The economic effects of a federal minimum wage in Germany

Empirical studies on its consequences for earnings, income, and employment

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Introduction

Motivation – the minimum wage in German economic policy

In 2013 Germany is among only 7 out of 27 EU member states that do not have a federal minimum wage (Funk and Lesch, 2006; Immervoll, 2007a; Schulten, 2012).[1] A lower wage threshold has always had a legal basis in the German Cicil Code (BGB): Wages below a certain threshold are considered ‘immoral’ (‘sittenwidrig’) and are therefore illegal (§138, 1 BGB). According to settled case-law a violation of moral principles is given when the payment for any work performance is obviously inadequate, or when a wage or salary is more than 30% below the local custom pay. Moreover, the German social security system provides basic income support in the form of unemployment benefits, social assistance, and additional transfers such as housing subsidies. From a worker’s perspective these transfers define an implicit minimum wage.

The debate about the minimum wage has intensified over the last 15 years instigating minimum wage legislation at the sectoral level. The first minimum wage in the main construction sector was introduced on 1 January 1997. Since then a number of additional sectoral minima have been established in the electrical trade (june 1997, re-introduced september 2007), the roofing sector (october 1997), among painters and varnishers (october 2003), the commercial cleaning industry (july 2007), industrial laundries (october 2009), waste removal services (january 2010), the nursing care sector (august 2010), the security industry (june 2011), temporary work agencies (january 2012), and lastly vocational training and development services (au-

[1] The others include Austria, Denmark, Italy, Cyprus, Finland, and Sweden.

gust 2012). The statutory basis is the German Posted Workers Act (Arbeitnehmer-Entsendegesetz) under which collectively agreed wages can be declared generally binding for all employees covered in a sector. This involves decisions by the committee of collective bargaining parties (Tarifausschuss) made up of employee and employer representatives and ultimately by the Federal Ministry of Labor.

Political positions have also changed over time. The Leftist Party, the Green Party, and the Social Democrats have demanded a statutory minimum wage for several years (Bundestag, 2011a,b,c; Bundesrat, 2013). For a long period a staunch opponent of minimum wages, the Christian Demoractic Party (CDU) has amended its program and agreed upon sectoral minima (CDU, 2011). Even the social-liberal wing of the market-oriented Liberal Party has opened up to the idea of additional sectoral minimum wages.

Since 2004 the union's umbrella organization DGB and the sevice sector union ver.di have demanded a federal minimum wage (DGB, 2013; Verdi, 2012). They have been joined by the union for metalworkers IG Metall which originally preferred sector-specific regulations. Solely the industrial union for chemical workers rejects a federal minimum wage and pledges for sector-specific regulations. The employers' associations continue to oppose any minimum wage legislation and emphasize the tariff autonomy in Germany (BDA et al., 2008; Raddatz and Wolf, 2007).

The minimum wage has been one of the most frequently discussed topics in German economic policy. Figures from the polling agency *infratest dimap* underline its political salience: between 2008 and 2012 the public support for a statutory minimum wage grew from 55% to about 75% among all voters in the country. The share of proponents among CDU voters increased from 45% to 66%. Therefore the minimum wage figures to remain a hot topic for economic and labor market policy in Germany and has been on the agenda for the federal elections in 2013. The dissertation looks into the economic implications its introduction might imply.

Research questions – the arguments for and against a minimum wage

Several arguments have been brought forward to justify a federal minimum wage. First, the increase of the low wage sector has been attributed to the deregulation of the labor market in Germany in the course of the 'Hartz reforms' 2004. The growth of low wage employment has been confirmed (Brenke, 2006; Bosch, 2007; Kalina and Weinkopf, 2009), but the development started already in the mid-1990s and came to a halt in 2006 (Brenke, 2012). Second, the increase in the overall inequality of gross wage incomes is also attributed to the labor market reforms and cited as motivation for a minimum wage. This trend has started already at the outset of the 1990s (Dustmann et al., 2009; Gernandt and Pfeiffer, 2007; Bosch et al., 2009). The declining importance of unions and collective bargaining is often argued to be a main driver of this development, although the empirical literature has so far not confirmed this (Antonczyk et al., 2010a). A minimum wage is to compensate the erosion of wage bargaining institutions. Third, it is argued that the incidence of poverty among working households and the increasing share of employees receiving top-up benefits could be tackled by a minimum wage. Fourth, the increase in inequality of disposable household incomes in Germany (Biewen and Juhasz, 2012; Grabka and Kuhn, 2012; Faik, 2012) serves as argument to introduce a federal minimum wage. Fifth, it is claimed that a minimum wage is fiscally desireable as it increases revenues from taxes and social security contributions (Ehrentraut et al., 2011; see Bauer et al., 2009 for a critical view).

The main counter-argument against a federal minimum wage are its potentially negative consequences for employment (see Neumark and Wascher, 2008 for an overview). The academic debate about the pros and cons of a statutory minimum in Germany[2] was spurred by studies on the employment effects of the minimum wage. Ragnitz and Thum (2007a, 2008) published the first, highly stylized and aggregated simulation study that implied very large employment losses of a federal minimum.

[2] An overview over the opinions is given in *ifo schnelldienst 61(06), 2008*, see also Franz (2007), Fitzenberger (2009a), Bispinck and Schulten (2008), Bosch and Weinkopf (2006), Bosch et al. (2009), Brenke (2006), Brenke and Eichhorst (2007).

König and Möller (2008a, 2009) provided the first micro-level evaluation of the employment effects of the minimum wage in the main construction sector. Both studies were harshly criticized for their methodology and interpretation of their findings. As a result various empirical simulation and evaluation papers have replicated, refined, and extended these studies.

The dissertation fits into this empirical literature on the economic effects of a federal minimum wage in Germany. The research questions are related to the arguments and issues that have been brought forward in the policy debate and that have been addressed in the economic literature on minimum wages:

- How would a federal minimum wage affect the distribution of gross wages? Which individuals would be particularly affected by its introduction?
- Does a general minimum wage induce a significant change in the distribution of disposable household incomes when the economic agents do not adjust their behavior? Will it reduce poverty and/or overall income inequality?
- How would a minimum wage affect the behavior of economic agents?
- Do labor supply and demand adapt after the introduction of a minimum wage? What will be the likely effects on total employment?
- Where does the large variation in the results of published simulation studies on the employment effects of a minimum wage come from?
- Did the introduction of the sectoral minimum wage in the main construction trade in 1997 have an impact on employment?
- Which consequences has the minimum for prices of consumption goods? How will households react, do they adapt their consumption behavior?
- Do behavioral changes at different margins modify the distributional effects of the minimum wage on disposable incomes? Is the minimum wage an effective instrument for income redistribution?
- How effective would different types of wage subsidies be when a statutory minimum is in place?

We tackle these questions empirically using various micro-datasets based on survey and administrative information. The disseration employs microsimulation and microeconometric techniques that are grounded in structural models of the labor market. The contributions to the literature are detailed in a brief dicussion of the individual chapters in the following sub-section.

Contributions to the literature – the economic consequences of a minimum wage

The neoclassical model of the labor market predicts a negative effect of a minimum wage on employment when its level is fixed above the market-clearing marginal product of labor. Early empirical studies supported this view (Brown, 1999). In the so-called 'new minimum wage research' (Card and Krueger, 1995; Neumark and Wascher, 2008) this assertion was challenged and (complementary) alternative models were provided to explain zero or even positive employment effects of the minimum wage. Manning (2003a,b, 2011) describes different constellations of monopsonistic competition in the labor market that leads to market power for employers and market wages below the marginal product. When the minimum is set between those points, it may increase employment. In search and matching models substantive explanations for monopsonistic competition are formally derived, e.g. search frictions, specific human capital, or match-specific capital (Lang and Kahn, 1998; Flinn, 2006; Ahn et al., 2011). Efficiency wage models provide an alternative rationale (Rebitzer and Taylor, 1995). As a result, the employment effects of a minimum wage have to be determined empirically. They depend on the market structure and the level of the minimum in relation to the wage distribution.

The empirical literature cannot be discussed adequately at this point (see Neumark and Wascher, 2008 and the individual chapters). In a nutshell, the 'first generation studies' are either based on time-series analyses of macro data, or panel information at the regional level. However, the identification in these studies has been challenged. The subsequent 'new minimum wage research' relied on natural experiments in specific sectors or regions and employs difference-in-difference estimation. The external validity for the rest of the economy is the primal concern here. Recent papers try to combine the strengths of both approaches (Dube et al., 2010).

No clear pattern of findings with regard to the employment effects has emerged from the empirical literature. The consensus is that the effects have to be determined for a given institutional setting, market structure and minimum wage level.

For Germany the first studies were ex ante simulations for the whole economy[3] that find negative employment effects ranging from about 100,000 to more than 1 million employees. The second strand of papers consists of ex post evaluations of various sectoral minimum wages that are based on difference-in-difference estimations.[4] Möller (2012) and Bosch and Weinkopf (2012) review those studies and conclude that there is little evidence for negative employment effects.

Comparatively litte research has been devoted to the distributional effects of minimum wages. A number of studies focus on the effects on the shape of the wage distribution.[5] The above-mentioned structural approaches of Flinn (2002) or Ahn et al. (2011) have also implications for the shape of the wage distribution. They analyze the question, whether the observed shape of the distribution provides evidence for disemployment effects, which parts of the distribution are affected, and whether spillover effects to quantiles above the nominal minimum wage occur. Another part of this literature addresses the question how the minimum wage affects the distribution of disposable household incomes and overall inequality.[6] For Germany some papers analyze the incidence of a federal minimum wage (Brenke, 2006; Bosch and Weinkopf, 2006; Kalina and Weinkopf, 2007). Knabe and Schöb (2009) consider its interaction with the tax-and-transfer system.

The dissertation aims to close some of the gaps in the empirical literature for Germany. The first focal point (chapters 1 and 2) is a comprehensive distributional analysis of the effects a federal minimum will have for labor earnings and disposable

[3]See Bauer et al. (2009), Ragnitz and Thum (2007a, 2008), and Knabe and Schöb (2009).

[4]These studies include Apel et al. (2012), Aretz et al. (2012), Bosch et al. (2012), Gürtzgen et al. (2004), and Mesaros and Weinkopf (2012).

[5]See Grossman (1983), DiNardo et al. (1996), Lee (1999), Autor et al. (2010), Dickens and Manning (2004), Stewart (2011), Green and Paarsch (1996), Donald et al. (2000), Neumark et al. (2004).

[6]See Johnson and Browning (1983), Burkhauser and Finegan (1989), Mincy (1990), Burkhauser et al. (1996a), Burkhauser et al. (1996b), Burkhauser and Sabia (2005), Sabia and Burkhauser (2010), Macurdy and McIntyre (2001), Addison and Blackburn (1999), Neumark and Wascher (2002), Neumark et al. (2005), Sabia and Nielsen (2012), Goldberg and Green (1999), Gosling (1996), Freeman (1996), Sutherland (2001).

household incomes. The distributional analysis of net income, the interaction of the minimum wage with the tax and benefit system and the integration of behavioral adjustments at different margins has been largely neglected in the debate. The findings put a number of arguments for the minimum wage into perspective. The depth of the empirical analysis at the micro level and some methodological extensions contribute to the distributional minimum wage literature in general.

The second emphasis of the thesis (chapters 2 through 5) is to complement the existing evaluation literature on the employment effects of minimum wages with structural approaches. These are particularly helpful when information on already implemented sectoral minimum wages is limited (data restrictions, lack of control groups) and the assumptions of the reduced-form evaluation methods are challenged (chapter 4). Moreover, structural models enable ex ante evaluations of the federal minimum wage in combination with other policies (chapter 5).

Chapter 1 analyzes the distributional consequences of the introduction of a nationwide legal minimum wage of 7.50 €/hour on disposable household incomes in Germany. We are especially interested in its effect on the incidence and depth of poverty. Assuming that there are no behavioral adjustments, i.e. no disemployment effects and spill-overs in parts of the wage distribution above the nominal minimum, we simulate the counterfactual wage distribution resulting from a statutory minimum wage and compare it with the observed distribution. We then use a static microsimulation model that translates various components of individual gross incomes into disposable income after taxes and transfers at the household level. A distributional minimum wage analysis of net incomes at the household level is a novelty in the minimum wage literature. We exploit individual and household data from the German Socioeconomic Panel (SOEP). Simulation results show that the minimum wage would be ineffective in reducing poverty, although it leads to a substantial increase in hourly wages at the bottom of the wage distribution. This is an upper bound effect, since potential negative employment effects are ruled out by assumption. The ineffectiveness of the minimum wage in preventing poverty is mainly explained by the existing system of income support – the labor income often substitutes means-tested transfers. Second, people earning low hourly wages do predominantly not live in poor households.

Chapter 2 builds on these first round effects of a statutory minimum wage on net household incomes that are simulated on the basis of a tax-and-transfer microsimulation model. The distributional analysis of chapter one is extended and generalized in various respects. First, we look at the effect of different minimum wage levels on the stated goal to reduce the degree and depth of income inequality among the working population. We systematically compare different scenarios – a low level of 5.00 €/hour, a relatively high level of 8.50 €/hour, and a really high minimum of 10.00 €/hour – that represent the different strands of the political debate sketched above. Second, whereas chapter 1 rules out behavioral adjustments due to the minimum wage, we estimate how individuals, households and firms adapt their behavior. Labor supply, labor demand and consumption effects are considered. These adjustments are directly incorporated into the microsimulation of disposable incomes at the household level. Third, the whole income distribution and overall inequality is analyzed. The microsimulation analysis is based on SOEP data. In addition, we exploit the IAB employment sub-sample for the labor demand estimations and the Continuous Household Budget Survey for Germany for the estimation of the consumption behavior.

A statutory minimum wage would have only a very moderate impact on the distribution of net household incomes and hardly reduce overall inequality. This holds regardless of the minimum wage level. The average gains in net incomes are reduced by half when the effects on labor demand are taken into account. When increases in product prices and the adaption of consumption are also included, these gains are further diminished. As shown in the previous chapter low wage earners are not concentrated at the bottom of the income distribution. Additional labor earnings are often subject to high marginal tax rates because transfer incomes are substituted or the splitting advantage is lost. In addition, the disemployment effects and price increases in consumption goods disproportionately affect low income households.

Chapter 3 considers various published empirical minimum wage studies that simulate employment effects of a federal minimum wage in Germany. We disentangle several factors that explain the variation of these simulation results. Based on data from the SOEP and the German Structure of Earnings Survey (GSES) we conduct robustness analyses that systematically test the range in the outcomes of different labor demand simulations. We find that labor demand effects are sensitive to measurement errors in wages, the representativeness of the sample with respect to several types of labor inputs as well as estimated and assumed labor demand and output price elasticities. Interdependencies of those determinants may lead to substantial differences in simulation outcomes.

Chapter 4 analyzes the sectoral minimum wage in the main construction sector. This study contributes to the evaluation literature for sectoral minimum wages in Germany. Instead of using the common difference-in-difference framework, the employment effects are estimated on the basis of a structural labor demand model. The structural and functional form assumptions allow to identify the effect from a single cross-sectional wage distribution of the GSES data. This data set contains reliable information on working hours and thus a precise measure of hourly wages. The administrative panel data that are used in all other evaluation studies lack this hours information which generates several problems. The methodological contribution of the chapter is to relax functional form assumptions of earlier papers by adopting semi-parametric censored quantile regressions to this framework. According to our results, employment levels would be 4-5% higher without the minimum wage in the East where the minimum bit quite hard. The effect for West Germany is markedly smaller as the minimum was hardly binding. These significantly negative effects are larger than in other evaluation studies. The semi-parametrically estimated structural approach proves to be a useful complement to established panel data or difference-in-difference models when the necessary institutional variation or data base is either not available, or the model assumptions are problematic.

Chapter 5 extends a static labor supply model by taking labor demand constraints into account. Contrary to previous studies we identify rationing not only from exogenous labor demand shocks, but also link the constraints to individual productivity.

The framework consists of a discrete choice labor supply model. Microsimulation is used to calculate net household incomes. A structural wage/productivity equation provides predicted market wages for the non-employed and also allows identifying individual productivity. The rationing risk depends on individual productivity relative to some institutionally given minimum standard of pay (e.g. a sectoral minimum wage) and exogenous demand side variables (e.g. the regional unemployment rate). Estimating the equations jointly allows us to also model unobserved individual characteristics that influence labor supply and rationing at the same time. We use data from the SOEP, the dataset "Indicators and Maps on the Spatial Development" for the regional labor demand variables, and the GSES data to approximate minimum standards for pay.

We show that the elasticities are biased in the unconstrained model. Therefore the labor supply adjustments estimated by a pure labor supply model will not be informative for a rationed labor market. Participation elasticities are uniformly upward biased whereas for hours elasticities the bias for men is positive and for women in West Germany negative. The extended labor supply model is suited to analyze labor supply and demand reactions to the introduction of a federal minimum wage in a coherent framework. We predict significant negative participation effects which are larger in East than in West Germany and also more negative for women compared to men. The loss in total working hours would be smaller, as people remaining employed expand their working hours. Reductions in the volume of employment might thus be relatively moderate. Nevertheless we showed that jobs from low-productive people might be substituted by more productive labor. The constrained model also made a comparison of different wage subsidies under a statutory minimum possible. While employee-oriented subsidies would be largely ineffective, subsidies paid to employers and targeted at low-productive workers could nearly offset the negative effects of a federal minimum wage on participation.

In the *conclusions* the different anlyses are related, the findings of the individual chapters are synthesized, and the policy implications and contributions to the literature are discussed. First, this disseration provides a detailed distributional analysis of the minimum wage. Although a federal minimum would substantially change the distribution of labor earnings, it neither decreases poverty nor overall income inequality. The minimum wage is no instrument for income redistribution. Second, although employment losses would not be as high as predicted by some simulation studies, the perception that a minimum wage would come at basically no cost is refuted in several respects. The ex-post evaluation of the sectoral minimum in the construction sector reveals a more negative picture for employment. The detrimental consequences of the minimum wage are heterogeneous and affect particularly low-productive people that also earn very low wages. Even if employment levels are hardly reduced, it is likely that low productive labor will be substituted. Adjustments at other margins, e.g. consumer prices, also disproportionately concern low-income households.

In contrast to the bulk of the empirical minimum wage literature the analyses of this disseratation are mostly based on structural models of the labor market. This enables an ex ante evaluation of the federal minimum wage. We show how structural assumptions may help when the preconditions for a standard evaluation design are not given. Except for the sectoral analysis the scope is always the German economy as a whole. The analysis is carried out at the micro level of individuals and households. We illustrate heterogeneous effects and potential trade-offs. An emphasis is put on the distributional dimension which is neglected in the literature and the public debate. On the other hand, we aim to get closer to equilibrium effects, e.g. adjustments at different margins and the interaction of labor supply and demand.

Chapter 1

Would a Legal Minimum Wage Reduce Poverty? A Microsumulation Study for Germany†

1.1 Introduction

Germany is one of the few OECD countries where no general legal minimum wage currently exists (Immervoll, 2007b). However, in view of increasing income poverty, the introduction of a legal minimum wage has recently become an important policy issue in Germany. An important argument in the policy debate is that earnings of anyone working full-time should be sufficient to cover at least the means-tested social minimum. In this view, a minimum wage is a means to prevent poverty among the working poor, which can only be achieved by a statutory nationwide minimum wage. Proponents of this approach, including the governing Social Democratic Party and the unions, have suggested a legal minimum wage of 7.50 €/hour. It is this latter view on which we focus in this paper. In particular, we will investigate whether the suggested legal minimum wage would achieve the stated goal to reduce the de-gree and depth of poverty among the working population.

Whereas there is an extensive literature on the employment effects of minimum

†This chapter is based on joint work with Viktor Steiner from Free University Berlin, see Müller and Steiner (2009).

wages (see, e.g., Brown 1999; Neumark and Wascher 2008, there has been little research on the important policy question to what extent minimum wages may serve as a policy instrument to reduce income poverty.[7] In particular, the differential impact of the minimum wage on poverty among families has hitherto been given little attention in the literature. In order to comprehensively analyze the potential income effects of minimum wages, the composition of households and the interplay of minimum wages and the tax-benefit system have to be taken into account. Those studies, which mostly deal with the US, have shown that only a small fraction of poor families includes workers that are employed at the minimum wage. Poor households often do not work at all or have only a single wage earner with the spouse caring for children. Therefore, a change of minimum wages is only weakly or not at all related to household in-come and has no significant effect on the reduction of poverty.

In this paper we analyze whether a legal minimum wage would affect poverty in a country like Germany where a comprehensive system of means-tested income support to prevent poverty is already in place. As an example, we analyze the introduction of a nationwide minimum wage of 7.50 €/hour which is currently on the policy agenda in Germany. To move from changes in hourly wages induced by the introduction of a minimum wage to changes in net household incomes, we apply a microsimulation model based on the German Socioeconomic Panel. This model accounts for the complexity of the German tax-benefits system, in particular various means-tested income-support schemes, exemptions of very low earnings from social security contributions, and the joint income taxation of married couples which impose relatively high marginal tax rates on secondary earners. Simulation results show that the proposed minimum wage would have little impact on the incidence and depth of poverty among households with at least one low-wage worker, even if it led to a substantial increase in hourly wages at the bottom of the wage distribution and had no negative employment effects. To a large extent, the ineffectiveness of a

[7] This literature includes Johnson and Browning (1983), Burkhauser et al. (1996b), Burkhauser and Sabia (2005), Bluestone and Ghilarducci (1996), Macurdy and McIntyre (2001), Neumark and Wascher (1997, 2000), Neumark (2008) for the US; Goldberg and Green (1999) for Canada; Gosling (1996) and Sutherland (2001) for the UK. OECD (1998) and Brown (1999) summarize the older literature.

minimum wage to increase net household incomes of the working poor to raise them above the poverty line and to reduce the depth of poverty in the poor population can be explained by the system of means-tested income support already existing in Germany.

