiD method seems to be an attractive way of investigating quasi-natural experiments like the introduction of a wage floor, it also relies on several other assumptions (see Lechner 2011) and requires certain settings, for instance, the choice of a suitable control group.

The first studies employing a DiD approach for investigating the wage and employment effects of minimum wages in Germany were the papers by König and Möller (2008, 2009).

3 Methodological and data problems in empirical studies using quasi-natural experiments

3.1 Data problems and the identification of treatment and control groups

In natural science experiments, treatment and control groups can be sharply distinguished from each other in most cases. In the social science context, this is typically not possible. An important reason for this is that indicator variables for treatment and control groups are contaminated. For example, one can define the treatment group in our case as those workers whose earnings per hour are less than the hourly minimum wage before such a wage floor is introduced. Here the problem is that the hourly wage can only be observed with an error. This is especially the case were the hourly wage is calculated as earnings divided by working hours, because nominator and denominator are subject to more or less severe reporting errors. Hence an exact identification of the treatment group in a minimum wage investigation is illusionary.

A further complication comes into play if components required for calculating the hourly wage are not directly observed. This is the case for German social security data which many researchers have used because of its high coverage and reliability as well as its panel structure. This source does contain three categories of qualitative information on working hours, but no quantitative information.

Even if the investigation is limited to the subgroup of full-time workers, ignoring the problem might lead to seriously biased results. Although there are no perfect remedies to cure the problem, there are attempts to limit its consequences.

In general, two approaches are possible: one can either impute working hours in the social security data by using other data sources, or, one can try to include a model for the distribution of working hours explicitly into the estimation model. In most cases researchers have chosen the first possibility.

But even if this is accomplished in a satisfactory manner, further contamination problems are likely to be of a certain magnitude. This is the case even though, in German social

security data, information on total earnings can be considered highly reliable because of legal sanctions in the case of misreporting.

Earnings per calendar day are calculated by dividing an earnings measure through the length of the spell (in days). Even if firms are quite accurate in reporting earnings, they might be sloppy when giving the information on the length of the employment spell. Especially for shorter employment spells, the noise in the data might be rather sizable. In the data there are quite a number of cases where daily earnings of full-time workers of, say, less than 15 € are calculated. The most plausible explanation of this is either the inaccuracy in the information on the length of the employment spell or a reporting error in the qualitative working time variable.

3.2 Choice of the control group: control group in the same industry

There are two main assumptions for the applicability of the DiD approach (see e.g. Lechner 2011): the common trend assumption (CTA) and the stable unit treatment value assumption (SUTVA). According to the first, the control group should be chosen so that individuals within the control group exhibit the same development as those in the treatment group. In the ideal case, the observable characteristics of controls should be identical to those of the treated except for the treatment. According to the SUTVA, the controls should not be directly or indirectly affected by the treatment.

A basic choice in the evaluation studies at the industrial level is whether or not to choose the control group within the same sector. Apparently, there is a tradeoff here. On the one hand, the CTA demands that persons in the control group should exhibit high similarity with the characteristics and conditions of those who are treated. This would be in favor of taking the controls from the same sector. On the other hand, the SUTVA is more likely violated if controls are taken within the same sector. The indirect effects of the treatment are especially difficult to control for. These indirect effects include substitutive and complementary relations between the treated and non-treated within the same sector. Furthermore, a control group within the same sector might be affected by so-called spillover effects (see, for instance, Rattenhuber 2011). If the wages of workers below the wage floor are increased to the minimum wage, then firms might also be inclined to increase the wages of those whose earnings were initially above the minimum wage. The argument for such a behavior goes as follows: managers have a strong interest in establishing a wage hierarchy that reflects the education, ability and motivation of the workers. If the relative structure of earnings within a firm is disturbed through the minimum wage, then management might tend to re-establish the former performance-related relative wages by increasing the pay not only for workers whose wage position is below the minimum wage but—at least to some extent—also for those above. There are good reasons, however, to expect that *ex post* the absolute differences of the adjusted wage structure are less than they were in the initial wage distribution (without a minimum wage). In other words, the spillover effects are the more powerful, the more similar the wages of the non-treated worker are to the wages of the treated.