In the next section, we provide the reader with some relevant information on the evolution of the income poverty in Germany and the relationship between low wages, means-tested income support and household incomes. Section 1.3 describes our methodological approach to estimate minimum wage effects on poverty. Simulation results on the effects of the introduction of a minimum wage on the wage as well as the income distribution and on poverty are presented and discussed in Section 1.4. Section 1.5 summarizes our main results and concludes.

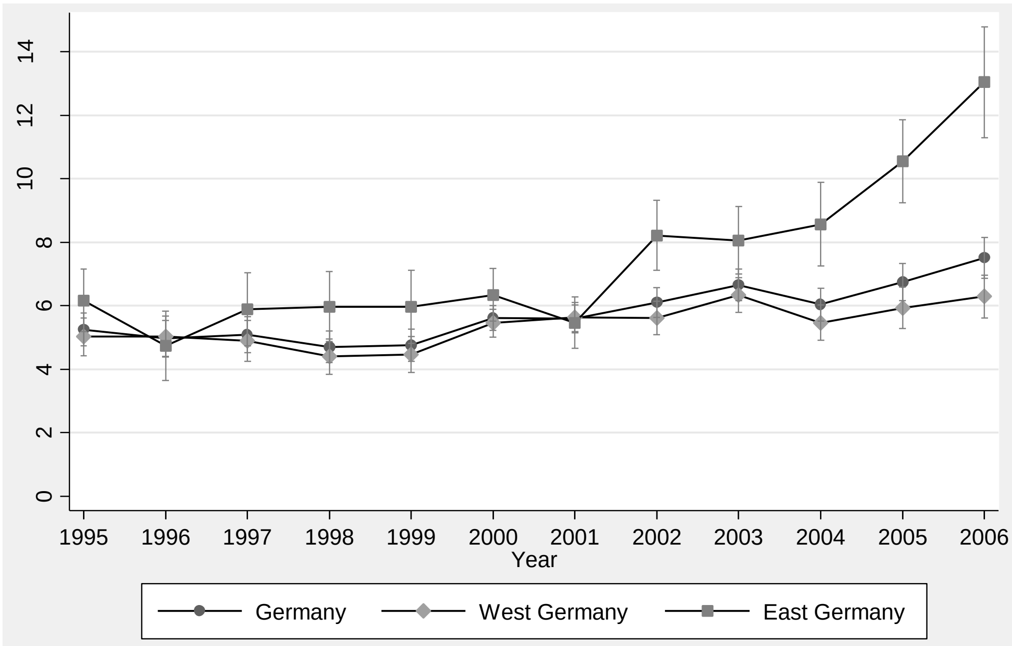
1.2 Institutional Background

Policy proposals to introduce a legal minimum wage in Germany are often made with reference to the alleged increase in poverty among the working poor associated with an expanding low-wage sector and increasing wage inequality. These developments are often said to have especially affected people in East Germany due to the still much higher unemployment and weak union coverage prevailing in the east. Figure 1 plots the poverty rate, i.e. the share of the working population with an equivalent net income of less than half the median, which is taken as the common poverty line for both regions here.[8] Measured this way, the poverty line amounts to about 650 € per month in 2008. Whilst the poverty rate has been increasing both in West and East Germany in the observation period, this increase has been very dramatic in East Germany where it has more than doubled, from about 6% in 1995 to about 13% in 2006. As the 95%-confidence bands in the graph indicate this increase is statistically significant. In contrast, in West Germany the slight increase in the poverty rate in the 1990's did not continue in recent years, as the indicator has remained constant at about 6%. Poverty has thus become a severe problem, especially in East Germany

[8] The new OECD scale has been used for the calculation of equivalent income which gives a factor of 1 to the head of household, of 0.5 to each adult person and of 0.3 to each child. For a discussion on the measurement of the poverty rate, see Section 1.3.

since the year 2001.

Figure 1.1: Poverty rate (in %), Germany total and by region, 1995-2006



Notes: The poverty rate (PR) is measured as the share of people (in %) with an equivalent income < 0.5 of the median, where this poverty line is assumed the same in East and West Germany. Equivalent income is based on the new OECD scale. The self-employed are not included without imposing further restrictions on the sample. Since retrospective information on income is used, incomes on the basis of a SOEP wave for a given year refer to the previous calendar year. Weighted estimates using household SOEP sampling weights. Vertical lines indicate 95%-confidence bands.
Source: Own calculations based on SOEP, waves 1996-2007.

In the current economic policy debate the increase in the poverty rate has been referred to as an argument for the introduction of a minimum wage. In particular, its proponents argue that earnings of anyone working full-time should be sufficient to at least cover the means-tested social minimum. In this view, a minimum wage is a means to prevent poverty among the working poor, which can only be achieved by a statutory nationwide minimum wage. However, this view does not take into account that low hourly individual wages need not translate into low household income due to the existing system of means-tested income support and the distribution of low wage earners among households. The German transfer system is characterized by a high 'social minimum' relative to net in-work income of low qualified people and benefit-withdrawal rates close to 100%. It includes a basic rate for each family member, which depends on the age of children, and a maximum amount for housing costs also depending on family size. Since 2005, the social minimum defines the amount of means-tested unemployment benefits (UB II) for people deemed 'employable' by the labor agency.[9] People not fulfilling this criterion receive 'social assistance' ('*Sozialgeld*') which is also means-tested and paid at similar amounts as UB II.

Table 1.1: Means-tested unemployment benefits, the 'implicit minimum wage', and its relation to average hourly wages in the 1st decile of the wage distribution and a minimum wage of 7.50 € / hour, 2008

	West Germany				**East Germany**			
	UB II	Implicit MW	Wage ratio 2008	MW	UB II	Implicit MW	Wage ratio 2008	MW
	€/month	€/hour	%	%	€/month	€/hour	%	%
Single women								
no children	601.42	4.81	89.60	64.15	563.63	4.51	81.83	60.12
1 child, < 7 years	1015.17	6.89	128.29	91.86	1,010.13	6.85	124.30	91.32
Couples (men working)								
no children	959.17	7.67	100.70	102.31	954.13	7.63	138.53	101.77
1 child, < 7 years	1198.62	8.36	109.67	111.43	1,161.45	8.06	146.27	107.46
2 children, 13 years	1,447.95	9.12	119.68	121.59	1,408.98	8.81	159.85	117.44

Notes: It is assumed that the household is eligible to UB II and that, in couple households, only one person would work full-time, i.e. 150 hours per month. Regular UB II benefits according to § 20 SGB II (Sozialgesetzbuch II) include subsidized housing costs (including heating) which are borne up to certain maximum amounts, depending on the number of people living in the household; instead of these maximum amounts we use average housing costs for UB II recipients and heating costs differentiated by size of household as derived from the SOEP data here.
Implicit MW = ([UB II - child benefit] / 150) × 1.2, including the employee's share of social security contributions of 20%, but no income tax paid and no transfers other than the child benefit which depends on the number and age of children. UB II is means-tested unemployment benefit which varies by number of household members and age of children.
Wage ratio = (implicit MW / wage) × 100, where wage is either the average hourly wage in the bottom decile of the 2008 wage distribution, or the proposed minimum wage of 7.50 €/hour. The average hourly wage in 2008 is taken from Table 1.2 in Section 1.4 (men west = 7.62 €/hour, men east = 6.27 €/hour, women west = 5.37 €/hour, women east = 5.51 €/hour).
Source: Own calculations based on data from SOEP/STSM.

Table 1.1 shows average amounts of UB II for various types of households.[10] For a single person the monthly UB II amount is quite close to the poverty line defined above. As Table 1.1 also illustrates, for people entitled to UB II the hourly wage which would yield the same net income in a full-time job may well come close to or even exceed the current wage in the low-wage sector. The *implicit* minimum wage, given by UB II levels for different household types (see the note to Table 1.1 for an

[9] 'Employability' is defined as the ability to work at least 3 hours a day and thus only excludes persons with severe physical and mental disabilities.

[10] The standard rate of UB II is derived from consumption expenditures of low income households observed in the Income and Expenditure Survey (EVS) of the Federal Statistical Office conducted every five years. The amounts reported in Table 1.1 differ between East and West Germany because of differences in housing costs.

exact definition), is especially high for one-earner couples with children.[11] A wage ratio exceeding 100% means that net household income of people entitled to means-tested income support would exceed their potential in-work income and they would therefore tend not to work.[12] For one-earner couples and for single women with at least one child, this wage ratio exceeds 100%. This wage gap is particularly large in East Germany where it is close to 200% for couples with children.[13]

Table 1.1 also reveals that a legal minimum wage of 7.50 €/hour, as recently suggested by the ruling party of Social Democrats and the labor unions, would fall short of the implicit minimum wage for couples, although it would exceed the implicit minimum for singles without children and would roughly be equal to the one for singles with children. Furthermore, these illustrative calculations also show that the minimum wage would not change the wage ratio and hence net household income for couples living in West Germany would essentially remain the same. Although net household income would be substantially higher for couples in East Germany, a minimum wage of 7.50 €/hour would still not be sufficient to raise net household income in full-time employment above the level of the means-tested unemployment benefit. Thus, to prevent families with children with one low-wage worker to become eligible for means-tested income support, the minimum wage would have to be set at a considerably higher level than the proposed 7.50 €/hour, perhaps as high as 10 €/hour for families with more than one child.

Although these illustrative calculations do indicate that, at least for certain types of households, there might only be a weak link between minimum wages and net household income, they do not account for various important features of the German tax-benefit system. These include income taxation, especially the joint taxation of couples, other means-tested transfers, such as housing benefits, the exemption of 'mini jobs' from social security contributions, and unemployment benefit withdrawal

[11]Given the scarcity of subsidized child care especially in West Germany (Wrohlich, 2011), full-time employment of both spouses is often not an option.

[12]Since take-up of means-tested income support is incomplete, not all eligible people would refrain from working, however. With regard to the incomplete take-up of means-tested income support in Germany see, e.g., Riphahn (2001), or Kayser and Frick (2001).

[13]If maximum rather than average amounts for housing and heating costs were assumed, the wage ratio for one-earner couples in East Germany would be even higher than those reported in Table 1.1 but would differ little in West Germany.

rates below 100%. Furthermore, not all households are entitled to means-tested unemployment benefits, and not all couple households with children consist of only one earner. In the subsequent empirical analysis we will analyze the relationship between the minimum wage, the hourly wage and net household income on the basis of a microsimulation model, as described in the next section.

1.3 Methodology

To analyze minimum wage effects on income poverty we make use of the *microsimulation model STSM* which incorporates all major components of the German tax-benefit system. STSM is based on the Socio-Economic Panel (SOEP) which is a representative sample of households living in Germany with detailed information on household incomes, working hours and household structure.[14] In a first step, we simply substitute the suggested minimum wage of 7.50 €/hour for the hourly gross wage of employed people in our sample if a person's observed wage falls short of the minimum. For each employed person, the gross hourly wage is obtained by dividing reported gross earnings in the month before the interview by the number of hours worked in that month, where paid overtime hours are included.[15] Using SOEP sampling weights, we then compare the observed wage distribution (no minimum wage) and the hypothetical wage distribution conditional on the minimum wage under the assumption of no labor market adjustment. In a second step, the tax-benefit calculator embedded in STSM allows us to compute net household incomes and poverty rates not only under the current wage structure but also for alternative wage structures, such as the one resulting from the introduction of a minimum wage.

Here we follow most previous empirical studies analyzing minimum wage effects

[14]STSM consists of a tax-benefit calculator that computes net household incomes for each sample household on the basis of information on gross incomes, and for different (hypothetical) legislations and different working hours of individuals, and an empirical labor supply model. A detailed description of STSM is contained in Steiner et al. (2008). For more information on the SOEP, see http://www.diw.de/soep.

[15]This hourly wage measure may underestimate the effective hourly wage, for at least two reasons: First, since the majority of people in the SOEP is interviewed in the first three months of the year, fringe benefits are underrepresented. Second, 'paid hours' may partly be paid for in later months, or may be compensated for by working less than normal hours in the future.

on the distribution of household incomes and poverty. Initially we abstract from potential *labor supply and demand adjustments* due to the minimum, as in, e.g., Burkhauser and Sabia (2005). These may be viewed as short-run ('first round') effects. In a further step restrictions on labor demand which are induced by the introduction of the minimum wage are included in the analysis (see (Müller and Steiner, 2010)) yielding distributional effects with behavioral adjustment ('second round' effects). Below we discuss how these employment effects may impact our main results.

The data we use for the following empirical analysis are from the SOEP wave for the year 2007. Since the STSM is based on retrospective information on income components for the computation of net household incomes for a given year, incomes computed on the basis of the SOEP wave from 2007 refer to the year 2006. Since our analysis is focused on the year 2008, we extrapolate incomes to that year on the basis of realized average growth rates for the period 2006-2007 and expected growth rates for 2008.[16] The tax-benefit system is also updated to include all known changes in regulations up to 2008.

Earnings from dependent employment display the most important income component for the vast majority of households. The SOEP also contains information on earnings (and working hours) from a 'secondary job', i.e. a job held in addition to the main job, which we add to wage income for the calculation of net household income. Employees' social security contributions and the income tax are deducted from gross household income and social transfers are added to get net household income. Social transfers include child allowances, child-rearing benefits, educational allowances for students and apprentices, unemployment compensation, the housing allowance, and social assistance. Taxable income is calculated by deducting certain expenses from gross household income.

[16]Since most interviews in the SOEP refer to the first quarter of the year, we have assumed that they will increase with the annual growth rate in that year. Average annual growth rates are derived from the following indices for the years 2007 and 2008: 1.016, 1.016 for consumer prices; 1.020, 1.025 for wages; 1.003, 1.012 for old-age pensions; 1.016, 1.016 for income from rents; and 1.04, 1.04 for income from profits (source: national accounts; BMWi (2007); own calculations). We discuss the sensitivity of our simulation results to the assumptions underlying the forecasting of wages in section 1.4.

An important methodological issue in *poverty measurement* is how to define the income level which draws the poverty line. Here, we define the poverty line to be 50% of median equivalent household income. We use the same poverty line for both East and West Germany, since the means-tested income support for unemployed people also does not, in principle, differentiate between the two regions, except for slight differences in covered housing costs. Equivalent income accounts for household size and is derived by dividing net household income by the new OECD scale (defined in footnote 2 above). We use this scale here because it gives similar weights as the weighting scheme implicit in the German means-tested income support system which defines the legally set 'social minimum'. We use 50% of the median, rather than the more commonly applied 60%, to define the poverty line here, because this corresponds more closely to the social minimum used in the simulations of net household income below.

To measure minimum wage effects on the level and depth of poverty, and also to differentiate these effects between various groups in the population, we use several decomposable poverty measures. Foster et al. (1984) have defined a class of poverty measures given by:

$$P_\alpha = N^{-1} \sum_{i=1}^{n} \left[\left(z - y_i^e \right) / z \right]^\alpha \tag{1.1}$$

where y^e is equivalence income, z is the poverty line, n is the number of people with equivalence income below the poverty line ($y^e < z$), and N is the overall number of people in the population. Depending on the chosen parameter α, several measures found in the literature can be derived:

- for $\alpha = 0$, $P_0 = n/N$, which is the *poverty rate* PR;
- $\alpha = 1$ yields the so called *poverty gap*, PG, with $0 \leq PG \leq PR$;
- for $\alpha = 2$, the poverty measure P_2 results which also accounts for the severity of poverty in the poor population.

PR is simply the ratio of the number of people with (equivalent) income below the poverty line; it is also referred to as the 'head count' measure in the literature.

PG measures the average deviation of the incomes of the poor from the poverty line, expressed relative to the total population, and thus measures the extent to which the population is poor, on average. PG can also be written as the product of the poverty rate and the average deviation of the equivalent income of the poor population from the poverty line, in the literature also called the *income gap ratio*.[17] P_2 also measures the depth of poverty by giving more weight to poor households with incomes further below the poverty line, and thus also factors in income inequality among the poor population measured by the *squared coefficient of variation*.[18]

As shown by Foster, Geer and Thorbecke (1984), the P_2 measure is consistent with standard requirements for poverty indicators introduced by Sen (1976) and discussed more generally by Atkinson (1987),[19] while the PR and the PG are not. However, since these measures, and the PR in particular, are widely used in the policy debate, we will use all three indicators together with the income gap ratio and the squared coefficient of variation to evaluate the impact the introduction of a legal minimum wage would have on poverty in Germany. Another advantage of these poverty measures is that they are additively decomposable by subgroup with population share weights, which allows us to assess the effects of changes of poverty within subgroups, such as differentiated by gender or type of household, on the total change in poverty. We estimate confidence intervals for the population values of all indicators to determine the significance of differences induced by the minimum wage.

[17] $PG = PR \times IGR$, where $IGR = (z - \bar{y}^e)/z$, with $\bar{y}^e = n^{-1} \sum_{i=1}^{n} y_i^e$, is known as the 'income gap ratio', see Sen (1976).

[18] $P_2 = \left(PG^2/PR\right) + \left([PR - PG]^2/PR\right) \times CV_P^2$ with $CV_P^2 \equiv$ squared coefficient of variation of income among the poor population (Foster et al., 1984; Kakwani, 1980).

[19] That means that the 'monotonicity axiom' (a reduction in the income of a poor household must, other things being equal, increase the poverty measure) as well as the 'transfer axiom' (an income transfer from a poor to a richer household must increase the poverty measure) are fulfilled.

1.4 Results

1.4.1 Wage effects on individuals

In Table 1.2 we summarize our results concerning the effects the introduction of a minimum wage of 7.50 €/hour would have on the wages of already employed people in the absence of employment effects. The upper part of the table shows for Germany overall and for various subgroups the average gross hourly wage prevailing in 2008 and the average wage of currently employed people if the minimum was introduced.[20] The numbers in parentheses give, for each group, the absolute and relative differences in these two wage measures. We also report the median and the mean of these two wages.[21] On average, a minimum wage of 7.50 €/hour amounts to about 52% of the median and to 47% of the average gross hourly wage in the German economy.[22] For the median, this share varies between about 43% for men in West Germany and about two third for women in East Germany.

As shown in the lower part of the table 1.2, in Germany overall about 10% of all employees would be affected by the minimum wage. Whilst among men in West Germany only about 4% of all employees would be affected, almost 12% of males in East Germany are currently employed below this minimum. For employed women this share amounts to 13% in West and 19% in East Germany. Except for men in West Germany, all currently employed people in the bottom decile of the wage distribution would be affected by the minimum wage. The minimum wage would disproportionately affect younger employees, those with low qualification, 'marginally' employed people (i.e., those in 'mini jobs'), employees in certain industries, in particular in agriculture and forestry or in the textile and food industry, and those working in

[20]Note that expected wages of currently not employed people would also be affected by the minimum wage and thus also potentially increase labor supply and employment (see sub-section 1.4.4 for a brief discussion).

[21]To account for measurement errors in the hours and wage data, we have excluded wages below 3 €/hour ($< 1\%$ percentile of the raw hourly wage distribution) received in regular employment. We have included hourly wages below 3 €/hour if they refer to supplementary work of people drawing unemployment benefits (see Section 1.2).

[22]People in full-time vocational and apprenticeship training as well as 'secondary jobs', i.e. jobs held in addition to the main job, are excluded here; regarding the latter exclusion restriction see discussion below.

Table 1.2: Wage distribution before and after the introduction of a legal minimum wage of 7.50 €/hour, currently employed people only, 2008

	Total		**Men**				**Women**			
	Germany		West		East		West		East	
	No MW	MW	No MW	MW	No MW	MW	No MW	MW	No MW	MW
1st-10th	6.02	7.50	7.68	8.34	6.28	7.50	5.44	7.50	5.52	7.50
percentile		(1.48; 24.58)		(0.66; 8.59)		(1.22; 19.43)		(2.06; 37.87)		(1.98; 35.87)
1st-5th	5.09	7.50	6.26	7.56	5.73	7.50	4.60	7.50	4.57	7.50
percentile		(2.41; 47.35)		(1.30; 20.77)		(1.77; 30.89)		(2.90; 63.04)		(2.93; 64.11)
6th-10th	6.98	7.50	9.12	9.12	6.89	7.50	6.27	7.50	6.47	7.50
percentile		(0.52; 7.45)		(0.00; 0.00)		(0.61; 8.85)		(1.23; 19.62)		(1.09; 17.00)
11th-15th	8.12	8.12	10.81	10.81	7.76	7.80	7.52	7.65	6.99	7.50
percentile		(0.00; 0.00)		(0.00; 0.00)		(0.04; 0.52)		(0.13; 1.73)		(0.51; 7.30)
16th-25th	9.62	9.62	12.47	12.47	8.87	8.87	8.67	8.67	7.68	7.73
percentile		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.05; 0.65)
Median	14.50	14.50	17.43	17.43	12.34	12.34	13.11	13.11	11.86	11.83
		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)
Mean	15.94	16.09	19.16	19.22	13.72	13.85	13.97	14.18	12.79	13.03
		(0.15; 0.94)		(0.07; 0.37)		(0.12; 0.87)		(0.21; 1.50)		(0.23; 1.80)
MW as % of										
median		51.72		43.03		60.78		57.21		63.24
mean		47.05		39.14		54.66		53.69		58.64
Affected (%)										
overall		9.75		4.1		12.01		12.75		19.04
1st decile		97.56		41.06		100		100		100
Δ wage bill										
(1000 €/m)		455,627		107,237		49,537		224,821		74,032
(% of total)		0.66		0.28		0.87		1.09		1.54

Notes: Only employed people aged 18-65 are included. Percentiles are defined for the wage distribution without the minimum wage. Means are calculated within the range of given percentiles. Δ wage bill is the difference between the wage sum with and without the minimum wage, with wage sum = $\sum$ (hourly wage × weekly working hours × 4.2); employers' social security contributions not included. The numbers in parentheses refer to absolute and relative differences in the two wage measures. Weighted data using sample weights to obtain population means.
Source: Own calculations based on SOEP, wave 2007.

small firms (Müller and Steiner, 2010).