Hence the spillover effect should be highest directly above the minimum wage and should phase out in higher regions of the wage distribution. Put differently, something like an accordion effect comes into play as a result of the compression from below.

There is a further chain of argument that is fairly contrary to the "compression-from-below phenomenon" and implies something like a "compression-from-above" phenomenon. This argument goes as follows: If firms are forced to pay a minimum wage for low-productivity workers this would result in a profit squeeze at least if the treated workers are indispensable and cannot be laid off. As a response to this profit squeeze, the firm might tend to reduce the remuneration of its workers in the upper tail of the distribution to re-gain its initial profit level. Hence an above-the-average growth of the wage level of the treated is accompanied by a below-the-average growth of those in the upper part of the wage distribution.

If the control group is chosen in the same industry then a spillover effect of the compression-from-below type would tend to underestimate the treatment effect as those who are taken as not treated are also affected to a certain extent. In contrast, effects of the compression-from-above type would lead to an upward bias in the estimated treatment effect.

Although spillover effects are likely to occur, the question is to what extent it invalidates a DiD application. What is required for the identification of a treatment effect is that second round, or indirect effects, are of a lower order of magnitude compared to the direct effect. At least in large data sets, a significant treatment effect should be discernible even if the effect is biased to some extent.

3.3 Choice of the control group: control group in different industries

Through choosing the control group from different industries or occupations one might get rid of some of the problems that have been discussed in the previous sections. For example, spillover effects should not play a role if the reference group for roofers is taken from electricians. This advantage, however, comes at rather high costs. The control group should be similar to the treatment group in structure, external conditions and trend development. Of course, the choice of the control group can be based on observed characteristics in the past. One might choose as reference groups

an occupation or industry that has a similar structure to the treated industry by e.g. pay, skill, gender, age and business conditions. However, industries and occupations differ in many characteristics only some of which are observed. One should keep in mind that the choice of a reference industry is based on plausibility but cannot be tested. Especially with respect to the business cycle, the same tradeoff as above arises. The more similar the occupations/industries are, the more likely are substitution and complementarity. For example, taking electricians as the control group for roofers might be justified because of accordance in the skill structure and the business cycle. However, both occupations are closely related to construction and can be considered as complementary in this sense. If, by contrast, an industry far from construction is chosen, then this might not be adequate because different business cycle conditions destroy the common trend assumption (which is perhaps more critical for the DiD method than the SUTVA).

3.4 Intensity of treatment: wage gap versus dummy variable approach

Another aspect is related to the question whether or not to consider the intensity of the treatment. Sometimes the intensity of the treatment is neglected although it might play an important role. For example, it likely makes a difference whether a worker earned, say, 5 € or 7.80 € before the introduction of an hourly minimum wage of 8 €. In the so-called dummy variable approach only binary information on the treatment is exploited, whereas in the wage-gap approach the relative distance of former earnings to the level of the minimum wage is explicitly considered (see Stewart 2004).

When accurate data is available, the wage-gap approach is preferable because it takes the intensity of the treatment into account. Things are much less clear if contaminated data come into play. For example, a typical case appears if an unusually low wage is calculated because, for example, the firm erroneously reports the length of the employment spell as five months instead of two. This would produce a seemingly high "wage gap". If extraordinarily high values of the wage gap variable are likely to result from data errors, corresponding estimates might totally obscure the treatment effect because these "outliers" influence the regression with a high weight. Although an error-in-the-variable problem also arises in the dummy-variable approach, the problem is less severe because there is no erroneous "high intensity" in this case.

3.5 Identification of the treated and the regression-to-the-mean phenomenon

A further complication for defining the treatment group arises if the instability of workers' remuneration is taken into account. Analyzing earnings data with a panel structure typically reveals a highly evident regression-to-the mean phenomenon. Independently of any wage floor regulation, individual wage growth tends to be higher in the left tail and lower in the right tail of the distribution. After a negative shock in earnings, workers apparently try to catch up in the subsequent period and *vice versa*.

This phenomenon could be seen as a challenge to the strategy of identifying the treatment group. Typically what one would like to identify as a worker affected by a wage-floor regime is a person with a permanent, not only transitory, low pay because this can be taken as an indicator for being a low-productivity worker.