Overall, the introduction of the minimum wage would increase the wage bill by about 455 million € per month, or 5.5 billion € per year, which is about 0.7% of the total wage bill in 2008. In absolute terms, the lion's share of this increase would go to female employees in West Germany, which reflects the still existing gender wage differential. The largest relative increase in the wage bill is estimated for women in East Germany (1.5%), while the wage bill would only increase by about 0.3% for men in West Germany.

Despite this substantial increase in the wage bill, the minimum wage would have very little effect on average wages: Overall, the average hourly gross wage would increase by less than 20 cent, or by about 1%. This direct wage effect varies between about 0.5% for men in West Germany to less than 2% for employees in East Germany. Table 1.2 also shows that for men in West Germany the modest wage increase would only occur in the bottom decile of the wage distribution, whereas wages would also slightly increase for the other groups with current wages just above the 10th percentile. However, compared to the very pronounced increase in the first decile of the distribution, and in particular in the 1st-5th percentile, these changes seem negligible. For Germany overall, the minimum wage would raise the average hourly gross wage in the first decile by about 25%, from 6.02 to 7.50 € per month. Within the first decile, the wage increase varies between 8.5% for men in West Germany to about 38% for women in West Germany. Within the 1st-5th percentile of the wage distribution, the average wage increase amounts to about 50%, ranging from about 20% for men in West Germany to almost 64% for women in East Germany.

1.4.2 Effects on disposable income

Do the significant increases in hourly wages at the bottom of the wage distribution lead to higher net disposable income at the household level and to changes in the income distribution? The first column of Table 1.3 shows that slightly more than 9% of all households are affected by the minimum wage. In East Germany this share (about 13.5%) is substantially higher than in West Germany (about 8%). Different types of families are affected to a varying degree: the share of affected households with children amounts to almost 14%, compared to only about 6% for families without children. Couple households, especially those with both spouses working, would benefit more from the minimum wage than single earner families. As documented in Table 1.6 in the Appendix, these differences by family type can also be observed within West and East Germany, although they are more pronounced in the west.

On average, the minimum wage would boost net monthly household income by about 50 € (1.9%) in Germany (1.8% in West and 2.5% in East Germany). Compared to the large wage increase at the bottom of the wage distribution, income changes are rather small and reflect the weak link between gross wages and net household incomes. Since means-tested transfers are related to the presence of children in the household and to the employment status of the spouse, the minimum wage would lead to smaller increases of the monthly household income for families with children

Table 1.3: Effects on net incomes of households affected by a minimum wage of 7.50 €/hour and on the distribution of net equivalent income, Germany, 2008

	Households affected by MW	No MW	MW of 7.50 €/hour Δ average income		Gini coefficients for net equivalent income by group		
	%	€/month	€/month	%	No MW	MW	Δ in %
Germany, overall	9.23	2,526	48.98	1.94	28.44	28.37	-0.27
West Germany	8.24	2,656	47.38	1.78	28.23	28.16	-0.25
East Germany	13.63	2,172	53.28	2.45	26.89	26.82	-0.26
without children	6.26	2,240	66.97	4.08	30.07	29.98	-0.32
with children	13.79	3,465	36.43	1.16	24.89	24.84	-0.20
Germany, couples	12.17	3,022	45.69	1.51	26.69	26.62	-0.25
without children	8.26	2,200	67.46	3.07	28.21	28.12	-0.32
with children	14.83	3,334	37.43	1.12	24.05	24.00	-0.21
both spouses work	15.24	3,325	54.46	1.64	22.66	22.54	-0.52
one spouse works	7.61	2,385	17.31	0.73	24.71	24.67	-0.17
Germany, singles	5.86	1,346	56.78	4.22	29.71	29.62	-0.31
without children	5.14	1,143	66.54	5.82	29.97	29.86	-0.34
with children	9.47	1,902	29.97	1.58	21.16	21.10	-0.27

Notes: Households affected by the minimum wage as percentage of all households in each group. Percentage changes of average income refer to households within the respective group. Gini coefficients multiplied by 100 and based on net equivalent income (new OECD scale).
Source: Own calculations based on SOEP, wave 2007.

and couples with only one employed spouse. Table 1.6 shows that this pattern is again somewhat more pronounced in West Germany, but can also be observed in the east.

How much do changes in disposable income influence the overall distribution of disposable income and income inequality? This is answered by the last three columns of Table 1.3 which report Gini coefficients (multiplied by 100) for the distribution of net equivalent incomes under the status quo and a minimum wage as well as the percentage change between both scenarios. A statutory minimum wage would only have a minor effect on the overall income distribution: the Gini coefficient declines by about 0.25% for Germany as a whole, which is not statistically significant even at the 10%-level.[23] This change is nearly identical for West and East Germany. Moreover, the reduction of income inequality varies little within specific types of families. In relative terms, the largest reduction in inequality would occur among couple households where both spouses are attached to the labor market. As Table 1.6 in the Appendix shows, these patterns hold for both West and East Germany, although differences between types of families are somewhat more pronounced in the

[23]Due to space restrictions we do not report confidence bands for the Gini coefficient in Table ch1:income. Confidence intervals are available from the authors upon request.

east. The largest (though still statistically insignificant) effect is estimated for East German couple households with both spouses working for whom the minimum wage would reduce income inequality as measured by the Gini coefficient by 1.65%.

1.4.3 Effects on poverty

Given that the effects on the income distribution as a whole are limited, to which extent are the substantial increases in hourly wages at the bottom of the wage distribution translated into a re-distribution at the lower end of the distribution of disposable household income and thus into a reduction in poverty? Table 1.4 shows that the introduction of the minimum wage would have only moderate effects on the incidence and depth of poverty. For Germany overall the *poverty rate* would decrease by less then 0.1% which is not statistically significant even at the 10%-level. The reduction is nearly identical in West and East Germany, although the incidence of poverty is twice as high in the East compared to the West. A look at the *poverty gap* and the poverty measure P_2 reveals that, if the depth of poverty in the total population is also taken into account, the minimum wage is even detrimental to poverty reduction. This can be explained by the fact that a minimum wage in Germany would benefit middle income households more than those below the poverty line, as shown by the increase in the *income gap ratio* and the *squared coefficient of variation* (see Section 1.3) measuring the depth of poverty and inequality among the poor. In consideration of these minimal differences and the estimated confidence intervals for all poverty measures the incidence and depth of poverty would remain unchanged after the introduction of a minimum wage of 7.50 €/hour.

As mentioned in section 1.3 we use 50% of the median equivalence income as poverty line for our main simulations. Are the insignificant differences for all poverty measures sensitive to a change of the *poverty line*? Results for alternatively defined poverty lines are reported in Table 1.7 in the Appendix: 60% of the median equivalence income, 50% of the mean equivalence income, and a flexible poverty line equal to UB II benefits per household (if each household was eligible). It is obvious that the measured degree of poverty (incidence as well as poverty depth) increases with

Table 1.4: Effects of a minimum wage of 7.50 €/hour on poverty, 2008

Poverty measures × 100	No MW	95%-CI	MW	95%-CI	Δ
Germany					
PR	11.64	(10.35; 12.92)	11.61	(10.34; 12.89)	-0.025
PG	2.08	(1.77; 2.40)	2.10	(1.78; 2.41)	0.012
IGR	17.91	(15.79; 20.03)	18.06	(15.95; 20.16)	0.150
P_2	0.81	(0.62; 1.00)	0.81	(0.62; 1.01)	0.004
CV_P^2	5.58	(4.06; 7.09)	5.60	(4.10; 7.11)	0.029
West Germany					
PR	9.69	(8.38; 11.00)	9.66	(8.36; 10.96)	-0.027
PG	1.83	(1.49; 2.18)	1.84	(1.50; 2.19)	0.013
IGR	18.91	(16.11; 21.70)	19.09	(16.32; 21.85)	0.180
P_2	0.76	(0.55; 0.97)	0.76	(0.55; 0.97)	0.003
CV_P^2	6.44	(4.47; 8.40)	6.46	(4.50; 8.41)	0.022
East Germany					
PR	20.36	(16.69; 24.04)	20.35	(16.67; 24.02)	-0.018
PG	3.22	(2.47; 3.96)	3.23	(2.48; 3.97)	0.011
IGR	15.79	(12.88; 18.70)	15.86	(12.95; 18.76)	0.070
P_2	1.05	(0.59; 1.51)	1.06	(0.60; 1.52)	0.006
CV_P^2	3.78	(1.57; 5.98)	3.82	(1.63; 6.01)	0.044

Notes: *PR* is the poverty rate, *PG* is the poverty gap, *IGR* is the income gap ratio, CV_P^2 is the squared coefficient of variation in the group of poor people and P_2 is the Foster-Greer-Thorbecke poverty measure, as defined in section 1.3. 95%-Confidence-Intervals for the population estimates of poverty measures in parentheses. Confidence intervals for the CV_P^2 calculated with the weighted Jackknife method.
Source: Own calculations based on SOEP, wave 2007.

an upper poverty line. The insignificant differences between the status quo and the minimum wage simulation remain robust for all poverty measures and for all reported poverty lines. The changes in the poverty rate are highest for the poverty rate set at 60% of the median equivalence income and a flexible poverty line identical to the equivalized level of UB II. In these simulations the differences for the poverty gap and the measure P_2 (for the flexible poverty line at the UB II level) become slightly negative yielding a small reduction of poverty depth. Yet again, all of these differences are highly insignificant. The minimum wage does thus not reduce poverty, even if a broader and more inclusive definition of poverty is used.

To check whether the insignificant results are driven by compositional effects, we report the *poverty rate* for several groups suggested by the analysis of differential wage effects, where it was shown that wage increases would differ greatly by region, gender, and family composition (for details see Müller and Steiner 2010).[24] Although

[24] Analogous calculations for the poverty gap and P_2 are reported in Table 1.8 in the Appendix.

differences in the incidence and depth of poverty are evident for different groups, the decomposed figures indicate that compositional effects are not responsible for our main result that the proposed minimum wage would have very little effect on poverty in Germany. There are little differences that indicate which group would benefit more from the legal minimum wage. As mentioned above the overall reduction of poverty is nearly identical in West and East Germany. Poor 'female households', i.e. female singles or couples with a female household head, would have above-average gains from the minimum wage: the decrease in the poverty rate for female households is higher than for males, especially in West Germany. Correspondingly the difference in poverty depth is smaller for 'female households' (see Table 1.8).

Table 1.5: Minimum wage effects on the poverty rate, by region, gender, family structures, and employment status of couples, 2008 (income projections based on average growth rates)

Poverty measures	**Germany**			**West Germany**			**East Germany**		
× 100	No MW	MW	Δ	No MW	MW	Δ	No MW	MW	Δ
Germany overall	11.639	11.614	-0.025	9.690	9.663	-0.027	20.365	20.347	-0.018
by gender									
Men	11.207	11.219	0.012	8.919	8.964	0.045	22.277	22.129	-0.148
Women	12.289	12.208	-0.081	10.891	10.752	-0.139	17.896	18.046	0.150
by family structures									
Overall									
without children	15.133	15.172	0.039	12.444	12.488	0.044	26.417	26.439	0.022
with children	6.27	6.145	-0.125	5.586	5.454	-0.132	9.676	9.587	-0.089
Couples	6.815	6.892	0.077	5.814	5.871	0.057	11.842	12.017	0.175
without children	9.149	9.493	0.344	7.142	7.413	0.271	18.459	19.142	0.683
with children	5.223	5.118	-0.105	4.928	4.844	-0.084	6.788	6.576	-0.212
both spouses work	0.463	0.451	-0.012	0.507	0.507	0.000	0.246	0.177	-0.069
one spouse works	6.607	6.463	-0.144	5.665	5.525	-0.140	14.711	14.537	-0.174
Singles	17.16	17.018	-0.142	14.323	14.196	-0.127	28.406	28.205	-0.201
without children	18.458	18.328	-0.130	15.477	15.391	-0.086	30.323	30.020	-0.303
with children	10.591	10.383	-0.208	8.454	8.116	-0.338	18.889	19.193	0.304

Notes: Poverty rate as defined in Section 1.3.
Source: Own calculations based on SOEP, wave 2007.

The largest difference in the degree of poverty reduction can be observed with respect to family structures. Whereas poor single households clearly benefit from the minimum wage as indicated by the comparably large negative difference between the poverty rates in Table 1.5, poor couple households do not gain at all; we even estimate a slight increase in the poverty rate for couples with this difference being larger in East Germany. The degree of poverty reduction is higher in families with children for all groups analyzed except for single households in East Germany. Finally, the poverty rate decreases slightly more within the group of couple households where only one person works compared to couple households with both spouses working.

1.4.4 Robustness: minimum wage level and labor demand effects

To this point the paper focused entirely on the effects of a minimum wage of 7.50 €/hour because this amount was proposed by the co-governing Social Democratic Party and therefore at the center of the political debate. Would the results change, if the level of the minimum wage was set substantially higher? We simulate the effects for an alternative statutory minimum of 10.00 €/hour which is proposed by the Leftist Party in its manifesto for the upcoming federal election. The main finding that the minimum wage has no significant effects on the incidence and depth of poverty in Germany remains unchanged (see Table 1.9 in the Appendix). Under the higher minimum wage the poverty rate actually increases slightly for Germany as a whole driven by changes in the income distribution for West Germany. This can be explained by the fact that equivalent income further up the distribution increases which affects the poverty line and leads to a higher poverty rate. In East Germany poverty incidence would be further reduced compared to a minimum wage of 7.50 €/hour. Regarding poverty depth the effects of a higher minimum wage are ambivalent. In West Germany poverty would be reduced to a greater, in East Germany to a smaller degree in comparison to the scenario with a statutory minimum of 7.5 €/hour. A minimum wage set at the substantially higher level of 10.00 €/hour would thus not at all improve its effectiveness to reduce poverty in Germany.

So far we assumed no behavioral adjustments of labor supply and demand which is only plausible in a short-run perspective. We discuss changes in employment as a consequence of a federal minimum in Germany and their integration in the microsimulation model elsewhere in greater detail (Müller and Steiner, 2010).[25] Labor supply effects are very small and thus negligible for the distributional analysis. Yet, employment losses due to demand side constraints are substantial, especially for

[25]Several empirical studies simulate labor demand effects of a federal minimum for Germany (see, e.g., Knabe and Schöb 2008 or Bauer et al. 2009. Müller (2009a) explains the variation in the results by differences in the data base, measurement errors for hourly wages and the simulation methodology.

marginally employed women in West Germany. Table 1.10 in the Appendix reports the same indicators as in Table 1.4 above if constraints of labor demand (separately for job status, qualification, gender and region) are included in the simulation of net household incomes. The insignificant results for all poverty measures remain unchanged. As expected the already moderate degree of poverty reduction is diminished by the decrease in labor demand and people becoming unemployed due to the minimum. Even worse, for nearly all poverty indicators the difference between the status quo and minimum wage alternative becomes positive, especially for the poverty rate which was negative throughout in Table 1.4. This means that the minimum wage may even increase the level and depth of poverty, albeit slightly and not statistically significantly. These detrimental effects on poverty would be aggravated under the above-mentioned scenario with a minimum wage set at a higher level.

1.5 Summary and conclusion

One popular rationale for the introduction of a legal minimum wage is to prevent poverty among the working-poor. The increase in the poverty rate in recent years has led to the proposed introduction of a statutory minimum wage in the amount of 7.50 €/hour in Germany. However, as stressed by previous minimum wage studies, there might only be a weak link between low hourly wages and net household incomes which renders the minimum wage policy a rather ineffective tool to combat poverty among the working poor. This may be of particular relevance for Germany, due to the existence of means-tested income support.

We have analyzed the distributional effects of the introduction of a nationwide minimum wage of 7.50 €/hour on the basis of a micro-simulation model which accounts for the complex interactions between individual wages, the tax-benefit system, household composition, and net household incomes. Simulation results on the basis of individual-level data from the German Socio Economic Panel (SOEP) show that the proposed minimum wage leads to substantial effects on wages at the bottom of the hourly wage distribution. However, this would have little impact on net household income, inequality and poverty. Disposable household income increases to a much lesser degree than gross wages. The minimum wage would neither reduce income inequality, nor the incidence and depth of poverty significantly. Moreover, the distribution of income within the poor population does also not change. These effects are reduced further if employment constraints due to the minimum are taken into account. The findings are robust to alternative definitions of the poverty line and a minimum wage set at a considerably higher level. The decomposition of poverty measures by various groups has shown that the insensitivity of overall poverty to the minimum wage is not driven by compositional effects. The minimum wage would not be well-targeted at families with children. Although poverty within poor households with children is reduced slightly compared to others, this difference is not substantial or statistically significant.

The suggested minimum wage is not an effective policy instrument to reduce poverty. This finding is explained by the structure of the means-tested income support in Germany with its relatively high social minimum and benefit withdrawal rates. In addition to this, low wage earners are not concentrated at the bottom of the income distribution. The results imply that the lion's share of the costs of income support for households with people earning low wages would be shifted from the tax-benefit system to the costs of employing those people. Given the high wage elasticities for the demand of low-skilled labor, the outlook on the usefulness of a minimum wage as re-distributive tool to reduce poverty becomes even more pessimistic, as simulations including the adjustment of employment have confirmed. The minimum wage could reduce the problem of incomplete take-up of means-tested income support and thereby reduce the degree of 'hidden' poverty, though.

Appendix

Table 1.6: Effects on net incomes of households affected by a minimum wage of 7.50 €/hour and on the distribution of disposable net household equivalent incomes measured by the Gini coefficient, West and East Germany, 2008

	Households affected by MW	No MW	MW of 7.50 €/hour Δ average income		Gini coefficients for net equivalent income by group		
	%	€/month	€/month	%	No MW	MW	Δ in %
West Germany, overall	8.24	2,656	47.38	1.78	28.23	28.16	-0.25
without children	5.00	1,652	70.49	4.27	29.45	29.36	-0.30
with children	13.08	3,228	34.24	1.06	24.99	24.94	-0.18
West Germany, couples	11.25	3,128	40.89	1.31	26.72	26.67	-0.19
without children	7.15	2,228	60.41	2.71	27.38	27.32	-0.23
with children	13.98	3,434	34.23	1.00	24.30	24.26	-0.18
both spouses work	14.47	3,413	46.23	1.35	23.20	23.12	-0.35
one spouse works	6.6	2,429	15.83	0.65	24.80	24.77	-0.15
West Germany, singles	4.65	1,293	66.18	5.12	29.49	29.39	-0.33
without children	3.76	1,026	81.46	7.94	29.50	29.39	-0.37
with children	9.16	1,851	34.27	1.85	21.18	21.11	-0.32
East Germany, overall	13.63	2,172	53.28	2.45	26.89	26.82	-0.26
without children	11.56	1,623	60.58	3.73	28.43	28.35	-0.26
with children	17.29	2,821	44.67	1.58	23.83	23.77	-0.22
East Germany, couples	16.78	2,667	61.87	2.32	24.99	24.87	-0.48
without children	13.41	2,132	84.90	3.98	28.15	28.00	-0.55
with children	19.36	2,950	49.70	1.68	22.31	22.21	-0.41
both spouses work	19.01	2,998	85.03	2.84	18.58	18.27	-1.65
one spouse works	16.33	2,229	22.46	1.01	18.59	18.53	-0.31
East Germany, singles	10.66	1,437	40.52	2.82	26.65	26.60	-0.21
without children	10.65	2,998	45.55	1.52	28.65	28.55	-0.33
with children	10.68	2,229	15.64	0.70	23.99	23.98	-0.03

Notes: Households affected by the minimum wage as percentage of all households in each group. Percentage changes of average income refer to households within the respective group.
Source: Own calculations based on SOEP, wave 2007.