3.6 DiD of higher order

A further aspect concerns the way how the treatment group is defined. It seems at least questionable to consider *all* workers in an industry where a wage floor is established as treated. Comparing industries without considering the position of the treated in the wage hierarchy would tend to obscure the true treatment effects.

An adequate response could be to consider an extension of the DiD method: the difference-in-difference-in-difference approach. This means that the treated are not only compared to a control group within the same industry, but the difference between the treated and the non-treated are compared between industries. This approach has been chosen, for instance, by Gregory, Arntz (2012).

3.7 What to consider and what to expect?

What are the relevant outcome variables for minimum wage studies? It is hardly controversial that the two central questions are: (i) Do treated workers exhibit higher wage growth? (ii) Do the treated have a higher probability of losing their jobs, or is the opposite the case? Hence the main variables to be investigated are wages growth and employment retention. However, there are further interesting research questions. For instance, are more (low-paid) workers attracted to the treated industry due to the incentive of higher earnings? And what about productivity, profits, prices, product quality, firm size and competition? Furthermore, one can expect an impact on the stability of job attainment and incentives for vocational training as well. All these effects might be different for different groups and might perhaps only develop over longer time periods. It is clear that the impact of a minimum wage on labor market relations is a complex issue. A wage floor influences various facets of the complex relationship between labor supply and labor demand as well as the goods market structure. For example, labor productivity might be endogenous, since the pay level feeds back to the motivation and effort of the worker. The response of labor demand heavily depends on market-specific parameters

like the price elasticity of product demand and the elasticity of substitution between capital and labor or between low-skilled and intermediate or high-skilled labor.

Since the scope of empirical research is limited, the focus is typically on wage and employment effects. As already clarified in the introduction, the predictions of the neoclassical and the monopsony model at very low and very high levels of a minimum wage are identical. The differences appear in the intermediate range of a moderate wage floor.

From the viewpoint of a strict neoclassical position there should be an effect on average wages in the industry after the introduction of a binding minimum wage, but no wage effect at the individual level. The reason is that if the pay exceeds the marginal productivity of the worker, the person would normally lose her or his job so that she/he would not show up in the wage data.

Hence the neoclassical approach predicts strong disemployment effects for those affected.

The predictions of the monopsony model are more "flexible". With a high initial wage, the predictions are identical to the neoclassical case: no individual wage effects and job losses. However, depending on the initial wage level and the difference imposed by the height of the wage floor, there might be individual wage effects without job losses. When the initial wage level is low and a moderate minimum wage is imposed, it is not excluded that higher wages will even lead to additional supply and employment of workers.

4 Results of the studies for various German industries

4.1 Data situation and research design

For several German industries studies on the impact of minimum wages were carried out between 1997 and 2010. Included in this issue are the analyses for the following seven industries:

- Main Construction (MC)
- Roofing Sector (RS)
- Painters and Varnishers (PV)
- Commercial Cleaning Industry (CC)
- Industrial Laundries (IL)
- Nursing Care Sector (NC)
- Waste Removal Services (WR).

Table 1 gives an overview of the characteristics of these industries and the design of the corresponding studies. Note that the data situation differs considerably. In particular in those industries where the minimum wage was introduced only recently (WR, IL, NC), there are no administrative micro data available. Hence the analysis has to rely on telephone surveys and case studies. In contrast, the analysis for CC, PV, RS and MC can be based on micro data on firms

and/or individual workers. For these sectors it was possible to combine large administrative data sets with other sources that also included information on working hours. Hence a reliable measure for hourly wage rates could be calculated for the period before and after the introduction of the minimum wage.

When no micro data is available, the evidence on the impact on minimum wages is of course relatively weak. Here the results rely crucially on the responses of firms and individuals that might be biased due to strategic response behavior and subjective factors. Although in these cases the studies tried to make the best out of the given data situation, the reliability of results is more questionable than in the other cases.