Table 1.7: Sensitivity of minimum wage effects on poverty measures with respect to the definition of the poverty line, by region, 2008 (income projections based on average growth rates)

Poverty measures × 100	Germany			West Germany			East Germany		
	No MW	MW	Δ	No MW	MW	Δ	No MW	MW	Δ
Poverty line 50% of median income: 801.70 € (no MW), 803.81 € (MW)									
PR	11.64	11.61	-0.21	9.69	9.66	-0.28	20.37	20.35	-0.09
PG	2.08	2.10	0.58	1.83	1.85	0.71	3.22	3.23	0.34
IGR	17.91	18.06	0.82	18.91	19.09	0.97	15.79	15.86	0.42
P_2	0.81	0.81	0.37	0.76	0.76	0.40	1.05	1.06	0.66
CV_P^2	5.58	5.60	0.11	6.45	6.46	0.05	3.79	3.82	0.36
Poverty line 60% of median income: 962.04 € (no MW), 964.58 € (MW)									
PR	19.80	19.64	-0.80	17.44	17.37	-0.35	30.39	29.78	-1.99
PG	4.40	4.39	-0.11	3.83	3.83	-0.05	6.94	6.92	-0.19
IGR	22.20	22.36	0.71	21.95	22.01	0.28	22.83	23.25	1.84
P_2	1.55	1.55	0.26	1.38	1.38	0.29	2.29	2.29	0.39
CV_P^2	4.76	4.80	0.44	5.09	5.13	0.37	3.89	3.91	0.26
Poverty line 50% of average income: 888.62 € (no MW), 890.17 € (MW)									
PR	16.51	16.55	0.27	14.37	14.33	-0.29	26.06	26.50	1.66
PG	3.25	3.24	-0.18	2.82	2.81	-0.32	5.16	5.17	0.21
IGR	19.68	19.59	-0.45	19.64	19.63	-0.05	19.78	19.50	-1.42
P_2	1.15	1.15	0.00	1.05	1.05	0.00	1.64	1.64	0.06
CV_P^2	4.83	4.85	0.18	5.30	5.34	0.38	3.69	3.68	-0.09
*Poverty line equivalent income from UB II entitlements: 793.34 € (no MW), 793.34 € (MW)**									
PR	16.26	16.00	-1.64	14.70	14.44	-1.80	23.24	22.97	-1.19
PG	2.79	2.77	-0.93	2.51	2.48	-1.00	4.07	4.04	-0.66
IGR	18.24	18.23	-0.02	19.48	19.44	-0.21	15.65	15.70	0.29
P_2	0.89	0.88	-0.45	0.82	0.82	-0.36	1.19	1.18	-0.93
CV_P^2	5.61	5.67	0.55	6.01	6.10	0.73	4.19	4.17	-0.20

Notes: PR is the poverty rate, PG is the poverty gap, IGP is the income gap ratio, CV_P^2 is the squared coefficient of variation in the group of poor people and P_2 is the Foster-Greer-Thorbecke poverty measure, as defined in Section 1.4.

Median and average income based on net equivalent incomes according to the new OECD scale which gives a factor of 1 to the head of household, of 0.5 to each adult person and of 0.3 to each child. For the definition of UB II, see notes to Table 1.1 in Section 1.2.

* Flexible poverty line according to household equivalent income equal to UB II entitlements. Reported figure of 793.34 € refers to average entitlements which are identical under both scenarios. For the IGR a fix average entitlement of 793.34 € is assumed.

Source: Own calculations based on SOEP, wave 2007.

Table 1.8: Minimum wage effects on poverty measures, by region, gender, family structures, and employment status of couples, 2008 (income projections based on average growth rates)

Poverty measures	**Germany**			**West Germany**			**East Germany**		
× 100	No MW	MW	Δ	No MW	MW	Δ	No MW	MW	Δ
PG									
Germany overall	2.085	2.097	0.012	1.832	1.845	0.013	3.215	3.226	0.011
by gender									
Men	2.082	2.099	0.017	1.859	1.871	0.012	3.160	3.199	0.039
Women	2.089	2.095	0.006	1.790	1.804	0.014	3.286	3.261	-0.025
by family structures									
Overall									
without children	2.767	2.784	0.017	2.452	2.470	0.018	4.088	4.103	0.015
with children	1.036	1.042	0.006	0.908	0.914	0.006	1.674	1.676	0.002
Couples	1.248	1.254	0.006	1.135	1.139	0.004	1.818	1.829	0.011
without children	2.065	2.069	0.004	1.800	1.797	-0.003	3.294	3.330	0.036
with children	0.692	0.698	0.006	0.692	0.701	0.009	0.691	0.682	-0.009
both spouses work	0.226	0.224	-0.002	0.253	0.254	0.001	0.091	0.077	-0.014
one spouse works	0.594	0.589	-0.005	0.548	0.541	-0.007	0.986	1.003	0.017
Singles	3.042	3.062	0.020	2.665	2.688	0.023	4.534	4.544	0.010
without children	3.157	3.181	0.024	2.826	2.854	0.028	4.478	4.483	0.005
with children	2.456	2.459	0.003	1.850	1.844	-0.006	4.811	4.848	0.037
P_2									
Germany overall	0.811	0.814	0.003	0.756	0.760	0.004	1.053	1.060	0.007
by gender									
Men	0.791	0.795	0.004	0.775	0.777	0.002	0.872	0.881	0.009
Women	0.84	0.844	0.004	0.728	0.733	0.005	1.287	1.290	0.003
by family structures									
Overall									
without children	1.085	1.090	0.005	1.060	1.064	0.004	1.192	1.202	0.010
with children	0.388	0.390	0.002	0.304	0.306	0.002	0.808	0.808	0.000
Couples	0.497	0.497	0.000	0.469	0.468	-0.001	0.638	0.641	0.003
without children	0.92	0.918	-0.002	0.846	0.842	-0.004	1.262	1.271	0.009
with children	0.209	0.209	0.000	0.217	0.219	0.002	0.162	0.159	-0.003
both spouses work	0.13	0.130	0.000	0.148	0.149	0.001	0.041	0.039	-0.002
one spouse works	0.124	0.128	0.004	0.116	0.120	0.004	0.196	0.196	0.000
Singles	1.17	1.178	0.008	1.100	1.108	0.008	1.445	1.455	0.010
without children	1.177	1.186	0.009	1.182	1.191	0.009	1.158	1.168	0.010
with children	1.131	1.137	0.006	0.684	0.689	0.005	2.868	2.878	0.010

Notes: PG is the poverty gap and P_2 is the Foster-Greer-Thorbecke poverty measure, as defined in Section 1.3.
Source: Own calculations based on SOEP, wave 2007.

Table 1.9: Effects of a minimum wage of 10.00 €/hour on poverty, 2008

Poverty measures × 100	No MW	95%-CI	MW	95%-CI	Δ
Germany					
PR	11.64	(10.35; 12.92)	11.67	(10.40; 12.95)	0.036
PG	2.08	(1.77; 2.40)	2.10	(1.80; 2.41)	0.019
IGR	17.91	(15.79; 20.03)	18.02	(16.02; 20.01)	0.104
P_2	0.81	(0.62; 1.00)	0.80	(0.62; 0.98)	-0.009
CV_P^2	5.58	(4.06; 7.09)	5.72	(4.26; 7.19)	0.147
West Germany					
PR	9.69	(8.38; 11.00)	9.76	(8.46; 11.06)	0.070
PG	1.83	(1.49; 2.18)	1.84	(1.51; 2.17)	0.008
IGR	18.91	(16.11; 21.70)	18.86	(16.27; 21.45)	-0.051
P_2	0.76	(0.55; 0.97)	0.74	(0.54; 0.94)	-0.016
CV_P^2	6.44	(4.47; 8.40)	6.42	(4.54; 8.29)	-0.018
East Germany					
PR	20.36	(16.69; 24.04)	20.25	(16.57; 23.92)	-0.118
PG	3.22	(2.47; 3.96)	3.28	(2.53; 4.03)	0.064
IGR	15.79	(12.88; 18.69)	16.20	(13.29; 19.10)	0.410
P_2	1.05	(0.59; 1.51)	1.07	(0.61; 1.54)	0.020
CV_P^2	3.78	(1.57; 5.98)	4.25	(2.00; 6.50)	0.470

Notes: PR is the poverty rate, PG is the poverty gap, IGR is the income gap ratio, CV_P^2 is the squared coefficient of variation in the group of poor people and P_2 is the Foster-Greer-Thorbecke poverty measure, as defined in section 1.3. 95%-Confidence-Intervals for the population estimates of poverty measures in parentheses. Confidence intervals for the CV_P^2 calculated with the weighted Jackknife method.

Source: Own calculations based on SOEP, wave 2007.

Table 1.10: Effects of a minimum wage of 7.50 €/hour on poverty, 2008 (income projections based on average growth rates), taking labor demand constraints into account

Poverty measures × 100	No MW	95%-CI	MW	95%-CI	Δ
Germany					
PR	11.64	(10.35; 12.92)	11.69	(10.42; 12.97)	0.055
PG	2.08	(1.77; 2.40)	2.11	(1.79; 2.43)	0.025
IGR	17.91	(15.79; 20.03)	18.04	(15.94; 20.14)	0.130
P_2	0.81	(0.62; 1.00)	0.82	(0.63; 1.01)	0.011
CV_P^2	5.58	(4.06; 7.09)	5.61	(4.08; 7.14)	0.037
West Germany					
PR	9.69	(8.38; 11.00)	9.74	(8.43; 11.04)	0.049
PG	1.83	(1.49; 2.18)	1.86	(1.51; 2.21)	0.027
IGR	18.91	(16.11; 21.70)	19.09	(16.34; 21.85)	0.190
P_2	0.76	(0.55; 0.97)	0.77	(0.56; 0.98)	0.012
CV_P^2	6.44	(4.47; 8.40)	6.48	(4.49; 8.48)	0.048
East Germany					
PR	20.36	(16.69; 24.04)	20.45	(16.78; 24.12)	0.084
PG	3.22	(2.47; 3.96)	3.23	(2.48; 3.97)	0.012
IGR	15.79	(12.88; 18.69)	15.78	(12.90; 18.66)	-0.010
P_2	1.05	(0.59; 1.51)	1.06	(0.60; 1.52)	0.006
CV_P^2	3.78	(1.57; 5.98)	3.79	(1.60; 5.98)	0.010

Notes: PR is the poverty rate, PG is the poverty gap, IGR is the income gap ratio, CV_P^2 is the squared coefficient of variation in the group of poor people and P_2 is the Foster-Greer-Thorbecke poverty measure, as defined in section 1.3. 95%-Confidence-Intervals for the population estimates of poverty measures in parentheses. Confidence intervals for the CV_P^2 calculated with the weighted Jackknife method.

Source: Own calculations based on SOEP, wave 2007.

Chapter 2

Behavioral effects of a federal minimum wage and income inequality in Germany[‡]

2.1 Motivation

Income inequality has been on the rise in Germany over the last years (Grabka and Kuhn, 2012; Faik, 2012). This trend is to a certain degree related to a growing low wage sector and increasing overall wage inequality (Dustmann et al., 2009; Antonczyk et al., 2010b; Gernandt and Pfeiffer, 2007). Descriptive analyses based on data from the German Socio-Economic Panel (SOEP) confirm these findings (Table 2.6 in the Appendix). The share of low-wage employment between 1995 and 2010 grew particularly for men, but also significantly for women until 2005. Overall wage inequality measured by the Gini coefficient also rose significantly. The rise in inequality is also reflected in net disposable household incomes where East Germany seems to be predominantly affected as the Gini coefficient for net equivalent income increased by almost 30% between 1995 and 2010.

Since Germany remains one of a few OECD countries without a statutory minimum wage (Immervoll, 2007b; Schulten, 2012), its introduction has been a dominant economic policy issue for quite some time.[26] One line of argument refers to the de-

[‡]This chapter is based on joint work with Viktor Steiner from Free University Berlin, see Müller and Steiner (2010).

[26]See, e.g., the debate in *ifo schnelldienst 61(06), 2008*, Franz (2007), or Fitzenberger (2009a).

clining union coverage in the economy. The wage bargaining system may no longer prevent 'excessive' downward wage pressure (Antonczyk et al., 2010a; Bosch, 2007; Möller and König, 2008). In this view a modest minimum wage is a necessary complement to wage subsidies in the low-wage sector. The wage-subsidy scheme proposed by Bofinger et al. (2006), for example, includes a low hourly minimum of 4.50 € to prevent wage dumping and mitigate deadweight effects. Another argument from a social policy perspective is that earnings of people working full-time should be sufficient to reach the means-tested social minimum. A minimum wage could then serve as a means to prevent in-work poverty and help to mitigate income inequality (Bosch, 2007). Proponents of this approach, among them the Social Democratic Party and the labor unions, have suggested a legal minimum wage of 8.50 €/hour; the Leftist Party propagates a minimum wage level of 10.00 €/hour.

The extensive literature on the economic effects of minimum wages primarily focuses on employment (Neumark and Wascher, 2008). Far less attention has been devoted to the question if and to what extent a minimum wage is able to affect the distribution of disposable household incomes and thus overall inequality.[27] For Germany a couple of papers analyzes the incidence of a federal minimum wage (Brenke, 2006; Bosch and Weinkopf, 2006; Kalina and Weinkopf, 2007). Knabe and Schöb (2009) discuss the interaction of a minimum wage with the German tax-and-transfer system.

In this paper we analyze the implications a federal minimum wage would have on the distribution of disposable net incomes in Germany. We investigate whether minimum wages of different magnitude would achieve the stated goal to reduce the degree and depth of income inequality among the working population. The analysis builds upon a previous paper (Müller and Steiner, 2009) where the first round effects of a statutory minimum wage on net household incomes is simulated using a tax-and-transfer microsimulation model. Focusing on the lower part of the income

[27] This literature includes a number of studies for the U.S., including Johnson and Browning (1983), Burkhauser and Finegan (1989), Mincy (1990), Burkhauser et al. (1996a), Burkhauser et al. (1996b), Burkhauser and Sabia (2005), Sabia and Burkhauser (2010), Macurdy and McIntyre (2001), Addison and Blackburn (1999), Neumark and Wascher (2002), Neumark et al. (2005), Sabia and Nielsen (2012). There are also papers by Goldberg and Green (1999) for Canada and Gosling (1996), Freeman (1996) or Sutherland (2001) for the UK.

distribution they find that a nationwide minimum wage would be ineffective in reducing poverty, if it had no behavioral and price effects. This paper extends the analysis methodologically in several respects: Whereas Müller and Steiner (2009) ignore any behavioral adjustments due to the minimum wage, we estimate in this paper how individuals, households and firms adapt their behavior and account for these adjustments in the simulation of household incomes. We consider labor supply, labor demand and consumption effects a federal minimum would induce. To our knowledge none of the existing distributional analyses of the minimum wage has modeled those different aspects at the individual or household level.

Müller and Steiner (2009) consider a moderate minimum wage level of 7.50 €; here we systematically compare different scenarios starting from a low level of 5.00 €, to 8.50 €, to a high minimum of 10.00 €/hour. The range represents the different strands of the political debate sketched above: a moderate level ought to prevent excessive wage dumping and deadweight effects for wage subsidies whereas a rather high minimum wage level is said to alleviate income inequality. The microsimulation analysis is based on SOEP data. In addition we exploit the IAB employment subsample for the labor demand estimations and the Continuous Household Budget Survey for Germany for the estimation of consumption behavior.

The next section discusses the distributional implications of a federal minimum wage as the link between low wages, means-tested income support and household incomes is examined. Section 3 describes the methodological approach and the data. First we discuss how we simulate the impact of different minimum wage levels on the distribution of hourly wages. Then we describe the microsimulation model that is used to translate shifts in the wage distribution into changes of net household incomes. After that we outline the estimation of labor supply, labor demand and consumption effects. Then it is shown how the different behavioral adjustments are integrated into the microsimulation model. Finally we describe the data used in this study. The empirical results are presented in Section 4. Section 5 concludes and discusses policy implications.

We show that a statutory minimum wage would have a minor impact on the overall distribution of net household incomes and the reduction of inequality among households with at least one low-wage worker. This holds even if the minimum wage would be set at a high level. If negative effects on labor demand are taken into account, the gain in net incomes is reduced by half. Considering also increases in product prices and the adaption of consumption further diminishes the gain in net income due to a minimum wage. The ineffectiveness of a minimum wage to increase net household incomes of the working poor and to reduce income inequality can be explained by the German system of means-tested income support, the spread of low wage earners over the whole range of the net income distribution, and differences in wage levels and consumption behavior among different groups of the population.

2.2 Distributional effects of a minimum wage

Distributional effects are addressed by two strands of the minimum wage literature (OECD, 1998; Brown, 1999). The first question that is adressed is to what extent a minimum wage affects the wage distribution and inequality of labor earnings. In the second branch of studies the issue is whether a minimum wage has an impact on the distribution of disposable household incomes and overall inequality. We sketch this research and then relate different distributional meachansims of the minimum wage to the German context.

2.2.1 Wage inequality

Assuming full coverage, compliance and no behavioral adjustments, all employees that earn sub-minimum wages remain employed and receive exactly the minimum wage after its introduction; other wages are not affected. The minimum wage compresses the distribution from below, creates a spike at the minimum and reduces inequality. Since these conditions are unrealistic, empirical studies try to identify different adjustment mechanisms. If the minimum reduces employment, the wage distribution might not be compressed and censored, but truncated or thinned out in the lower tail. If the minimum wage affcets the entire wage structure, the distribution will be shifted leaving relative positions and inequality only modestly affected. Grossman (1983) is one of the first to make the argument for *spillover effects* to higher parts of the wage distribution formally and provides first evidence. Both disemployment effects and wage spillovers diminish or even counteract the redistributive impact of a minimum.

DiNardo et al. (1996) semi-parametrically estimate wage distributions and isolate the effects of different factors with decomposition techniques. They show that the decrease of the real value of the minimum wage in the U.S. contributed to the rise in wage inequality between 1979 and 1988. Lee (1999) analyzes the impact of the minimum wage on the wage distribution in the U.S. during the 1980s. He utilizes regional variation in state minimum wages and concludes that a large part of the rise in inequality in the lower tail of the distribution is attributable to the decline in the real value of the minimum wage. Autor et al. (2010) re-investigate the early studies and demonstrate that the magnitude of the effect is overestimated because of errors-in-variables and correlation of state minimum wages and wage dispersion. Estimated spillovers may entirely be an artefact of measurement error.

Dickens and Manning (2004) estimate the influence of the U.K. minimum wage on the wage distribution without finding noticeable spillover effects. Stewart (2011) reaches a similar conclusion on the basis of U.K. data. Green and Paarsch (1996) estimate hazard functions to derive conditional wage densities (Donald et al., 2000) and estimate the effect of the minimum wage on the shape of the wage distribution with Canadian data. They find evidence for substantial wage increases for those who earned below the minimum wage level and also evidence for spillover effects.

Neumark et al. (2004) try to identify the effects of changes in the minimum wage on wages, employment, working hours and labor income from regional variation in minimum wages levels within a given year in the U.S. They find positive effects on wages, but negative on hours and employment which is why the change in labor income is also negative. Effects are much higher for those people with wages close to the minimum. Neumark et al. show that one period lagged effects are more important than the contemporaneous influence of the minimum. Moreover, Machin et al. (2003) estimate the effect of the U.K. minimum wage in a sector where the minimum bit hard and find a large compression of the wage distribution at the lower end. Employment or hours reductions are found to be limited which is why wage inequality was reduced significantly.

Contrary to the reduced form approaches Flinn (2002) estimates a structural job search model to infer the distributional consequences of a federal minimum wage. He models spillovers and employment reactions and is able to derive welfare effects induced by the minimum finding mixed evidence for the U.S. In the same vein Ahn et al. (2011) set up a one-shot search model with endogenous labor supply and demand. In their framework a minimum wage might lead to small (even positive) changes in the employment level. Yet this masks significant turnover on the labor market with exits and entries not being evenly distributed. Matches with subminimum wages are pushed out of the labor market in favor of more productive jobs leading to negative welfare effects of the minimum.

There is ample evidence for sizeable wage effects of the minimum in the lower part of the distribution. The findings concerning wages spillover are more ambiguous. Depending on the specific situation (minimum wage level, the affected group) some studies also find employment adjustments (via hours reductions, substitution or layoffs). We avoid assumptions about changes in the whole wage structure, but include estimated labor supply and demand adjustments in our simulation model.

2.2.2 Income inequality

An analysis of wage inequality does not reveal whether a minimum wage is an effective tool for redistribution. A broader measure for economic wellbeing – disposable household income – has to be considered. The size and composition of the household and other income sources play an important role as well as the tax and transfer system. Increased wage equality does not directly translate into higher overall income equality for several reasons. First, low wage earners are not concentrated in the lower part of the income distribution; also richer households will significantly benefit from the minimum wage. Second, interactions with the tax and transfer system lead to high marginal tax rates or substitution of transfer incomes among minimum wage earners (depending on the household structure). Third, higher labor costs induced by the minimum wage might boost product prices and disproportionately affect low income households with high consumption rates. Two types of analyses can be distinguished in this literature. Simulation studies model the aforementioned relationships explicitly, whereas reduced form approaches try to identify the causal impact of the minimum wage on the distribution of household incomes.

Johnson and Browning (1983) is one of the first simulation studies that assesses the distributional effects of a stutory minimum wage on household incomes in the U.S. According to their results this effect is marginal because of the small share of low wage earners and low wage income in poor households and the large marginal tax rates low wage earners face. Burkhauser and Finegan (1989) demonstrate that the close link between low household income and the incidence of low wage employment has loosened over time. The minimum wage benefits workers who reside in households above the poverty line relatively more in the U.S. during the 1980s. Based on simulations from U.S. wage and income data Burkhauser et al. (1996a) confirm this assertion. Household composition and size as well as non-wage income are more closely related to the risk of poverty. Bluestone and Ghilarducci (1996) also argue that besides potential disemployment effects the minimum wage suffers from insufficient target efficiency. Burkhauser and Sabia (2005) replicate the incidence analyses of low wage earnings for the 1990s showing that the link between wages and equivalent income remains weak. Sabia and Burkhauser (2010) simulate the distributional effect of an increase of the federal minimum from \$7.25 to \$9.50 and show that only about 11% of those benefiting actually live in poor households.[28]

In their simulation exercise Macurdy and McIntyre (2001) assume no spillover effects in wages, no disemployment effects, no reductions in working hours and no

[28] Mincy (1990) reaches a more optimistic assessment of the distributional effects. He differentiates earnings gains from an increase in the minimum wage by household incomes, incorporates disemployment effects, but neither considers price effects, nor the tax system. Mincy concludes that the U.S. minimum wage reducess poverty more than previously found (see also Card and Krueger (1995)). Burkhauser et al. (1996b) show that distributional analyses of the minimum react very sensitive to the definition of income. Contrary to Mincy (1990); Card and Krueger (1995) argue to rely on equivalent household income as a measure of economic well-being.

adjustment of consumers' behavior. They confirm previous findings that income gains are almost evenly distributed over income quintiles. In addition, Macurdy and McIntyre explicitly look at the costs which are induced by higher product prices and borne by all households. They show that although in absolute terms richer households bear the majority of this burden, poor households lose more in relative terms because of their above-average consumption rates.