With the exception of IL and NC all studies applied a DiD method for a treatment/control group design. Under some ideal conditions the estimated treatment effect can be interpreted as a causal effect. However, this interpretation crucially depends on the common trend and stable unit treatment value assumption. Most studies present some indirect tests and robustness checks that give some further evidence. Since a direct test is not possible, however, it remains an open question as to whether these conditions are fulfilled or not. The causal interpretation, therefore, should be considered with caution. As discussed in Sect. 3.4, there is a fundamental tradeoff in the choice of the control group. Where the data situation allowed it, a control group was formed with observations both within and outside the sector (WR, RS and MC). It goes without saying that some of the results are not independent of the choice of the control group.

4.2 The specifics of the sectoral structure

Table 1 also shows that the characteristics of the minimum wage sectors under investigation differ widely. Among others, this concerns the competition structure on goods and labor markets, the share of labor costs, the wage elasticity of labor demand and supply as well as the employment and market trends. For example, a situation where higher costs can be easily shifted over to costumers is completely different from a situation where the product demand is highly price elastic. An example of the former is the waste removal service sector where a cost-recovery principle widely prevails. Hence it can be expected in this sector that the higher costs of a minimum wage can be passed over to the municipalities and other costumers. If a wage floor is effective, wage cost competition in the sense of pressing the wage to very low levels is at least limited. Under such circumstances significant employment effects are not likely to occur. However, the minimum wage might create an incentive to substitute low-skilled labor by technical equipment.

A further example is the roofing industry (RS). Here there is a strong complementarity with other construction activities since every building requires a roof. Also, repairs should

Table 1 Basic information on minimum wage sectors and the design of the corresponding minimum wage studies

	Industry						
	Waste removal (WR)	Industrial Laundries (IL)	Commercial Cleaning Industry (CC)	Nursing Care Sector (NC)	Painters and Varnishers (PV)	Roofing Sector (RS)	Main Construction (MC)
Introduction date	01.01.2010	24.10.2009	01.07.2007	01.08.2010	01.12.2003	01.10.1997	01.01.1997
Specifics of sector	Limited competition; heterogeneity of firm size	Small firms dominating, some concentration trend	Growth of small and large firms (polarization); 2/3 females; 1/4 foreigners; 80 % part-time	Monopsonistic market structure; shortage of (qual.) workers; 36.4 % full time; increasing fictitious self-empl.	Small firms; trend towards 1-person firms	Trend towards small firms	Mainly male workers; call for tender gives monopsony power to large customers; high market power index for firms
Employment trend	Stable	Stable	At least stable	Strong growth	Decline	Decline	Decline
Price elast. (dem.)	Low	High at firm level	High at firm level	Intermediate	High at firm level	Low	High at firm level
Share of labor costs	Low/intermediate (8–23 %)	Intermediate	High (72 %)	High	Relatively high	Intermediate (30 %)	Intermediate
Units for analysis	Firms	Firms	Firms, regions, workers	Firms	Firms, workers	Firms, workers	Workers, firms, regions
Definition of treatment	At least 1 worker affected and others	Wage increases due to MW	Wage increases due to MW	(i) # persons affected; (ii) Wage gap	(i) Persons affected; (ii) Dummy variable	(i) # persons affected; (ii) Wage gap	(i) # persons affected; (ii) Wage gap
Control group	(i) Obs. in similar ind.; (ii) Obs. within same ind.	No control group design	Similar occupations in different ind.	No control group design	Obs. in similar industries and others	(i) Obs. in similar ind.; (ii) Obs. within same ind.	(i) Obs. in similar ind.; (ii) Obs. within same ind.
Data source	Firm survey	Firm survey	Adm. data; micro-census; firm survey	*Pflegestatistik*; online survey	Adm. data; micro-census; firm survey	Adm. data, micro-census, surveys	Adm. data, micro-census, surveys
Method	DiD	Descriptive	DiD	Panel data method	DiD	DiD; DiDiD, Panel data method	DiD

be expected to exhibit low price sensitivity because one has to fix roof damages immediately if possible massive further damages are to be avoided. Again, substitutions of labor through capital or new roofing techniques that are less labor-intensive can become a strategy of the firm.

Substitution and complementarities can likewise play a role between sectors. If the main construction sector is affected by a minimum wage which drives up costs and lowers housing demand via the price mechanism, then the market for roofing services will shrink as well. In such cases the SUTVA might be violated even when the control group is taken from a different sector.