Several reduced-form studies try to causally identify the effect of the minimum wage on poverty or income inequality. Addison and Blackburn (1999) esitmate fixed-effects regressions on data from U.S. states. They show that the minimm wage did not reduce poverty in the 1980s but in the 1990s and speculate that this difference might be explained by its smaller impact on employment. Neumark and Wascher (2002) exploit regional variation in U.S. minimum wages. According to their results the minimum wage increases both the outflow from and the inflow into poverty and therefore does not reduce overall inequality. Neumark et al. (2005) estimate the effect of minimum wage increases on the whole income distribution using kernel density estimators in a difference-in-difference framework. They exploit variation in state level minima over time and find that the minimum wage increases the share of households below or near the poverty line. Sabia and Burkhauser (2010) analyze the relationship between changes in the minimum wage rate and poverty incidence at the state level in a fixed-effects regression framework. Their estimates based on CPS data show no significant effects. Sabia and Nielsen (2012) use a similar identification strategy to estimate the effect of state minimum wage increases on different measures of hardship (income poverty, financial insecurity, food or health insecurity) without finding significant relationships.

2.2.3 Situation in Germany

Germany has no federal minimum wage, but several sectoral minima have been established since 1997. Contract wages set at the industry level can be declared generally binding by the government on the basis of a special regulation contained in the law on the posting of workers ("Entsendegesetz").[29] Several studies (Rattenhuber, 2011; Apel et al., 2012) show that these minima compressed the wage distribution within the sector.

Brenke (2006) documents that in West Germany a federal minimum wage would affect most marginally employed persons whereas it would bind a higher share of regularly employed people in the East. Bosch and Weinkopf (2006) report similar results on the basis of administrative employment register data. Kalina and Weinkopf (2007) show that in 2004 about 14% of all dependently employed persons would have received a hypothetical minimum wage of 7.50 €/hour, with higher shares among unskilled workers, women, youth, and people in marginal employment. Knabe and Schöb (2009) note that households eligible to means-tested unemployment benefits would hardly benefit from a minimum wage because of the benefit-withdrawal rate implicit in the German social welfare system.

Müller and Steiner (2009) confirm that workers who would receive the minimum wage are not concentrated in the lower part of the income distribution. They also analyze interactions with the German tax system and welfare state which is characterized by a high "social minimum" relative to net in-work income of low qualified people and benefit-withdrawal rates close to 100%. The basic rates for each family member depend on the age of children; the maximum amount for housing costs derives from family size. The social minimum defines the amount of means-tested unemployment benefits (UB II) for "employable" individuals.[30]

This social minimum also establishes an implicit minimum wage equaling the hourly wage which would yield the same net income in a full-time job as UB II. The illustrative calculations carried out in Müller and Steiner (2009) show that this implicit minimum is close to or exceeds the wages currently earned in the low-wage sector in Germany. In relative terms it is highest for one-earner couples with

[29]It was first introduced in the construction industry on order to prevent firms from other EU countries to compete at lower wages than the contract wage set by German employers and labor unions. Since then it has been extended to the waste industry, to roofers and electricians, to the laundry industry, to painters and varnishers, and to care services.

[30]"Employability" is defined as the ability to work at least 3 hours a day and determined by the labor agency. Persons with severe physical and mental disabilities are exempted. Outside of this definition people receive means tested "social assistance" ("Sozialgeld") which is paid at similar amounts as UB II.

children and in East Germany. A relatively moderate minimum wage of 7.50 €/hour would increase the net household incomes above UB II levels neither for single-earner couples in West Germany nor for couples with both spouses working full-time in East Germany. To become effective in this sense a minimum wage would have to be set at substantially higher levels. We therefore present a simulation with a high minimum wage of 10.00 €/hour. On the other hand, the implicit minimum wage for singles without children is substantially lower. For those households a moderate minimum wage level of 8.50 €/hour may already be sufficient. We also present simulations with a low level of 5.00 €/hour to cover the range debated in public and of existing minimum wages.[31] In addition to UB II entitlement the simulation model includes further features of the German tax-benefit system, including the joint taxation of couples, other means-tested transfers, exemptions from social security contributions, or unemployment benefit withdrawal rates below 100%.

The empirical analyis of this paper comprises all the mechanisms discussed in the literature: The position of low wage earners within the income distribution is taken into account. Interactions of the minimum wage with the German tax and transfer system are modeled at the household level. Behavioral adjustments at different margins are also included in the simulations as well.

2.3 Methodology

This section details our methodological approach. First, we describe the simulation of pure wage effects without behavioral adjustments. Then the simulation of net household incomes from an increase in gross hourly wages is discussed. The following subsection explains the estimation of behavioral adjustments induced by a minimum wage. After that it is shown how these adjustments are incorporated into the simulation model. Finally we give an overview over the data.

[31] A low minimum wage of 4.50 €/hour as a complement to a wage subsidy in the low-wage sector was suggested by Bofinger et al. (2006); this is equivalent to a value of about 5.00 €/hour in 2012. Low minimum wage levels can be found in some Eastern and Southern European countries. The United Kingdom, the U.S. or Italy exhibit average minimum wage levels whereas, e.g., France or the Netherlands have rather high minimum wages (Marx et al., 2012).

2.3.1 Simulation of wage effects

In a first step we calculate minimum wage effects on the distribution of wages. The observed hourly gross wage of those persons employed at a wage below the minimum is replaced by a minimum wage at different levels (5.00, 8.50, 10.00 €/hour). We rule out spillover effects, i.e. wages higher than the minimum wage remain constant. For each employed person, the gross hourly wage is obtained by dividing reported earnings in the month before the interview by the number of hours worked in that month, where paid overtime hours are included.[32] We then compare the observed wage distribution and the hypothetical wage distribution conditional on the minimum wage under the assumption of no further labor market adjustments.

We make use of wage data from the latest available wave of the German Socio-Economic Panel Study (SOEP, see sub-section 2.3.5) collected in 2010. Since the great majority of respondents is interviewed in the first quarter of the year, we interpret these wage data to refer to the year 2009. To simulate the wage distribution in 2012 we extrapolate wages two years in the future assuming constant growth rates.[33] Another assumption concerns the treatment of very low hourly wages. To account for measurement errors in the hours and wage data we exclude wages below 3 €/hour earned in regular employment. This equals roughly the first percentile of the raw hourly wage distribution. We have included hourly wages below 3 €/hour, though, if they refer to supplementary work of people drawing unemployment benefits (so-called "Aufstocker"). We conduct sensitivity analyses of the scenarios where hourly wages below 3 €/hour remain in the analysis as measured or are set to the margin of 3 €/hour, respectively. People in full-time vocational and apprenticeship training as well as disabled employees are discarded from the sample. "Secondary jobs", i.e. jobs held in addition to the main job, are excluded in the base simulations; a sensitivity analysis is provided.

[32] This hourly wage measure may underestimate the effective hourly wage, for at least two reasons: First, since the majority of people in the SOEP is interviewed in the first three months of the year, fringe benefits are underrepresented. Second, 'paid hours' may partly be paid for in later months, or may be compensated for by working less than normal hours in the future.

[33] To check the sensitivity of the results with respect to this assumption we estimated dynamic panel data models instrumenting the lagged dependent variable and predicted the future wages individually. Findings did not change significantly.

2.3.2 Simulation of income effects

In a second step the simulated wage increases are translated into changes of disposable household incomes. We go beyond previous papers that calculate marginal tax rates for households (Johnson and Browning, 1983) or approximate the effects of the tax system by looking at different household types (Macurdy and McIntyre, 2001). Following Müller and Steiner (2009) we model the link between gross wages and net incomes for each household with the microsimulation model STSM. This approach (see Creedy and Duncan (2002) for an overview) is appropriate for the distributional issues we address as it provides net disposable income for each household. The static model consists, first, of a representative micro data set (the SOEP, see sub-section 2.3.5 below) with the necessary information on household structure, income from different sources, working hours, and socio-demographic characteristics. Second, a tax-transfer model computes net household incomes based on various gross incomes.

The STSM (Steiner et al., 2012) contains the main features of the German tax and transfer system. Gross household income is composed of earnings from dependent employment, income from capital, property rents and other income. Earnings from dependent employment is the most important income component for the great majority of households.[34] Taxable income is calculated by deducting various expenses from gross household income. The income tax is computed by applying the income tax formula to the individual incomes of unmarried spouses; for married spouses, income is taxed jointly based on an income splitting factor of 2. Employees' social security contributions and the income tax are deducted from gross household income and social transfers are added to get net household income. Social transfers include child allowances, child-rearing benefits, educational allowances for students and apprentices, unemployment compensation, the housing allowance, and social assistance. The model accounts for nonlinearities and interactions within the German tax-benefit system, in particular means-tested income-support schemes, exemptions of very low earnings from social security contributions, and the joint income taxation

[34] The SOEP also contains information on earnings (and working hours) from a "secondary job", i.e. a job held in addition to the main job, which we add to wage income for the calculation of net household income.

of married couples imposing relatively high marginal tax rates on secondary earners.

Analogous to the wage analysis we simulate net household incomes not only under the observed wage structure but also for the counterfactual situation after the introduction of a minimum wage. We then simply compare the distribution of net equivalent incomes in both scenarios assuming that behavior of employees and firms does not adapt.

2.3.3 Estimation of behavioral adjustments

In addition to the mechanical changes in gross wages and household incomes (given compliance and coverage) we estimate behavioral adjustments after the introduction of a federal minimum wage at different margins. The majority of empirical minimum wage studies focuses on the employment effects (Neumark and Wascher, 2008) without explicitly distinguishing labor supply and demand.[35] Employment reductions are usually attributed to reduced labor demand because of higher labor costs whereas positive employment effects are explained by improved labor supply incentives in monopsonistic labor markets. Some structural papers (Flinn, 2002; Ahn et al., 2011) disentangle different adjustment mechanisms on the labor market. In our simulation we have to rely on estimated labor supply and demand elasticities to gauge the potential employment effects. In addition we also calculate adjustments of product prices as an additional margin of adjustment and estimate the adaption of household consumption behavior.

Labor supply

Labor supply is modeled as the joint decision of spouses at the household level within a discrete choice framework.[36] As suggested by van Soest (1995) or Aaberge et al. (1995) the basis is a household utility model where utility is jointly maximized by

[35]For Germany some evaluation studies have been published that try to identify the employment impact of the sectoral minimum wages without finding major effects (König and Möller, 2008a; Apel et al., 2012; Aretz et al., 2012; Boockmann et al., 2012; Bosch et al., 2012; Gürtzgen et al., 2012; Harsch and Verbeek, 2012; Mesaros and Weinkopf, 2012; Bachmann et al., 2012) .

[36]The model is estimated separately for different household types: couple households where both spouses' labor supply is assumed to be flexible, couple households where one spouse's labor supply is assumed to be fix, male and female single households.

the choice of different bundles j of disposable income and leisure:

$$\{(y_j, lm_j, lf_j); j = 1, 2, \ldots, m\} \tag{2.1}$$

with leisure for males (lm_j) and females (lf_j) given as $lm_j = TE - hm_j$, $lf_j = TE - hf_j$. TE is the total time endowment, hm_j and hf_j are working hours of the male and female spouse.[37] Net household incomes y_j for all hours categories and both scenarios with and without minimum wage are obtained from the microsimulation model (sub-section 2.3.2 above). We assume a quadratic specification of the direct utility function for the $i = 1, 2, \ldots, N$ households:

$$U_{ij} = \alpha_c + \alpha_y y_{ij} + \alpha_{yy} y_{ij}^2 + \alpha_{lf} lf_{ij} + \alpha_{lf^2} lf_{ij}^2 + \alpha_{lm} lm_{ij} + \alpha_{lm^2} lm_{ij}^2 + \alpha_{lflm} lf_{ij} lm_{ij} \tag{2.2}$$

Preference heterogeneity is introduced by a number of household- or individual-specific taste shifters X (age, children, handicap, region), i.e. the parameters α are functions of X. Adding identical and independently type I extreme value distributed error terms to the utility function yields the Multinomial Logit model (McFadden, 1974) for the choice probability of alternative k:

$$Pr_{ik} = Pr(V_{ik} > V_{ij}, = 0, \ldots, m) = \frac{exp\{U(y_{ik}, lm_{ik}, lf_{ik})\}}{\sum_{j=1}^{m} exp\{U(y_{ij}, lm_{ij}, lf_{ij})\}} \tag{2.3}$$

The model is estimated for the situation without a minimum wage on the SOEP data set (see sub-section 2.3.5 below). Participation, hours worked and the resulting changes in disposable household income are predicted for the status quo and under different minimum wage scenarios. The difference yields the labor supply effects and income changes after the adjustment of labor supply.[38]

[37] We assume 4 categories for men (non-employment, part-time, full-time, over time) and 5 categories for women (non-employment, low part-time, high part-time, full-time, over time).

[38] For the households that are affected by the minimum wage the theoretically expected effect on labor supply is ambiguous, since income and substitution effects act in opposite directions.

Labor demand

Labor demand changes are determined by the increase in labor costs induced by minimum wage and by the elasticity of labor demand. When labor demand is considered other simulation studies either assume and simulate the effects of different average elasticities (Johnson and Browning, 1983; Macurdy and McIntyre, 2001), or they take estimated elasticities from the literature (Mincy, 1990). Here we use estimated labor demand elasticities, but allow for more effect heterogeneity and substitution between different labor categories that are defined by region, gender, qualification level and type of contract (full-, part-time and marginal employment)[39] For given wages, factors of production and demand for goods the direct labor demand effect for a given labor category results from substitution due to an increase in the cost of labor. Indirect effects follow from the substitution between different categories of labor which are all, but to a different degree, affected by the minimum wage. The demand for labor is further reduced by a decreasing demand for goods as a result of higher production costs and prices.[40]

To take these different determinants into account, we utilize empirical labor demand elasticities estimated by Freier and Steiner (2007a, 2010) on data from the BA Employment Panel (BAP, see subsection 2.3.5 below). Given labor demand elasticities for $L = 8$ groups, the change of the demand for labor of a specific group $k(\Delta B_k)$ to a relative change in the hourly wage of this group $(\Delta w_k/w_k)$ can be estimated by:

$$\Delta B_k = \sum_{l=1}^{8} c_l \left(\sigma_{kl} + \eta\right) \left(\Delta w_l / w_l\right) B_k \tag{2.4}$$

where σ_{kl} is the (Hicks/Allen-) substitution elasticity, c_l is the share of the wage costs of group l in total wage costs, and η is the price elasticity of demand for goods.[41]

[39]We distinguish between skilled (secondary school or vocational education) and unskilled (neither secondary school nor vocational education) full-time workers, part-time workers and marginally employed. Those groups are divided by gender, yielding 8 different categories and are estimated separately for West and East Germany. Highly skilled workers (with university degree) are assumed to be a quasi-fix factor in the short run.

[40]We do not consider adjustments of the capital stock here. In the long run it is likely that low-skilled labor is substituted by capital.

[41]Bauer et al. (2009) follow a similar approach but define different labor market groups. They use a slightly different specification of the labor demand model as well as a different data base for

Consumption effects

Another margin of adjustment for firms facing higher labor costs because of a minimum wage is to pass those costs onto consumers. Johnson and Browning (1983) assume that all households bear this total cost in proportion to their income. Macurdy and McIntyre (2001) relax the one-product assumption and relate the rise in the cost of labor for different industries to prices increases for various types of goods using input-output matrices. The rise in product prices is borne by all households depending on their concumption rate and structure. We follow this procedure here and assume perfect competition and perfectly elastic supply of goods. Increases in labor costs are thus fully borne by consumers. The average wage increase for a given sector is simulated as described in sub-section 2.3.1 above. Price increases for goods Δp_n produced in sector n result from wage increases in the same sector Δw_n (scaled by the share of wage costs ws_n), wage increases Δw_m in all other sectors m where intermediary inputs for sector n are produced (scaled by their share of wage costs ws_m), and the share of intermediary inputs in sector n in relation to all inputs as measured by the input coefficient a_{mn}:

$$\Delta p_n = (\Delta w_n) ws_n + \sum_m a_{mn} (\Delta w_m) ws_m \tag{2.5}$$

Contrary to previous simulation studies we also consider the adaption of the consumption behavior after these price increases. We estimate Engle curves for the shares of different consumption goods on data from the Continuous Household Budget Survey for Germany (Laufende Wirtschaftsrechnungen (LWR), see sub-section 2.3.5 below):

$$C_{gi}/C_i = \alpha + \beta_1 log(Y_i) + x_i'\beta + u_i \tag{2.6}$$

where C_i is total consumption expenditures of household i, C_{gi} is expenditures on good g, Y_i is available net household income, and x_i is a vector of socio-demographic characteristics. We estimate the system for 12 non-durable consumer goods cor-

the employment figures. Ragnitz and Thum (2008) and Knabe and Schöb (2009) use a simpler method assuming the labor demand elasticity to be the same for all groups (Müller, 2009a).

responding to the one-digit classification in the German income and consumption survey. C_i is also estimated as a function of current net household income and the variables included in x_i.[42]

2.3.4 Microsimulation with behavioral adjustments

Having estimated behavioral reactions at different margins we are able to incorporate them into our simulation model and analyze their distributional consequences. To our knowledge none of the aforementioned papers has integrated behavioral effects into a microsimulation model. Analyzing *labor supply* effects within a simulation model is common (Creedy and Duncan, 2002). As those effects turn out to be small (see section 2.4) we exclude labor supply from the distributional analysis without further consequences.

Based on the estimated *labor demand* changes in (2.4) we predict the share of people who become unemployed ($\Delta B_k/B_k$) for a given minimum wage level and for each labor type k.[43] We then draw a weighted random sample of the same size among those who are affected by the minimum wage (i.e. earn wages below the level of the minimum) per group k with the weights being determined linearly by the distance between the earned wage and the minimum wage. The individuals selected in this manner become unemployed under the simulated minimum wage scenario. The unemployment probability varies with individual characteristics and the distance of the observed wage from the minimum wage level. We capture the distributional implications of potential disemployment effects. The procedure is repeated 50 times and average net household incomes are simulated as described in sub-section 2.3.2 above to get robust results. For the simulation of *consumption effects* we use the structural parameters of (2.4) to predict household-specific consumption shares with the SOEP data. This enables us to simulate the effects of the federal minimum wage

[42]Estimation results for the consumption function are reported in Table 2.12 in the Appendix. Further information on measurement, the exact calculation of the burden and detailed results from the consumption share equations are available from the authors upon request.

[43]Depending on the assumed size of η the demand change is positive for some i. Since we abstract from labor supply effects and in order to simplify the analysis we disregard positive employment changes in this version of the simulation. The only group where this simplification is relevant are women working part-time in West Germany.

on consumption as described in sub-section 2.3.2 as pure price effect and with the behavioral adjustments after an increase in consumer prices.

Our approach is limited in several ways. The simulation of wage effects rests on the assumptions about coverage, compliance and no wage spillovers. Although we allow for more heterogeneity in behavioral adjustments than previous studies, limitations remain with respect to labor demand and consumption. For both margins we are only able to differentiate the analysis by combining individual and household characteristics. The distributional effects are therefore approximated by the resulting groups. Although different adjustment mechanisms are considered, we do not conduct a general equilibrium analysis as interdependencies between labor supply and demand or consumption and employment are not explicitly modeled. We do not simulate "third round" effects here (i.e. the distribution of saved benefits and tax revenues), since we do not want to speculate about a re-distribution mechanism.[44] Nevertheless a microsimulation approach is better suited for the distributional questions we adress here than, e.g., computable general equilibrium models.

2.3.5 Data

The simulation of wage effects, the microsimulation and labor supply estimation are based on data from the German Socio-Economic Panel (SOEP) which is a representative sample of households living in Germany with detailed information on household incomes, working hours and the household structure (Wagner et al., 2007). We use the current wave for the year 2010. Since the STSM is based on retrospective information on income components for the simulation of net household incomes for a given year, wages and incomes computed on basis of the SOEP wave from 2010 refer to 2009. Because our analysis refers to the year 2012, we extrapolate incomes on the basis of realized average growth rates for 2010 and 2011, and expected growth rates for 2012.[45] The tax-benefit system is also updated to include all known changes in

[44]Müller and Steiner (2011) simulate the effects of a statutory minimum wage where the gains in fiscal revenues are redistributed via an employer-oriented wage subsidy.

[45]Most interviews in the SOEP refer to the first quarter of the year. We assume that incomes will increase with the annual growth rate in that year. Average annual growth rates are derived from the following indices for the years 2010, 2011 and 2012: 1.011, 1.023, 1.021 for consumer prices;

regulations up to 2012.

Labor demand estimations are based on the BA Employment Panel (BAP, Koch and Meinken (2004)) provided by the Federal Employment Agency. The BAP contains quarterly information on employment and wages for a 2% random sub-sample of all employees subject to social insurance between 1998 and 2003 amounting to about 600,000 observations per quarter. Freier and Steiner (2007a) and Freier and Steiner (2010) provide more details. The calculation of price effects and the estimation of Engle curves is based on data from the Continuous Household Budget Survey for Germany ("Laufende Wirtschaftsrechnungen", LWR, Statistisches Bundesamt (2007)). The LWR are provided by the German Federal Statistical Office and consist of repeated cross-sections (on a monthly and partly a quarterly basis) between 2002 and 2007. The data set used in this paper consists of about 25,500 observations for West Germany and nearly 7,000 observations for East Germany. The LWR contains detailed information on income, consumption, and savings at the household level.