The share of labor costs ranges from high levels in CC, NC and PV to fairly moderate ones as in RS. Moreover, the sectors under investigation are partly declining ones (PV, MC) or strongly growing such as NC.

4.3 The bite of the minimum wage

An important aspect for minimum wage analysis is the level of productivity and wages as well as the remuneration structure before a wage floor was introduced. Of course, a wage floor of, say, 8 € can be expected to have a completely different impact in an industry where the bottom decile of the wage distribution is 5 € or 7.5 €, respectively. An indicator for the bite of the minimum wage is the magnitude of the wage floor relative to the sector's median wage, the so-called Kaitz index.[1]

Table 2 shows that the Kaitz index—although being not available for all minimum wage industries—differs widely. At the time of introduction of the minimum wage, the Kaitz index was below 60 percent in PV in West Germany, but almost 100 percent for skilled workers in the same industry in the East. All in all, the minimum wage bites harder in the East than in the West. In international comparison, the Kaitz index is at high or even extremely high levels in the minimum wage sectors considered here.

A further interesting measure is the share of workers and firms affected by the wage floor. Again, the relative number of firms and workers affected seems to be higher in the East. In the WR (IL) case, for instance, only 15 (28) percent of firms are affected in the West, but 42 (67, respectively) in the East. An especially high share of affected firms can be found in the CC sector where on average 78 percent of firms are in the treatment group. Almost 50 percent of the firms in this sector employ minimum wage workers only.

4.4 What can be learned from the present studies?

A first result of the studies is that the minimum wage in all the sectors under investigation is binding in both parts of the country, although the bite seems to be harder in the East. The econometric estimates give overwhelming evidence for the positive wage growth effects of the minimum wage for those who are affected.

A second important finding is that—despite the comparatively high level of the minimum wage as indicated by the Kaitz index—the evidence does not support strong disemployment effects. Except for the Roofing Sector in both parts of the country and perhaps the Main Construction Sector in the East (which—also in the light of previous findings—partly yields ambiguous results), there is no indication that the wage floor in the seven sectors under investigation led to job losses in Germany (see Table 2). Note that in the East, the Kaitz index is extraordinarily high in both cases.

All in all, from a pure neoclassical point of view the findings are clearly at odds with expectations, but roughly in line with the view that there are important imperfections in the labor market. Hence the competitive market paradigm does not appear to be a suitable description of labor market responses to a wage floor. At the same time, it would be too hasty to interpret the evidence as "proof" of the monopsonistic view. Some of the studies express some skepticism about that. For instance, the study for the Roofing Sector (Aretz et al. 2012) has questioned the monopsonistic view by pointing to the fact that firms see the current wage as being sufficiently high for the recruitment of new workers. This can be taken as an indication that firms are at the labor demand curve. However, as I have argued in the Introduction, being at the labor demand curve is quite possible even from the monopsonistic viewpoint. Exactly such a situation can be expected if the minimum wage exceeds the competitive equilibrium market level. Given that the Roofing Sector shows the negative employment effects of the wage floor, one might presume that this is the case here. What would be required is not information *ex post*, i.e. after the introduction of a wage floor, but *ex ante*.

A phenomenon that can be neither re-conciliated with the monopsony nor the neoclassical approach is that when the minimum wage bites hard, as in the Roofing or Main Construction sectors in the East, there is clear evidence that the wage distribution is compressed not only from below but also from above. A possible explanation for this is that in a situation where the wage floor is close to the median wage it serves more and more as a reference point for the "going" wage. The wage floor then defines the standard of pay. As indicated in the firms' and workers' surveys, such a compression is prone to criticism from both sides. Both firms and workers complain about too little differentiation and a lack of incentives for higher motivation and good work.

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[1]The information content of the Kaitz index is limited since in some industries the wage distribution was initially more compressed than in others. A superior measure would be the increase in the total wage bill required to comply to the minimum wage as used by Machin et al. (2003), among others.