2.4 Empirical results

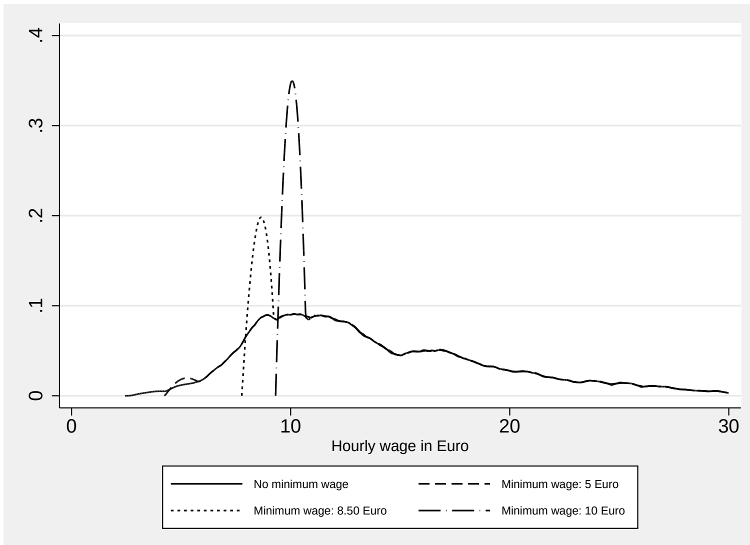
2.4.1 Wage inequality

The impact on the wage distribution of employed people – disregarding employment effects for the moment – crucially depends on the level at which the minimum wage is set. The kernel density estimates of the observed and simulated distributions in Figure 2.1 illustrate those differences. A minimum wage of 5.00 €/hour (dashed line) has only a minimal impact on the distribution. Minima set at 8.50 or 10.00 €/hour respectively generate marked spikes in the distribution. The graph also visualizes the assumptions we make. The simulated wage distributions under a minimum wage are censored at the minimum and wages above the minimum wage level remain

1.007, 1.030, 1.026 for wages; 1.003, and 1.05, 1.035, 1.035 for income from profits (source: national accounts; BMWi (2010); own calculations).

unchanged.[46] Given these assumptions the minimum wage by definition only affects lower parts of the wage distribution: A minimum wage of 5.00 €/hour changes only the first 5 percentiles, a minimum of 8.50 €/hour alters the distribution up to the 15th percentile and set at a level of 10.00 €/hour up to the 20th percentile.

Figure 2.1: Kernel density estimates of wage distributions



Source: Own calculations based on SOEP, wave 2010.

As Table 2.1 shows, a minimum wage of 5.00 €/hour amounts to about 30% of the median and 33% of the average gross hourly wage in the German economy.[47] These ratios increase to about 56% and 51% under a minimum of 8.50 €/hour and to 66% and 60% for a minimum wage in the amount of 10.00 €/hour. Only about 1% of all German employees would be affected by a minimum wage of 5.00 €/hour, whereas the incidence increases to more than 11% (19%) for a minimum of 8.50 €/hour (10.00 €/hour). The introduction of a minimum wage of 8.50 €/hour would increase the total wage bill by about 650 million €/month, or 7.8 billion €/year, which is about 0.9% of the wage bill in 2012. The increase in the wage bill would be substantially lower for a moderate minimum of 5.00 €/hour and only amounts to 0.04% of the total wage bill. An increase in the minimum wage level to 10.00 €/hour on the other

[46]As mentioned above wages below 3 €/hour earned in regular employment are excluded from the analysis. Wages below 3 €/hour are included if they refer to supplementary work of people drawing unemployment benefits.

[47]People in full-time vocational and apprenticeship training as well as 'secondary jobs', i.e. jobs held in addition to the main job, are excluded here.

hand more than doubles the increase in the total wage bill to 1.5 billion €/month or almost 2% of the total wage bill.

Table 2.1: The effects of a minimum wage on the wage distribution, Germany total; only currently employed people, 2012

	MW=5.00 €/hour		MW=8.50 €/hour		MW=10.00 €/hour	
Incidence						
MW as % of						
Median		29.83		55.92		65.79
Mean		32.89		50.72		59.67
Affected (%)						
overall		1.14		11.39		18.97
1st decile		11.58		100.00		100.00
Change in wage sum						
1000 €/m		32,340		647,388		1,464,828
% wage sum		0.04		0.86		1.95
Wage inequality – no MW						
Gini coefficient (× 100)	25.76	(24.90; 26.62)	25.76	(24.90; 26.62)	25.76	(24.90; 26.62)
Mean log deviation (× 100)	10.74	(9.92; 11.57)	10.74	(9.92; 11.57)	10.74	(9.92; 11.57)
Atkinson ($\epsilon = 2$) (× 100)	18.35	(17.37; 19.32)	18.35	(17.37; 19.32)	18.35	(17.37; 19.32)
Wage inequality – MW						
Gini coefficient (× 100)	25.69	(24.84; 26.55)	24.27	(23.43; 25.12)	22.27	(21.42; 23.12)
Δ (Δ %)	-0.07	(-0.27)	-1.49	(-5.78)	-3.49	(-13.55)
Mean log deviation (× 100)	10.62	(9.80; 11.44)	9.32	(8.54; 10.11)	8.07	(7.31; 8.83)
Δ (Δ %)	-0.12	(-1.12)	-1.42	(-13.22)	-2.67	(-24.86)
Atkinson ($\epsilon = 2$) (× 100)	17.97	(17.03; 18.92)	15.31	(14.41; 16.22)	13.10	(12.22; 13.99)
Δ (Δ %)	-0.38	(-2.07)	-3.04	(-16.57)	-5.25	(-28.61)

Notes: Only employed people aged 18-65 are included. Wage projections for 2012 are based on average growth rates. Weighted data using sample weights to obtain population means. Δ wage bill is the difference between the wage sum with and without the minimum wage, with wage sum = $\sum$ (hourly wage × weekly working hours × 4.2); employers' social security contributions not included. The Gini coefficient is sensitive to changes in the middle of the income distribution. The mean log deviation of equivalent income is a 'bottom-sensitive' inequality measure. The Atkinson inequality measure is calculated for a high degree of inequality aversion ($\epsilon = 2$); see Cowell (2000). 95%-confidence bands are given in parentheses.
Source: Own calculations based on SOEP, wave 2010.

To assess the effects on wage inequality several synthetic measures are calculated (Table 2.1). According to the *Gini coefficient* which is sensitive to changes in the middle of the distribution, a minimum of 5.00 €/hour would not significantly reduce inequality. Setting the minimum at 8.00 or even 10.00 €/hour yields a sgnificantly smaller measure; inequality would decrease by about 6% or 14% respectively. The more bottom-sensitive *Mean log deviation* or *Atkinson inequality measure* yield qualitatively similar results. A minimum of 5.00 €/hour could not siginificantly decrease wage inequality the higher minima would achive this and reduce inequality by about 15% and 25% respectively. Minimum wages set at higher levels would thus substantially decrease wage inequality, if the assumptions described at the outset were to hold.

There is considerable heterogeneity in the incidence and wage effects of the minimum wage across regions and gender (see Table 2.7 in the Appendix for a minimum of 8.50 €/hour). Whilst among men in West Germany only about 6% of all employees would be affected, 17% of males in East Germany and almost 13% (22%) of employed women in West (East) Germany earn wages below this minimum. Except for men in West Germany, all currently employed people in the bottom decile of the wage distribution would be bitten by the minimum wage. The minimum wage would disproportionately affect younger employees, those with low qualification, marginally employed people and those working in small firms. The magnitude of the wage changes differs little by age and qualification, but significantly by employment status. Low-pay of people in marginal employment (jobs earning less than 400 €/month and without social security coverag) has been one alleged reason for introducing a minimum wage. As shown in Table 2.7 hourly gross wages of people holding such jobs would be raised by almost 40% in the bottom decile compared to about 25% for full-time employed people.

The wage simulations proved robust with respect to the forecasting with average growth rates. Estimating dynamic wage growth regressions and using individual growth rates does not affect the results. Another sensitivity check concerns the treatment of secondary jobs. Since the 2003 “Mini Jobs” reform, jobs with earnings below 400 €/month have been exempted from employees’ social security contributions if held in addition to a main job (Steiner and Wrohlich, 2005). Including those jobs leads to higher simulated wage gains in the first decile, but overall findings change only marginally without affecting our conclusions. Given the robustness of our simulation results (see also Müller and Steiner (2010)) we continue the analysis on the basis of the simulation results in Table 2.1.

2.4.2 Behavioral effects

Labor supply

Labor supply effects are small overall but naturally depend on the level of the minimum wage (see Table 2.8 in the Appendix). Setting the minimum at 5.00 €/hour would induce virtually no labor supply response (less than 3,000 persons); at 8.50 €/hour labor force participation would increase by about 65,000 persons and by almost 140,000 if the minimum wage was fixed at 10.00 €/hour. The effects on total hours worked amount to about 6,000, 200,000, and 400,000 full-time equivalents, respectively. The main explanation for these moderate effects – even after sizeable increases of gross wages – is the previously described loose relationship between hourly wages and household income (see also the results in sub-section 2.4.3 below). Therefore the incentives to increase the supply of labor remain rather limited.

Except for singles in East Germany labor supply effects are larger for women compared to men both with respect to participation and hours choices. Overall, households in the East show larger labor supply responses compared to West Germany as the relative level of the minimum wage is higher. Since the participation effects are fairly small, we will not consider labor supply changes in the simulation of household incomes with behavioral adjustment in this paper. Detailed estimation results for the conditional logit models are presented in Table 2.9 in the Appendix, all model assumptions (see (van Soest, 1995) for details) hold.

Labor demand

The simulation on labor demand effects rests on compensated own and cross wage elasticities of the demand for labor (number of workers) for different types of labor that are estimated by Freier and Steiner (2007a, 2010). These elasticities are conditional on the level of output and the capital stock and estimated separately for West and East Germany. They reveal a rather complex pattern of substitution and complementarity among labor inputs (see Table 2.10 in the Appendix). For instance, marginally employed women in West Germany and women working part-time are substitutes in production whereas marginally employed women and skilled women with full-time jobs are complements. For a given demand for goods a relatively high increase in wages for marginally employed women induced by the minimum wage will lead to a decrease in labor demand for this group and also for skilled women in full-time, but an increase in labor demand for women working part-time. The elasticities for East Germany follow a similar pattern for this group. Note that highly skilled individuals were assumed to be quasi-fixed which is why we do not calculate labor demand effects for this group.

The second determinant of labor demand responses is the average wage change per type of labor induced by the minimum wage. In Table 2.11 in the Appendix the simulated wage increases are broken down to the labor types used in the labor demand estimations. The highest relative wage increase occurs for marginally employed workers; for a minimum wage of 8.50 €/hour it amounts to 13% (24%) for men and 7% (12%) for women in West (East) Germany. Part-time employed and unskilled women working full-time in East Germany would also experience notable wage rises. The incidence and wage changes obviously depend on the minimum wage level: only 14% (7%) of marginally employed men in the West (East) would be affected by a minimum wage rate of 5.00 €/hour. The incidence rate for this group increases to 38% (42%) for a level of 8.50 €/hour and to 45% (50%) when the minimum is fixed at 10.00 €/hour. The incidence rate not only increases within, but is very different between labor types for varying minimum wage levels. Looking again at marginally employed as an example, men in West Germany with an incidence rate of 14% are clearly more often affected by a minimum wage of 5.00 €/hour compared to women in the West (less than 4%) of men in the East (7%). When the minimum would be set at 10.00 €/hour men in the East (50%) and women in the West (48%) are more often affected than men in West Germany (45%).

In Table 2.2 the employment effects for different minimum wages are reported which were calculated on the basis of the demand elasticities, the wage changes per type of labor, and 3 different price elasticities for the demand for goods (0, -1, -2). The overall employment effects depend on the assumed level of the minimum wage and the price elasticity of the demand for goods. If the latter was perfectly inelastic, overall labor demand would decrease by about 6,000 persons for a minimum wage of 5.00 €/hour, by 70,000 individuals for a level of 8.50 €/hour, and by 135,000 persons for a level of 10.00 €/hour. In these scenarios the loss of marginal employment would partially be compensated by an increase in demand especially for part-time employed women. If the demand for goods was highly elastic with respect to price changes (assumed elasticity of -2), the overall decrease in demand for labor would amount to

Table 2.2: Changes in labor demand (heads) after the introduction of a legal minimum wage, 2012

			MW=5.00 €/hour Output price elasticities			**MW=8.50 €/hour** Output price elasticities			**MW=10.00 €/hour** Output price elasticities		
			0	-1	-2	0	-1	-2	0	-1	-2
West Germany											
Full-time	Skilled	*Women*	-353	-1,697	-3,041	-9,653	-33,336	-57,019	-20,795	-78,695	-136,594
		Men	969	-1,581	-4,132	17,696	-27,244	-72,184	39,691	-70,178	-180,046
	Unskilled	*Women*	-2	-213	-424	-3,818	-7,537	-11,255	-9,424	-18,515	-27,605
		Men	67	-316	-700	3,294	-3,462	-10,219	4,427	-12,091	-28,610
Part-time		*Women*	2,007	449	-1,108	23,968	-3,478	-30,925	39,688	-27,413	-94,513
		Men	-450	-638	-826	-831	-4,146	-7,460	1,304	-6,799	-14,902
Marginally employed		*Women*	-4,886	-5,545	-6,203	-64,392	-75,994	-87,596	-116,446	-144,810	-173,175
		Men	-1,373	-1,554	-1,736	-18,671	-21,861	-25,052	-32,945	-40,745	-48,545
Total			-4,021	-11,095	-18,169	-52,406	-177,058	-301,709	-94,501	-399,245	-703,990
East Germany											
Full-time	Skilled	*Women*	270	-767	-1,803	-2,078	-33,754	-65,430	-5,572	-73,765	-141,959
		Men	191	-1,620	-3,432	3,132	-52,223	-107,579	7,458	-111,713	-230,885
	Unskilled	*Women*	145	90	34	1,282	-413	-2,108	2,163	-1,487	-5,136
		Men	-251	-439	-627	-342	-6,086	-11,829	203	-12,162	-24,526
Part-time		*Women*	-713	-1,766	-2,819	5,158	-27,026	-59,210	8,792	-60,496	-129,783
		Men	-43	-207	-370	-1,203	-6,203	-11,202	-1,186	-11,949	-22,712
Marginally employed		*Women*	-1,245	-1,589	-1,932	-13,396	-23,889	-34,381	-24,954	-47,543	-70,132
		Men	-394	-508	-622	-8,007	-11,492	-14,978	-15,107	-22,610	-30,114
Total			-2,039	-6,805	-11,571	-15,454	-161,086	-306,717	-28,203	-341,725	-655,248

Notes: Own- and cross-wage elasticities taken into account. Demand changes in numbers of employees ('heads').
Qualification categories according to Freier and Steiner (2007a, 2010): 'skilled' = secondary-school education or vocational training, 'unskilled' = neither secondary-school education nor vocational training.
Source: Own calculations based on elasticity estimates taken from Freier and Steiner (2007a, 2010), SOEP wave 2010.

about 30,000, 600,000, and 1.35 million persons, respectively. Again the lion's share of employment losses concerns marginal employment. In this scenario the demand for skilled full-time labor would also shrink considerably due to the strong reduction in the demand for goods. We regard the scenario with an assumed price elasticity of demand for goods of -1 the most plausible one for the German economy. The resulting decrease in labor demand for a minimum wage of 5.00 €/hour amounts to about 18,000 persons, for a minimum wage level of 8.50 €/hour to about 340,000 individuals, and for a level of 10.00 €/hour to 740,000 persons. We use this variant for the simulation of household incomes that include the behavioral adjustment of labor demand in the next sub-section.[48]

Consumption

Facing minimum wage induced price increases in consumption goods households will decrease their consumption level and adjust the composition of consumed goods as relative prices change, too. In addition to the price increases we simulate the adjustment of overall consumption in this paper. Estimation results for the consumption rate are presented in Table 2.12 in the Appendix. The consumption rate significantly decreases with household income both in East and West Germany. Poorer households consume a larger share of their income underlining the regressive effect of the minimum wage induced price increases. The consumption rate also significantly differs with wealth, the composition of the household, the individual characteristics, the labor force participation, and the social position of all household members. We will use the structural parameters from this model to predict the consumption rate and simulate its adjustment after the introduction of a minimum wage.

[48]Our estimated employment effects are much smaller than those obtained by Bauer et al. (2009); Ragnitz and Thum (2008); Knabe and Schöb (2009). Bauer et al. assume a rather small price elasticity of demand of -0.2 value and use different compensated labor demand elasticities which imply that most labor categories are gross complements. However, the main reason for differences in simulated employment effects seem to be that Bauer et al. base their simulations on much larger relative wage changes induced by a minimum wage than we find in our study. Ragnitz and Thum (2008) use the same data set and assume a uniform labor demand elasticity of -0.7, which is also assumed in the study by Knabe and Schöb who use SOEP data instead. Müller (2009a) discusses the sensitivity of the labor demand estimations.

2.4.3 Income inequality

As shown above a minimum wage set at higher levels would lead to a significant increase of hourly wages at the bottom of the distribution and reduce wage inequality in Germany. In this sub-section we present results from the microsimulation analysis on the effects of a minimum wage on household incomes and overall income inequality. First, we discuss the average effects and then look into the distributional consequences. In each sub-section a static scenario without behavioral adjustments is presented. In the second scenario labor demand adjustments are taken into account. The final simulations additionally incorporate price adjustments of firms for consumption goods and the adaption of the consumption rate by households.

Average effects

The overall share of households affected in Germany is 2%, 12% and about 20% for the respective minimum wage levels of 5.00, 8.50, and 10.00 €/hour (Table 2.3). Regional differences can also be identified for the minimum wage incidence at the household level as East German households are more frequently affected. Given a level of 8.50 €/hour the incidence rate is 10% in West and 18% in East Germany. Without behavioral adjustments a minimum wage set at 5.00 €/hour would increase net monthly incomes for those households affected by it by only about 5 € (0.2%). When the minimum wage is set at 8.50 €/hour this amount increases to 80 € (3%), and to 120 € (5%) for a level of 10.00 €/hour. The average increase in income is clearly higher for households in East Germany. For a minimum wage set at 8.50 €/hour the difference is 6% in the East vs. 2% in the West.

When behavioral effects are not considered the income change would amount to about 2.9 million €/month, or roughly 35 million €/year in total when the minimum is set at 5.00 €/hour. The total sum increases to 267 million €/month (3.2 billion €/year) and 652 million €/month (7.8 billion €/year) for minimum wages of to 8.50 €/hour and to 10.00 €/hour, respectively. Roughly the same total amount would go to West and East Germany, although only about 20% of the total population lives in the East. The absolute sums are substantially smaller compared to the

Table 2.3: Minimum wage effects on net incomes of households affected by the minimum wage, 2012

	MW=5.00 €/hour			**MW=8.50 €/hour**			**MW=10.00 €/hour**		
	Total	West	East	Total	West	East	Total	West	East
Incidence (%)	2.0	1.8	2.7	12.2	10.5	17.8	19.8	17.4	27.5
Avg. income no MW (€/m)	2,784	3,195	1,870	2,448	2,668	2,032	2,470	2,646	2,111
Δ Average income with MW									
No behavioral effects (€/m)	5.2	-1.6	20.3	80.4	58.7	121.4	121.2	95.6	173.4
No behavioral effects (%)	0.2	-0.1	1.1	3.3	2.2	6.0	4.9	3.6	8.2
With employment effects (€/m)	-1.1	-7.0	12.0	42.6	32.5	61.8	51.6	41.5	72.3
With employment effects (%)	0.0	-0.2	0.6	1.7	1.2	3.0	2.1	1.6	3.4
Consumption price effects (€/m)	-27.7	-34.6	-12.3	-19.9	-23.3	-13.4	-15.9	-19.6	-8.2
Consumption price effects (%)	-1.0	-1.1	-0.7	-0.8	-0.9	-0.7	-0.6	-0.7	-0.4
Total consumption effects (€/m)	0.6	-3.4	9.4	24.4	17.9	36.6	32.9	24.8	49.5
Total consumption effects (%)	0.0	-0.1	0.5	1.0	0.7	1.8	1.3	0.9	2.3
Δ Total income with MW									
No behavioral effects (mill. €/m)	2.9	-0.6	3.5	266.5	127.3	139.2	652.3	345.0	307.2
With employment effects (mill. €/m)	-0.6	-2.7	2.0	141.3	70.4	70.9	277.9	149.6	128.2
Consumption price effects (mill. €/m)	-15.2	-13.1	-2.1	-66.0	-50.6	-13.4	-85.5	-70.9	-14.6
Total consumption effects (mill. €/m)	0.3	-1.3	1.6	80.8	38.8	42.0	177.2	89.5	87.7

Notes: Incidence = Households affected by the minimum wage as percentage of all households in each group. Percentage changes of average income refer to households within the respective group, percentage changes of total income are calculated relative to the whole population. Employment status refers to the situation before the introduction of a minimum wage. When accounting for employment effects of a minimum wage a fraction of the employed is simulated to become unemployed according to demand side constraints of Table 2.4. Wage projections for 2012 are based on average growth rates.
Source: Own calculations based on SOEP, wave 2010.

total increase in the wage bill (see Table 2.1). The shares of net income gains from the increases in gross wages equal 9% for a minimum of 5.00 €, 41% for a minimum of 8.50 € and 45% for a minimum of 10.00 €/hour. In this simulation where agents do not adapt their behavior, the relatively smaller increase in net incomes can be explained by the substitution of means-tested income transfers by higher wage incomes and progressive taxation. Raising hourly wages through a statutory minimum at the bottom of distribution leads to the withdrawal of social transfers, higher income taxes, and increased public savings. The impact on net household incomes is diminished by those components.[49]

Under a scenario that takes employment effects into account ("with employment effects" in Table 2.3) the average monthly income gain for households affected by the minimum wage is roughly cut by half. For a minimum set at 8.50 €/hour it decreases from about 80 € to 43 €. For the low minimum wage level of 5.00 €/hour the income effect becomes even slightly negative because of the labor demand reactions. Likewise the total increase in household incomes shrinks considerably. As would be expected employment losses due to the legal minimum further reduce the modest increases in household incomes substantially.

In addition to labor demand adjustments the following simulations take also consumption effects into account. If only the prices of consumption goods increased due to a minimum wage and households did not adjust their demand for consumption goods to changes in real net household income ("consumption price effects" in Table 2.3), the change of net incomes becomes negative for all three minimum wage levels. Households affected by the federal minimum wage would, on average, suffer an income loss of 28 €, 20 €, and 16 € for minimum wages set at 5.00 €, 8.50 €, and 10.00 €/hour respectively. Accordingly, the total income effect would become negative. If the estimated adjustment of consumption behavior induced by changes in real net household income is also considered ("total consumption effects" in Table

[49] We do not consider fiscal effects here, but simulate the effects of an increase in wage costs through behavioral adjustments of labor demand and consumption. Potential public savings are diminished by lower output levels and higher unemployment. Bauer et al. (2009) look into the fiscal effects of a nationwide minimum wage. Müller and Steiner (2011) simulate the effects of a legal minimum wage when fiscal revenue is re-distributed by an employer-oriented wage subsidy.

2.3), the price effect of the minimum wage on net household incomes is partly compensated for by a reduction in the demand for goods with a relatively high income elasticity (quantity effect).[50] Except for the scenario with the low minimum wage in West Germany, the price and quantity effect together (total consumption effect) have positive effects on net household incomes. Yet, the average increase in household income is substantially reduced by about one-half compared to the simulation with employment effects.

The income effects of a minimum wage are *heterogeneous* with respect to different household types. The incidence rate is higher for couples than for singles and for households with children compared to those without. Among couples the share is also greater for families where both spouses work (see Table 2.13 for a minimum wage of 8.50 €/hour).[51] Since means-tested transfers are related to the presence of children in the household and to the employment status of the spouse, the minimum wage leads to smaller increases of the monthly household income for families with children. Depending on behavioral adjustments the average gain in net income is between 40 and 60% lower for households with children. Labor demand constraints are not evenly distributed over households. Families with children would be penalized more strongly. This pattern also holds for the simulations that take consumption effects into account. In the scenario where only price effects are considered singles without children are the only group that maintains a positive income difference. When quantity adjustments are allowed all household types – except for couples with only one working spouse – exhibit positive net income effects. Yet, households with children react less elastic in their consumption behavior and thus bear more of the price increase. Although households with children would be more often affected by a minimum wage, their net gain from this policy would be significantly below-average. The minimum wage is thus not well targeted at families with children.

[50] We are not able to consider substitution effects between different (types of) consumption goods here as we do not have detailed demand elasticities for different (groups of) goods at our disposal.

[51] Detailed results for different minimum wage levels and by region are available from the authors upon request. Müller and Steiner (2010) have shown these differences to be more pronounced in West Germany.

Distributional effects and inequality

The effects of the minimum wage on overal income inequality depend on the distribution of minimum wage earners accros different income levels and the average income changes of affected households at different locations of the income distribution. The share of persons affected by the minimum wage in the bottom decile of the net equivalent income distribution is substantially smaller than the incidence rates in each of the 2nd-6th deciles (Table 2.4). Only in the higher deciles of the distribution does this share decline below the level it obtains in the bottom decile. This pattern holds regardless of the level of the minimum wage. A regional breakdown conducted by Müller and Steiner (2010) reveals that the minimum wage incidence varies across deciles of the net equivalence income distribution between West and East Germany. Whereas the share of people affected by the minimum is low in the first and second decile and highest between the 3rd and 7th decile in the East, the incidence rate is highest in the 2nd decile and declines after that in West Germany. Confirming the interational evidence the minimum wage would not be targeted at the poor from the perspective of the distribution of net equivalence incomes.

Without behavioral adjustments net equivalent income would increase for households affected by the minimum wage of 8.50 €/hour by about 55 €, or 4%, on average (see Table 2.4). The largest relative increase in average equivalent income would occur in the 2nd decile of the income distribution and amount to about 80 €/month, or about 8% of this group's net equivalent income in 2012. The negative difference for the very small share of affected households in certain deciles for the scenario with a minimum wage level of 5 €/hour probably follows from the loss of the splitting advantage of joint taxation of couples in Germany as soon as the second earner's income grows as a result of the minimum wage. These negative effects are not substantial, neither in relative nor in absolute terms.

In the simulations that take employment effects into account net equivalent income gains decline considerably: for a minimum wage of 8.50 €/hour the remaining average increase in equivalent income amounts to about 23 €/month (see Table 2.4). Especially the relatively high absolute gains in the 2nd-6th deciles are reduced

Table 2.4: Effects of a minimum wage on net equivalent incomes of households affected, Germany 2012

Decile	Avg. income no MW	Incidence MW=			MW: without behavioral effects						MW: with employment effects					
					MW=5.00€/hour Δ avg. income		MW=8.50€/hour Δ avg. income		MW=10.00€/hour Δ avg. income		MW=5.00€/hour Δ avg. income		MW=8.50€/hour Δ avg. income		MW=10.00€/hour Δ avg. income	
	(€/m)	5.00€ (%)	8.50€ (%)	10.00€ (%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)
1st	727	1.9	13.0	17.8	14.5	1.8	41.6	5.2	62.6	7.9	10.7	1.3	22.2	2.8	31.4	3.9
2nd	985	6.1	25.4	36.6	16.8	1.7	82.9	8.4	118.7	12.1	9.2	0.9	40.8	4.1	45.6	4.6
3rd	1,175	2.2	19.9	33.5	3.1	0.3	57.2	4.9	101.4	8.6	1.5	0.1	20.5	1.8	33.3	2.8
4th	1,369	4.5	24.9	34.6	5.7	0.4	73.2	5.4	113.9	8.4	5.1	0.4	28.4	2.1	50.2	3.7
5th	1,558	3.5	21.0	33.1	4.1	0.3	41.6	2.7	75.9	4.9	-3.8	-0.3	23.4	1.5	19.7	1.3
6th	1,748	1.9	12.2	22.6	-13.1	-0.8	35.9	2.1	57.5	3.3	-10.8	-0.6	15.8	0.9	26.6	1.5
7th	1,951	2.3	12.7	19.4	13.3	0.7	36.4	1.9	54.4	2.8	-4.7	-0.2	9.9	0.5	8.2	0.4
8th	2,195	1.6	8.3	17.2	-35.7	-1.6	46.0	2.1	56.0	2.6	-40.1	-1.8	-4.5	-0.2	-14.7	-0.7
9th	2,600	0.6	5.8	13.2	6.9	0.3	37.2	1.5	54.3	2.1	6.3	0.3	26.5	1.1	19.7	0.8
10th	4,234	2.4	4.6	5.8	-8.9	-0.3	26.6	0.8	38.9	1.1	-12.5	-0.4	-2.5	-0.1	16.2	0.4
Average	1,854	2.7	14.8	23.4	5.0	0.3	55.8	3.9	85.3	5.8	-1.2	-0.1	22.7	1.5	28.2	1.8

Decile	Avg. income no MW	Incidence MW=			MW: with employment & consumption price effects						MW: with employment & total consumption effects					
					MW=5.00€/hour Δ avg. income		MW=8.50€/hour Δ avg. income		MW=10.00€/hour Δ avg. income		MW=5.00€/hour Δ avg. income		MW=8.50€/hour Δ avg. income		MW=10.00€/hour Δ avg. income	
	(€/m)	5.00€ (%)	8.50€ (%)	10.00€ (%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)	(€/m)	(%)
1st	727	1.9	13.0	17.8	-0.8	-0.1	3.8	0.6	4.3	0.7	6.3	1.0	16.2	2.5	21.9	3.4
2nd	985	6.1	25.4	36.6	-5.3	-0.6	-5.0	-0.6	2.2	0.3	4.3	0.5	15.3	1.7	29.2	3.3
3rd	1,175	2.2	19.9	33.5	-13.1	-1.2	-11.8	-1.1	-8.3	-0.8	2.3	0.2	11.6	1.1	13.7	1.3
4th	1,369	4.5	24.9	34.6	-15.1	-1.2	-12.0	-0.9	-9.3	-0.7	-4.3	-0.3	15.8	1.2	22.2	1.7
5th	1,558	3.5	21.0	33.1	-17.4	-1.2	-17.1	-1.2	-14.7	-1.0	1.2	0.1	5.7	0.4	15.6	1.1
6th	1,748	1.9	12.2	22.6	-20.5	-1.3	-15.2	-0.9	-15.9	-1.0	-4.1	-0.3	12.4	0.8	11.3	0.7
7th	1,951	2.3	12.7	19.4	-23.7	-1.3	-21.4	-1.1	-18.8	-1.0	-5.4	-0.3	4.6	0.2	10.3	0.6
8th	2,195	1.6	8.3	17.2	-14.8	-0.7	-20.1	-0.9	-23.4	-1.1	7.1	0.3	10.7	0.5	0.6	0.0
9th	2,600	0.6	5.8	13.2	-25.5	-1.1	-24.8	-1.0	-23.7	-0.9	2.2	0.1	7.2	0.3	7.6	0.3
10th	4,234	2.4	4.6	5.8	-33.5	-1.0	-24.8	-0.7	-21.9	-0.6	-9.6	-0.3	14.3	0.4	18.9	0.5
Average	1,854	2.7	14.8	23.4	-15.6	-1.1	-12.9	-0.9	-11.2	-0.8	-0.3	0.0	11.6	0.8	16.2	1.1

Notes: Deciles for the distribution of equivalent net incomes are calculated for the wage structure in 2012 (without minimum wage). Incidence = households affected by the minimum wage as percentage of all households within a given decile of the net equivalence income distribution. Δ avg. income = change of average incomes measured in equivalence units for affected households within a given decile. Wage projections for 2012 are based on average growth rates.
Source: Own calculations based on SOEP wave 2010.

substantially as those regions would be particularly affected by decreases of labor demand. When price effects for consumption goods are also considered without the behavioral adjustment of the consumption rate, the effects on net household equivalent incomes are negative throughout the whole income distribution and for all minimum wage levels. For a minimum wage set at 8.50 €/hour income losses are on average 13 €/month. When the adaption of consumers' behavior is also considered, the effects become positive again. The income gains which equal 12 €/month on average for a minimum wage of 8.50 €/hour are albeit smaller compared to the scenario without consumption effects (see Table 2.4). The redistributive effect of the minimum wage is also reduced in this simulation, because households in the lower income deciles have higher consumption rates and are disproportionately negatively affected by the indirect effects of the minimum wage on consumption.

To investigate the potential effects the introduction of a legal minimum wage would have on the overall income distribution, Table 2.5 reports standard summary inequality measures. For the scenario without behavioral adjustments of labor demand and consumption the *Gini coefficient*, which is sensitive to income changes in the middle of the distribution, does not record any significant change. The bottom-sensitive mean logarithmic deviation (MLD) measure reveals a very small decline in income inequality, which is also recorded by the Atkinson measure assuming a relatively high value for the inequality aversion parameter ($\epsilon = 2$). These very small reductions in income inequality are comparable between West and East Germany (Müller and Steiner, 2010). Thus, in neither region would the minimum wage have any noticeable effect on overall income inequality. These findings hold for the whole range of minimum wage levels between 5.00 and 10.00 €/hour.

The minimum wage becomes even less effective with respect to the reduction of overall income inequality when labor demand effects are taken into account. This is illustrated by the smaller differences for the inequality measures compared to simulation results not accounting for negative employment of the minimum wage. The already small redistributive effects of a minimum wage are further reduced or vanish completely when the effects on consumption are also taken into account. In

Table 2.5: Minimum wage effects on inequality measures, Germany, 2012

	MW=5.00 €/hour		MW=8.50 €/hour		MW=10.00 €/hour	
Status quo - no MW						
Gini coefficient (× 100)	27.60	(25.50; 29.70)	27.60	(25.50; 29.70)	27.60	(25.50; 29.70)
Mean log deviation (× 100)	13.09	(10.57; 15.62)	13.09	(10.57; 15.62)	13.09	(10.57; 15.62)
Atkinson ($\epsilon = 2$) (× 100)	22.88	(19.87; 25.88)	22.88	(19.87; 25.88)	22.88	(19.87; 25.88)
No employment effects						
Gini coefficient (× 100)	27.60	(25.50; 29.69)	27.43	(25.34; 29.53)	27.22	(25.13; 29.31)
Δ (Δ %)	0.00	(0.00)	-0.17	(-0.62)	-0.38	(-1.38)
Mean log deviation (× 100)	13.09	(10.57; 15.62)	12.97	(10.46; 15.48)	12.82	(10.32; 15.32)
Δ (Δ %)	0.00	(0.00)	-0.12	(-0.92)	-0.27	(-2.06)
Atkinson ($\epsilon = 2$) (× 100)	22.87	(19.86; 25.87)	22.73	(19.71; 25.74)	22.58	(19.56; 25.60)
Δ (Δ %)	-0.01	(-0.04)	-0.15	(-0.66)	-0.30	(-1.31)
With employment effects						
Gini coefficient (× 100)	27.60	(25.20; 29.99)	27.53	(25.13; 29.93)	27.50	(25.10; 29.90)
Δ (Δ %)	0.00	(0.00)	-0.07	(-0.25)	-0.10	(-0.36)
Mean log deviation (× 100)	13.10	(10.19; 16.00)	13.05	(10.15; 15.96)	13.06	(10.16; 15.96)
Δ (Δ %)	0.01	(0.08)	-0.04	(-0.31)	-0.03	(-0.23)
Atkinson ($\epsilon = 2$) (× 100)	22.88	(19.57; 26.17)	22.85	(19.56; 26.17)	22.95	(19.67; 26.36)
Δ (Δ %)	0.00	(0.00)	-0.03	(-0.13)	0.07	(0.31)
With employment & consumption price effects						
Gini coefficient (× 100)	27.64	(25.35; 29.93)	27.63	(25.34; 29.92)	27.61	(25.32; 29.90)
Δ (Δ %)	-0.04	(-0.14)	-0.03	(-0.11)	-0.01	(-0.04)
Mean log deviation (× 100)	13.14	(10.37; 15.90)	13.13	(10.37; 15.89)	13.12	(10.35; 15.88)
Δ (Δ %)	0.05	(0.38)	0.04	(0.31)	0.03	(0.23)
Atkinson ($\epsilon = 2$) (× 100)	22.94	(19.83; 26.04)	22.93	(19.82; 26.03)	22.92	(19.81; 26.02)
Δ (Δ %)	0.06	(0.26)	0.05	(0.22)	0.04	(0.17)
With employment & total consumption effects						
Gini coefficient (× 100)	27.60	(25.33; 29.87)	27.55	(25.29;29.81)	27.50	(25.23; 29.77)
Δ (Δ %)	0.00	(0.00)	0.05	(0.18)	0.10	(0.36)
Mean log deviation (× 100)	13.09	(10.36; 15.83)	13.06	(10.33; 15.79)	13.03	(10.30; 15.75)
Δ (Δ %)	0.00	(0.00)	-0.03	(-0.23)	-0.06	(-0.46)
Atkinson ($\epsilon = 2$) (× 100)	22.87	(19.80; 25.95)	22.83	(19.76; 25.90)	22.81	(19.72; 25.88)
Δ (Δ %)	-0.01	(-0.04)	-0.05	(-0.22)	-0.07	(-0.31)

Notes: Wage projections for 2012 are based on average growth rates.
The Gini coefficient is sensitive to changes in the middle of the income distribution. The mean log deviation of equivalent income is a 'bottom-sensitive' inequality measure. The Atkinson inequality measure is calculated for a high degree of inequality aversion ($\epsilon = 2$); see Cowell (2000). 95%-confidence bands are given in parentheses.
Source: Own calculations based on SOEP, wave 2010.

fact, the income distribution under a federal minimum becomes more uneven in certain instances since negative income effects are more pronounced in the lower deciles. This is mirrored by a slight increase in some of the inequality measures under the scenarios that include consumption effects. Contrary to the sizeable and significant reductions of hourly wage inequality (see Table 2.1 above) a statutory minimum wage would be ineffective in reducing overall income inequlity, even if it would be set at comparatively high levels.

2.5 Conclusions

In this paper we analyze the effects of the introduction of a nationwide minimum wage on the distribution of disposable household incomes in Germany. On the basis of individual- and household-level data from the German Socio Economic Panel (SOEP) we simulate wage changes, estimate behavioral adjustments at different margins and incorporate them into a micro-simulation model. This approach not only takes the distribution of minimum wage earners for different household incomes into account but also models the complex interactions between individual wages, the tax-benefit system and net household incomes. We compare scenarios with different levels of the minimum that were suggested in the recent policy debate (5.00, 8.50, 10.00 €/hour).

Simulation results show that changes at the bottom of the hourly wage distribution would be substantial, if the level of the minimum wage is not set very low. Fixed at 8.50 €/hour a minimum wage would significantly reduce wage inequality, even more so when it is set at a higher level of 10.00 €/hour. These changes would disproportionately concern women East German and younger employees, low-qualified and marginally employed people.

In contrast to the substantial wage increases the introduction of a minimum wage would have a limited impact on average net household incomes regardless of the level at which it is set and even without behavioral adjustments. The discrepancy can be explained by the substitution of means-tested transfers and progressive income taxation. If labor demand and concumption effects are also considered, income gains are further reduced. The total income gain induced by a minimum wage of 8.50 €/hour would only amount to a 40% share of the increase in the wage sum and is diminished further to slightly more than 10% when labor demand and consumption effects are taken into account. Families with children would receive substantially smaller income increases. The minimum wage would also not be targeted at low income households. The share of minimum wage earners in the bottom decile of the distribution of net equivalent household income is markedly below the respective shares in the middle of the distribution. Although the largest relative increase in average equivalent incomes would occur in the bottom deciles of the income distribution the a legal minimum would only have negligible effects on the overall income distribution. This finding holds for the whole range of analyzed minimum wage levels between 5 and 10.00 €/hour.

The minimum wage is thus not an effective policy instrument for income redistribtion in Germany. This result is in line with other distributional studies on minimum wages. We contribute to this literature methodologically by modeling interactions of the minimum wage with the tax-and-transfer system and incorporating various behavioral adjustment mechanisms and their distributional implications into a microsimulation model. Empirically we provide more comprehensive empirical evidence for Germany than previous papers. This simulation study rests on several assumptions and does not represent an equilibrium analysis of the minimum wage. We are confident that neither of those limitations generally affects our main conclusion. The various mechanisms – the tax-and-transfer system, the position of minimum wage earners in the income distribution, employment and consumption effects – all operate in the same direction and diminish the redistributive efficiency of the minimum wage. Even if there are no negative employment effects or consumption prices would not change, the minimum would be largely ineffctive for income redistribution. Instead of the exclusive focus on potential disemployment effects the public debate should be re-directed to the question what a minimum wage can accomplish – more wage inequality – and what it will not achieve, namely alleviating poverty and lowering overall income inequality.

Appendix

Table 2.6: Wage and income inequality by region, 1995-2010

	1995	(95%-CI)	**2000**	(95%-CI)	**2005**	(95%-CI)	**2010**	(95%-CI)
Gross wages - low wage share[1]								
Men West	0.02	(0.01; 0.03)	0.04	(0.03; 0.04)	0.06	(0.04; 0.07)	0.08	(0.06; 0.10)
Men East	0.03	(0.01; 0.04)	0.03	(0.02; 0.04)	0.06	(0.03; 0.09)	0.09	(0.06; 0.13)
Women West	0.05	(0.04; 0.07)	0.06	(0.05; 0.06)	0.08	(0.06; 0.09)	0.06	(0.05; 0.08)
Women East	0.04	(0.02; 0.06)	0.07	(0.05; 0.08)	0.09	(0.06; 0.13)	0.05	(0.03; 0.07)
Gross wages - Gini coefficient[1]								
Men West	0.23	(0.21; 0.25)	0.22	(0.21; 0.23)	0.23	(0.22; 0.24)	0.26	(0.24; 0.27)
Men East	0.22	(0.20; 0.24)	0.24	(0.23; 0.26)	0.25	(0.23; 0.27)	0.33	(0.24; 0.42)
Women West	0.23	(0.21; 0.25)	0.22	(0.21; 0.24)	0.24	(0.23; 0.25)	0.26	(0.23; 0.30)
Women East	0.22	(0.20; 0.25)	0.24	(0.23; 0.25)	0.28	(0.26; 0.30)	0.26	(0.23; 0.29)
Net equivalent income - Gini coefficient[2]								
West	0.26	(0.24; 0.27)	0.24	(0.23; 0.25)	0.25	(0.24; 0.26)	0.27	(0.26; 0.28)
East	0.21	(0.20; 0.22)	0.22	(0.21; 0.23)	0.25	(0.24; 0.26)	0.27	(0.26; 0.29)

Notes: [1]Hourly gross wage using longitudinal individual weights. [2]Net household equivalent income using longitudinal household weights.
Source: Own calculations based on SOEPlong, wave 2010.