Table 2 Level of minimum wage, treated firms and workers and wage and employment effects

	Industry						
	Waste removal (WR)	Industrial Laundries (IL)	Commercial Cleaning Industry (CC)	Nursing Care Sector (NC)	Painters and Varnishers (PV)	Roofing Sector (RS)	Main Construction (MC)
West							
Level I (Kaitz-Index)	8.02 €	7.51 €	7.87 €	8.50 € (Kaitz: 67–69 %)	7.69 € (Kaitz: 59.5)	8.20 € (Kaitz: 65.2)	8.69 € (Kaitz: 64)
Level II (Kaitz-Index)			10.43 €		10.53 € (Kaitz: 76.1)		
Treated workers I (II)	n.a.	n.a.	n.a.	9/10 %	4.2 % (4.8 %)	3.9 %	4.0 %
Treated firms	15 %	28 %	78 %	n.a.	n.a.	n.a.	27 %
Wage effect	n.a.	n.a. +	+	++	Not sign.	Not sign. (+)	+
Employment effect (econometric)	Not sign.			Not sign.	Not sign.	+1.5 (DiD); −6.0 (DiDiD)	Not sign.
Firms reporting disemployment effects	n.a.	21 %	n.a.	n.a.	n.a.	n.a.	n.a.
East							
Level I (Kaitz-Index)	8.02 €	6.36 €	6.36 €	7.50 € (Kaitz: 73–81 %)	7.00 € (Kaitz: 73.3)	7.70 € (Kaitz: 82.2)	8.00 € (Kaitz: 85)
Level II (Kaitz-Index)			7.83–8.06 €		9.20 € (Kaitz: 97.6)		
Treated workers I (II)	6 %	n.a.	n.a.	28/18 %	7.8 % (48.9 %)	13.1 %	24.0 %
Treated firms	42 %	67 %	See West	n.a.	n.a.	n.a.	71 %
Wage effect	n.a.	West +	n.a.	++	++ (II)	++	++
Employment effect (econometric)	Not sign.		See West	Not sign.	Not sign.	−0.7 (DiD); −2.8 (DiDiD)	Ambiguous, not sign.
Firms reporting disemployment effects	n.a.	21 %	n.a.	n.a.	n.a.	n.a.	n.a.

Notes: In CC the analysis provides no differentiation between East and West; level I (II): minimum wage for low-skilled and skilled workers at introduction

Source: Author's compilation

5 Conclusions

The present studies on minimum wage sectors in Germany offer a wealth of information. Minimum wage research has made substantial progress. Empirical minimum wage studies in Germany are catching up to international standards. However, certain weaknesses have to be mentioned. The data situation in some sectors is not satisfactory. Of course, the insights that can be obtained without micro data evidence are fairly limited. Hence the analysis for the sectors WR, IL, NC should be based on econometric estimates when sufficient information is available in the administrative data sets.

Moreover, the "philosopher's stone" has not been found with respect to the choice of the control group. In general, there is a fundamental tradeoff: Defining the control group in a different sector of the economy almost surely violates the CTA, whereas defining the control group in the same sector almost surely violates the SUTVA. Given that no reliable tests are possible because the counterfactual cannot be observed, more evidence is needed in order to check the robustness of results. It should be clear that even if a placebo test does not fail, this is not a guarantee that the research design is correct. Hence a general *caveat* is in order.

There are several routes for further research. First, not only the research design but also the specification of the estimation models using micro data should be re-considered thoroughly. For example, there is some indication of a significant regressions-to-the-mean phenomenon in individual earnings. This should be considered in the specification. Second, our empirical knowledge of the validity of spillover effects as well as of substitutability and complementarity of workers in different positions of the wage hierarchy should be improved. Third, the issue of measurement errors should be taken more seriously. This concerns not only survey data but also administrative micro data. For example, we should find out more about the effects of the fuzziness in the identification of treatment and control groups. Perhaps it would be a promising idea to consider different forms of measurement errors explicitly in the specification of the model. Fourth, we need more direct evidence on the validity of the opposing paradigms of the labor market. A fruitful research agenda would be to understand *why* firms respond to a market intervention like a wage floor in a specific way. Crucial for this is to find better evidence on the magnitude of labor market imperfections. For instance, we need reliable indicators of the relative market power of firms and workers in different segments of the labor market. It would then be possible to shed some light on the validity of the opposing paradigms.

Executive summary

In contrast to most OECD countries there is no general statutory minimum wage in Germany. According to the Workers Posting Law, however, a wage floor exists for a number of industries. The crucial question is which impacts on wages, employment and other outcome variables are caused by such interventions on the labor market.

From a theoretical point of view two approaches can be derived that make contradictory predictions especially on the employment effects of a binding minimum wage. These two approaches basically differ in their perception of the functioning of the labor market. If—as suggested in the neoclassical perspective—the labor market can be described as a perfectly competitive market then each political intervention into market mechanisms would automatically lead to job losses. If however, market power of employers comes into play, no unambiguous effects can be determined. In contrast to the canonical monopsony model—where a single company dominates the local labor market—more recent approaches assume monopsonistic competition. Here, the market power of a firm is explained by asymmetric information, transaction costs or the exploitation of idiosyncratic preferences.

Since the effects of a minimum wage are depending on a bunch of factors and are by no means determined theoretically in an unambiguous way, empirical analysis is required. German studies on the effects of minimum wages in the past often did not meet international methodological standards. Calculations based only on the wage elasticity of labor demand are barely objective since they start from the untested assumption of the neoclassical model. Experiences from other countries suggest that such an approach typically leads to completely unrealistic propositions on the disemployment effects of a minimum wage. Similarly, demand-oriented macro models that a priori exclude any disemployment effects of a wage floor are untenable as well.

International minimum wage research today is typically based on micro data analysis. Hereby the development of economic variables before and after the introduction of a minimum wage for a treatment group is compared to that of a control group (difference-in-difference approach). Mainly considered are wages and employment retention probability. Under certain assumptions it is possible to identify the causal effect of a minimum wage on the outcome variables.

A corresponding method is applied in a series of recent German studies aiming at the evaluation of the introduction of the minimum wage in a number of industrial branches. Through these studies minimum wage research in Germany has made substantial progress and caught up to standards of the international literature.

However, there are still open methodological questions concerning the fulfillment of the assumptions of the difference-in-difference approach. In this context especially the assumptions of "common trends" (CT) and of a "stable unit treatment value" (SUTV) are to be emphasized. The former implies that the economic development of the treatment group without the treatment would have paralleled that

of the control group. The latter states that the control group is not at all influenced by the treatment. In realistic settings, these assumptions are more or less violated. Unfortunately there is a tradeoff: If on the one hand the control group is chosen from the same industry, then a violation of the SUTV assumption is to be feared. If, on the other hand, the control group is taken from a further industry, then the the CA assumption is called into question. Although the mentioned studies have thoroughly carried out a number of alternative estimates and robustness checks, some questions remain.

As a central finding from the existing minimum wage studies in Germany is that the employment effects as predicted by the neoclassical model of perfect competition are hard to find. By contrast, wage effects can be identified in most studies, especially in the eastern part of Germany. In general, this result supports the relevance of the model with monopsonistic competition. To strengthen this statement deeper analyses are required that focus on the mechanisms of market power. Here is an open field for future research.

Kurzfassung

Im Unterschied zu den meisten anderen OECD-Ländern existiert in Deutschland kein allgemeiner gesetzlicher Mindestlohn. Allerdings sind im Rahmen des Entsendegesetzes in bestimmten Branchen Mindestlöhne eingeführt worden. Die entscheidende Frage ist, welche Wirkungen auf Löhne und Beschäftigung sowie weitere ökonomische Variablen von diesem Markteingriff ausgehen. Aus theoretischer Sicht gibt es zwei Ansätze, die zu widerstreitenden Aussagen insbesondere über die Beschäftigungswirkungen eines bindenden Mindestlohnes führen. Diese Ansätze haben unterschiedliche Prämissen, was die Funktionsweise des Arbeitsmarktes betrifft. Lässt sich dieser wie in der neoklassischen Perspektive als Wettbewerbsmarkt beschreiben, so muss jeder Markteingriff zwangsläufig zu Jobverlusten führen. Kommt hingegen Marktmacht der Arbeitgeber ins Spiel, so lassen sich keine eindeutigen Effekte auf die Beschäftigung bestimmen. Im Unterschied zum traditionellen Monopsonmodell (eine Firma beherrscht einen lokalen Arbeitsmarkt) gehen modernere Ansätze von monopsonistischer Konkurrenz aus. Demnach lässt sich die Marktmacht der Firma über asymmetrische Information, Such- und Transportkosten oder über die Ausnutzung idiosynkratischer Präferenzen der Marktteilnehmer erklären.

Da die Auswirkungen eines Mindestlohns von einer Vielzahl von Faktoren abhängen und theoretisch keineswegs eindeutig bestimmt sind, bedarf es einer empirischen Analyse. Deutsche Untersuchungen über Mindestlohneffekte entsprachen in der Vergangenheit oft nicht den internationalen methodischen Standards. So sind Berechnungen, die allein auf einer Schätzung der Lohnelastizität der Arbeitsnachfragefunktion beruhen, nicht objektiv, da sie ungeprüft die Gültigkeit des neoklassischen Wettbewerbsmodells unterstellen. Erfahrungen aus anderen Ländern zeigen, dass dieser Ansatz zu vollkommen unrealistischen Aussagen über die Beschäftigungswirkungen eines Mindestlohns führt. Ebenso unhaltbar sind nachfrageorientierte Makromodelle, die von vornherein eine negative Beschäftigungswirkung einer Lohnuntergrenze ausschließen.

Mittlerweile beruhen die Analysen der internationalen Mindestlohnforschung auf Mikrodaten. Dabei wird die Entwicklung von ökonomischen Variablen vor und nach Einführung eines Mindestlohns für eine Gruppe von Betroffenen mit der einer Kontrollgruppe verglichen (Differenz-von-Differenzen-Ansatz). Im Fokus stehen vor allem die Löhne sowie die Wahrscheinlichkeit einer Weiterbeschäftigung. Unter bestimmten Annahmen lässt sich dann der kausale Effekt des Mindestlohns auf die Ergebnisvariablen identifizieren.

Diese Methode wurde in einer Reihe von neueren deutschen Studien verwendet, die sich der Evaluation der Mindestlohneinführung widmen. Die Mindestlohnforschung in Deutschland hat damit große Fortschritte gemacht und Anschluss an die internationalen Standards gefunden. Der wissenschaftliche Diskurs sollte hier anknüpfen.

Allerdings bleiben einige methodische Fragen, die sich darauf beziehen, inwieweit die Voraussetzungen des Differenz-in-Differenzen-Ansatzes erfüllt sind. Dabei sind vor allem die Annahme von sogenannten „common trends" (CT) sowie die Annahme des „stable unit treatment value" (SUTV) zu nennen. Die erste Annahme impliziert, dass die ökonomische Entwicklung von Betroffenen und Kontrollpersonen ohne Mindestlohn den gleichen Trends gefolgt wäre. Der zweiten Annahme zufolge wird die Kontrollgruppe durch den Mindestlohn nicht beeinflusst. Diese Annahmen sind in der Realität mehr oder weniger stark verletzt. Dabei besteht ein Zielkonflikt: Wird die Kontrollgruppe in der gleichen Branche gesucht, besteht die Gefahr, gegen die SUTV-Annahme zu verstoßen. Wird hingegen die Kontrollgruppe aus einer anderen Branche gewählt, ist es wahrscheinlich, dass die CT-Annahme verletzt ist. Obwohl in den genannten Studien sorgfältige Alternativrechnungen vorgenommen wurden und die Robustheit der Ergebnisse geprüft wurde, verbleiben einige Unsicherheiten.

Als wesentliches Ergebnis aus den bisher vorliegenden Mindestlohnstudien für Deutschland folgt: Die von einem neoklassischen Wettbewerbsmodell des Arbeitsmarktes vorausgesagten Beschäftigungsverluste durch einen Mindestlohn sind weitgehend ausgeblieben. Insbesondere in Ostdeutschland lassen sich hingegen deutliche Effekte der Lohnuntergrenze auf die Lohnverteilung nachweisen. Grundsätzlich könnte dieser Befund für die Relevanz eines Modells des monopsonistischen Wettbewerbs sprechen. Um

diese Aussage zu erhärten, wäre es allerdings erforderlich, die Mechanismen von Marktmacht am Arbeitsmarkt eingehender zu untersuchen. Hier sollte ein Ansatzpunkt für zukünftige Forschung liegen.

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