Table 2.7: Mean hourly gross wage (in €) with and without a minimum wage of 8.50 €/hour, within first decile of the hourly wage distribution, 2012

	Affected (in %)		**No MW**	**MW**		
	Overall	1st decile	€/hour	€/hour	Δ €	% Δ
Germany overall	11.39	100.00	6.53	8.50	1.97	30.17
Gender & Region						
Men West Germany	5.62	56.84	7.81	8.84	1.03	13.19
Men East Germany	16.95	100.00	5.86	8.50	2.64	45.05
Women West Germany	12.51	100.00	6.49	8.50	2.01	30.97
Women East Germany	22.21	100.00	5.63	8.50	2.87	50.98
Age						
18-25 years	22.85	100.00	6.37	8.50	2.13	33.44
26-35 years	10.61	100.00	6.74	8.50	1.76	26.11
36-45 years	9.19	100.00	6.68	8.50	1.82	27.25
46-55 years	10.44	100.00	6.38	8.50	2.12	33.23
56-65 years	12.67	100.00	6.45	8.50	2.05	31.78
Qualification						
High	4.39	100.00	6.75	8.50	1.75	25.93
Medium	11.95	100.00	6.58	8.50	1.92	29.18
Low	19.35	100.00	6.27	8.50	2.23	35.57
Employment status						
Employed full-time	5.97	100.00	6.81	8.50	1.69	24.82
Employed part-time	16.54	100.00	6.62	8.50	1.88	28.40
Marginally employed	38.75	100.00	6.13	8.50	2.37	38.66
Firm size						
< 5 employees	21.42	100.00	6.33	8.50	2.17	34.28
5-10 employees	16.89	100.00	6.73	8.50	1.77	26.30
20-100 employees	15.90	100.00	6.79	8.50	1.71	25.18
100-200 employees	10.18	100.00	6.45	8.50	2.05	31.78
200-2000 employees	9.57	100.00	6.64	8.50	1.86	28.01
> 2000 employees	5.30	100.00	6.90	8.50	1.60	23.19
Missing, not assignable	2.73	100.00	6.74	8.50	1.76	26.11

Notes: Wage data for 2009 are extrapolated to 2012 using average growth rates (see text), weighted using SOEP personal sample weights to obtain population means.

Source: Own calculations based on SOEP, wave 2010.

Table 2.8: Labor supply effects of a legal minimum wage, Germany, 2012

	MW=5.00 €/hour		**MW=8.50 €/hour**		**MW=10.00 €/hour**	
Additional labor supply (in 1,000 persons)						
Couple, both spouses flexible						
West, men	0.25	(0.03; 0.48)	5.31	(3.51; 7.12)	12.00	(8.25; 15.74)
West, women	0.24	(0.04; 0.45)	6.70	(4.46; 8.94)	14.99	(10.31; 19.67)
East, men	0.10	(0.02; 0.18)	3.34	(1.84; 4.85)	6.95	(4.05; 9.86)
East, women	0.10	(0.03; 0.18)	3.48	(1.81; 5.15)	7.23	(3.99; 10.48)
Couple, one spouse flexible						
West, men	0.02	(-0.02; 0.06)	0.29	(-0.09; 0.66)	0.96	(-0.06; 1.98)
West, women	0.36	(-0.38; 1.10)	3.53	(1.12; 5.93)	7.73	(4.07; 11.39)
East, men	0.00	(0.00; 0.01)	0.78	(-0.07; 1.63)	1.79	(-0.05; 3.64)
East, women	0.02	(-0.03; 0.08)	1.64	(0.55; 2.73)	3.65	(1.56; 5.73)
Singles						
West, men	0.20	(-0.03; 0.42)	9.30	(3.11; 15.48)	19.73	(3.11; 15.48)
West, women	0.93	(-0.64; 2.50)	15.20	(8.83; 21.57)	33.12	(8.83; 21.57)
East, men	0.25	(-0.03; 0.52)	10.27	(5.15; 15.40)	17.30	(5.15; 15.40)
East, women	0.16	(0.00; 0.33)	5.16	(3.11; 7.21)	13.01	(3.11; 7.21)
Additional working hours (in 1,000 ftes)						
Couple, both spouses flexible						
West, men	0.86	(0.24; 1.49)	21.25	(14.09; 28.14)	46.62	(14.09; 60.85)
West, women	1.64	(0.46; 2.81)	36.10	(26.19; 46.02)	81.95	(63.98; 99.91)
East, men	0.39	(0.10; 0.67)	15.47	(9.56; 21.38)	15.47	(20.05; 43.96)
East, women	0.60	(0.09; 1.11)	17.23	(11.61; 22.86)	17.23	(25.83; 48.47)
Couple, one spouse flexible						
West, men	0.03	(-0.03; 0.09)	0.68	(-0.16; 1.51)	2.06	(-0.07; 4.19)
West, women	0.53	(-0.56; 1.62)	5.86	(1.70; 10.02)	18.23	(10.15; 26.30)
East, men	0.00	(0.00; 0.01)	1.89	(-0.07; 3.85)	4.23	(0.11; 8.39)
East, women	0.08	(-0.08; 0.23)	3.92	(1.60; 6.24)	9.61	(5.04; 14.18)
Singles						
West, men	0.38	(-0.08; 0.83)	23.86	(8.61; 39.10)	50.68	(24.71; 76.65)
West, women	1.29	(-0.97; 3.54)	32.60	(20.98; 44.21)	83.12	(59.63; 106.61)
East, men	0.61	(-0.11; 1.33)	30.53	(15.53; 45.53)	51.60	(29.45; 73.76)
East, women	0.32	(-0.01; 0.64)	13.67	(8.43; 18.91)	37.77	(26.10; 49.45)

Notes: Bootstrapped 95%-confidence bands are given in parentheses.
Source: Own calculations based on STSM and SOEP, wave 2010.

Table 2.9: Conditional logit labor supply models, 2012

Variables	**Couples both flexible**		**Couples women fix**		**Couples Men fix**		**Singles Men**		**Singles Women**	
	Coeff.	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
Income	1.191	10.483	-13.424	6.986	-6.439	4.151	1.714	3.687	-12.497	2.870
Income squared	0.665	0.635	1.001	0.326	0.951	0.214	0.480	0.115	0.834	0.096
Income × husbands leisure	-1.377	0.345	0.067	0.678			-1.424	0.632		
Income × wifes leisure	-0.808	0.291			-1.082	0.426			0.921	0.471
Husbands leisure	52.277	8.436	18.781	10.330			49.654	11.160		
Husbands leisure squared	-5.987	0.405	-2.027	0.882			-4.521	0.916		
Wifes leisure	21.870	7.482			18.187	7.817			0.402	7.636
Wifes leisure squared	-2.191	0.379			-0.751	0.731			-0.321	0.657
Husbands leisure × wifes leisure	0.869	1.476								
Husbands leisure × dummy1	6.680	6.426	-0.263	0.450			-0.172	0.330		
Wifes leisure × dummy1	5.143	5.791			0.397	0.854			-0.444	0.277
Husbands leisure × wifes leisure × dummy1	-1.508	1.516								
Income × dummy1	2.135	9.727								
Income squared × dummy1	-0.059	0.628								
Husbands leisure × dummy2	-5.966	2.816	-1.667	0.851			-1.517	0.865		
Wifes leisure × dummy2	-7.322	2.647			-1.904	0.384			-0.597	0.518
Husbands leisure × wifes leisure × dummy2	1.347	0.693								
Income × dummy2	-3.368	2.667								
Income squared × dummy2	0.194	0.187								
Husbands leisure × husbands age	-0.024	0.055	-0.182	0.128			-0.105	0.102		
Husbands leisure squared × Husbands age squared	0.129	0.060	0.282	0.142			0.188	0.116		
Wifes leisure × wifes age	-0.066	0.068			-0.191	0.142			-0.204	0.087
Wifes leisure squared × wifes age squared	0.195	0.077			0.324	0.147			0.343	0.100
Husbands leisure × husbands health status	1.194	0.505	2.249	1.324			1.997	0.842		
Wifes leisure × wifes health status	0.992	0.437			0.057	0.467			-0.004	0.736
Wifes leisure × dummy 3	5.477	0.438			3.139	0.855			4.855	0.822
Wifes leisure × dummy 4	2.785	0.332			3.130	0.654			2.948	0.522
Wifes leisure × dummy 5	2.245	0.208								
Husbands leisure × dummy 3			0.928	0.696			0.857	0.943		
Husbands leisure × dummy 4			0.779	0.699			0.139	1.122		

Notes: Dummy 1: Head of household (person answering the GSOEP household questionnaire) is German. Dummy 2: Household is living in East Germany Dummy 3: Children under the age of 3 in household. Dummy 4: Children between 3 and 6 in household. Dummy 5: Children between 7 and 16 in household. × indicates an interaction term.
Source: Own calculations based on STSM and SOEP, wave 2010.

Table 2.10: Compensated own- and cross-wage elasticities (number of workers)

West Germany	FT,U,M	FT,S,M	PT,M	ME,M	FT, U,W	FT,S,W	PT,W	ME,W
FT, U, M	**-0.510**	0.419	0.003	-0.001	0.050	0.034	-0.048	0.055
FT, S, M	0.085	**-0.200**	0.001	0.004	0.032	0.062	0.002	0.017
PT, M	0.023	-0.001	**-0.070**	-0.110	0.031	-0.268	0.204	0.186
ME, M	-0.019	0.316	-0.246	**-0.130**	-0.093	0.187	0.148	-0.162
FT, U, W	0.108	0.367	0.012	-0.013	**-0.370**	-0.055	-0.081	0.030
FT, S, W	0.020	0.136	-0.014	0.005	-0.009	**-0.160**	0.071	-0.051
PT, W	-0.044	0.007	0.033	0.011	-0.044	0.196	**-0.260**	0.099
ME, W	0.255	0.495	0.144	-0.058	0.056	-0.805	0.483	**-0.570**
East Germany	FT,U,M	FT,S,M	PT,M	ME,M	FT, U,W	FT,S,W	PT,W	ME,W
FT, U, M	**-0.300**	-0.086	-0.076	0.028	-0.036	0.487	-0.008	-0.008
FT, S, M	-0.002	**-0.110**	-0.008	0.005	0.006	0.091	0.015	0.005
PT, M	-0.135	-0.235	**-0.290**	0.006	0.114	0.235	0.302	-0.002
ME, M	0.172	0.476	0.019	**-0.300**	0.152	-0.778	0.332	-0.073
FT, U, W	-0.060	0.099	0.116	0.041	**-0.250**	-0.273	0.237	0.091
FT, S, W	0.044	0.128	0.012	-0.011	-0.014	**-0.230**	0.076	-0.010
PT, W	-0.010	0.063	0.055	0.018	0.040	0.245	**-0.440**	0.032
ME, W	-0.038	0.323	-0.008	-0.053	0.248	-0.582	0.437	**-0.330**

Notes: FT, U, M - Full-time unskilled men; FT, S, M - Full-time skilled men; PT, M - Part-time men; ME, M - Marginally employed men; FT, U, W - Full-time unskilled women; FT, S, W - Full-time skilled women; PT, W - Part-time women; ME, W - Marginally employed women.
Numbers in italics are own-wage elasticities.
Source: Freier and Steiner (2007a, 2010).

Table 2.11: Changes in wages after the introduction of a legal minimum wage, 2012

			MW=5.00 €/hour				MW=8.50 €/hour				MW=10.00 €/hour			
			Affected (%)	No MW (€/hour)	MW (Δ €)	MW (Δ %)	Affected (%)	No MW (€/hour)	MW (Δ €)	MW (Δ %)	Affected (%)	No MW (€/hour)	MW (Δ €)	MW (Δ %)
West Germany														
Full-time	Skilled	*Women*	0.15	16.81	0.00	0.01	3.72	16.81	0.03	0.21	11.64	16.81	0.15	0.89
		Men	0.26	18.73	0.00	0.02	2.49	18.73	0.04	0.22	5.61	18.73	0.11	0.56
	Unskilled	*Women*	0.00	12.10	0.00	0.00	11.94	12.10	0.23	1.91	33.76	12.10	0.59	4.91
		Men	0.37	16.01	0.01	0.04	4.36	16.01	0.06	0.40	17.16	16.01	0.22	1.37
Part-time		*Women*	1.30	14.46	0.01	0.05	11.96	14.46	0.19	1.33	20.91	14.46	0.45	3.10
		Men	1.66	14.80	0.02	0.11	32.45	14.80	0.51	3.46	34.97	14.80	1.04	7.05
Marginally employed		*Women*	3.60	10.52	0.04	0.40	37.84	10.52	0.72	6.87	48.20	10.52	1.41	13.37
		Men	14.42	9.57	0.14	1.45	38.45	9.57	1.28	13.41	45.28	9.57	2.02	21.15
Total			0.72	15.70	0.01	0.06	9.50	15.70	0.13	0.83	19.47	15.70	0.36	2.29
East Germany														
Full-time	Skilled	*Women*	0.00	12.64	0.00	0.00	21.13	12.64	0.29	2.29	34.99	12.64	0.70	5.56
		Men	0.99	13.61	0.01	0.05	16.94	13.61	0.31	2.29	27.23	13.61	0.65	4.76
	Unskilled	*Women*	0.97	14.64	0.00	0.02	35.61	14.64	0.57	3.88	43.47	14.64	1.14	7.78
		Men	3.48	12.87	0.05	0.43	28.28	12.87	0.43	3.35	33.57	12.87	0.88	6.87
Part-time		*Women*	2.84	12.90	0.04	0.30	24.40	12.90	0.45	3.52	41.27	12.90	0.96	7.45
		Men	2.91	12.12	0.02	0.19	31.09	12.12	0.76	6.30	43.15	12.12	1.36	11.25
Marginally employed		*Women*	7.58	8.64	0.10	1.17	41.17	8.64	1.03	11.97	65.03	8.64	1.91	22.09
		Men	7.21	6.95	0.10	1.43	46.20	6.95	1.66	23.86	50.48	6.95	3.06	44.02
Total			1.31	12.36	0.01	0.08	26.31	12.36	0.39	3.16	45.25	12.36	0.95	7.69

Notes: Qualification categories according to Freier and Steiner (2007a, 2010): 'skilled' = secondary-school education or vocational training, 'unskilled' = neither secondary-school education nor vocational training.
Source: Own calculations based on SOEP wave 2010.

Table 2.12: OLS-estimation of household's consumption rate

Variable	West Germany Coeff.	S.E.	East Germany Coeff.	S.E.
Log(disposable income)	-0.270***	0.010	-0.335***	0.032
Dummy1: single men without children[1]	0.213*	0.093	-0.211	0.299
Dummy2: single with children	-0.643***	0.141	-0.137	0.330
Dummy3: couple without children	-0.303**	0.103	-0.124	0.282
Dummy4: couple with more than 1 child	-0.079	0.109	0.106	0.307
Dummy5: other households	-0.467***	0.123	-0.126	0.309
Log(disposable income) × dummy1	-0.033**	0.012	-0.055	0.031
Log(disposable income) × dummy2	-0.021	0.017	-0.051	0.039
Log(disposable income) × dummy3	-0.062***	0.011	-0.047	0.033
Log(disposable income) × dummy4	-0.098***	0.014	-0.060	0.043
Log(disposable income) × dummy5	-0.086***	0.012	-0.073*	0.037
Log(disposable income) × dummy6[2]	-0.039**	0.014	-0.044	0.037
Donations & heritages	-0.000***	0.000	-0.000***	0.000
Female household head	0.009	0.006	-0.011	0.009
Dummy capital income	-0.035***	0.005	-0.040***	0.011
Dummy car in household	0.097***	0.007	0.101***	0.013
Dummy owned house	-0.019***	0.004	0.001	0.011
Dummy owned apartment	-0.025***	0.006	-0.013	0.015
Residential area in square meters	0.001***	0.000	0.001***	0.000
Age of household head	-0.008	0.007	0.041**	0.015
Age squared	0.000	0.000	-0.001*	0.000
Age cubed	0.000	0.000	0.000*	0.000
Household head working part-time[3]	0.038**	0.014	-0.006	0.037
Household head marginally working	0.056	0.072	-0.131*	0.056
Household head working, no information	0.048	0.047	0.016	0.088
Household head not working	-0.059**	0.019	0.059	0.119
Second person working full-time[4]	0.859***	0.110	0.010	0.026
Second person working part-time	0.872***	0.110	0.012	0.027
Second person marginally working	0.867***	0.110	-0.042	0.039
Second person working, no information	0.873***	0.111	(dropped)	0.000
Second person not working	0.865***	0.110	-0.002	0.026
Dummies for household heads education[5]				
University of applied science	0.005	0.005	-0.002	0.010
Technical school	-0.009	0.005	-0.033**	0.011
Apprenticeship	-0.013**	0.005	-0.040***	0.011
Other graduation	-0.028*	0.011	-0.023	0.038
In education, student	-0.011	0.017	-0.029	0.039
No graduation	-0.034**	0.013	-0.039	0.052
Social position of household head[6]				
White-collar worker	-0.020***	0.004	-0.016	0.014
Blue-collar worker	-0.016**	0.006	-0.034*	0.016
Unemployed	0.079***	0.020	-0.078	0.116
Retired person	0.134***	0.023	-0.004	0.115
Old-age pensioner	0.140***	0.024	(dropped)	0.000
Constant	2.751***	0.112	3.115***	0.320
R-squared		0.425		0.423
Number of observations		25,687		6,813

Notes: [1] Base are single female households without children and couple with one child. [2] Dummy6 stands for couple with one child. [3] Base is household head working full-time. [4] Base is no second person in household. [5] Base is college. [6] Base is public servant.
Other controls in the regression not shown in table: dummies for federal land, community size, family status, foreigners, main source of income in household, interaction terms for household head's employment and second person's employment.
* Significance at 5% level. ** Significance at 1% level. *** Significance at 0.1% level.
Source: Own calculations based on LWR, several waves.

Table 2.13: Heterogeneity of minimum wage effects (MW=8.50 €/hour) on net incomes of households affected by the minimum wage, 2012

	Overall			Couples					Singles		
	Total	No children	With children	Total	No children	With children	Both work	One works	Total	No children	With children
Incidence (%)	12.2	9.0	17.5	17.8	14.0	20.7	18.0	14.1	8.1	6.9	11.9
Avg. income no MW (€/m)	2,448	1,742	3,062	3,089	2,467	3,420	3,020	4,295	1,412	1,122	1,964
Δ Average income											
No behavioral effects (€/m)	80.4	102.6	61.1	88.8	121.2	71.6	92.0	33.5	66.8	86.7	29.0
No behavioral effects (%)	3.3	5.9	2.0	2.9	4.9	2.1	3.0	0.8	4.7	7.7	1.5
With employment effects (€/m)	42.6	64.4	23.7	44.6	70.5	30.9	47.8	-10.1	39.3	59.2	1.6
With employment effects (%)	1.7	3.7	0.8	1.4	2.9	0.9	1.6	-0.2	2.8	5.3	0.1
Consumption price effects (€/m)	-19.9	-10.8	-27.8	-32.1	-24.5	-36.1	-30.8	-53.4	-0.2	0.9	-2.4
Consumption price effects (%)	-0.8	-0.6	-0.9	-1.0	-1.0	-1.1	-1.0	-1.2	0.0	0.1	-0.1
Total consumption effects (€/m)	24.4	36.0	14.3	24.8	37.2	18.2	26.7	-9.1	23.7	35.0	2.2
Total consumption effects (%)	1.0	2.1	0.5	0.8	1.5	0.5	0.9	-0.2	1.7	3.1	0.1
Δ Total income											
No behavioral effects (mill. €/m)	267	158	108	182	86	96	178	4	85	72	13
With employment effects (mill. €/m)	141	99	42	91	50	41	93	-1	50	49	1
Consumption price effects (mill. €/m)	-66	-17	-49	-66	-17	-48	-60	-6	0	1	-1
Total consumption effects (mill. €/m)	81	55	25	51	26	24	52	-1	30	29	1

Notes: Incidence = Households affected by the minimum wage as percentage of all households in each group. Percentage changes of average income refer to households within the respective group, percentage changes of total income are calculated relative to the whole population. Employment status refers to the situation before the introduction of a minimum wage. When accounting for employment effects of a minimum wage a fraction of the employed is simulated to become unemployed according to demand side constraints of Table 2.4. Wage projections for 2012 are based on average growth rates.
Source: Own calculations based on SOEP, wave 2010.

Chapter 3

How Robust Are Simulated Employment Effects of a Legal Minimum Wage in Germany?

3.1 Introduction

In recent years the debate about the introduction of a statutory minimum wage for Germany has gained steam (see the debate in *ifo Schnelldienst 6/2008* or the review in Schulten, 2009, 2010). Several empirical studies have been published that simulate the potential employment effects of a minimum wage.[52] The findings range from job losses of 1.2 million (Bachmann et al., 2008; Bauer et al., 2008, 2009) to a comparably moderate net decrease in labor demand of 0.15 million (Müller and Steiner, 2008b). Various factors could be responsible for such substantial differences in the simulations: the data sets and related measurement errors, or the assumptions underlying the theoretical framework to calculate the labor demand effects. Differences in findings are only sporadically acknowledged in the existing papers, yet so far no attempt has been made to look at all potential factors responsible for the variation of the simulation results. Policy makers constantly and understandably complain about sizable differences in economic evaluations and forecasts, as long as no plausible explanations are offered. If the margin of findings is too broad, they do

[52] Recent ex ante evaluation studies include Kalina and Weinkopf (2007), Brenke (2006), Bachmann et al. (2008); Bauer et al. (2008, 2009), Ragnitz and Thum (2007b, 2008), Knabe and Schöb (2008), Müller and Steiner (2008b). The lone ex post analysis on employment effects of the minimum wage was conducted by König and Möller (2008b).

not help to assess potential consequences of specific policies.

This paper tries to systematically analyze the robustness of wage and labor demand effects of a minimum wage of 7.50 €/hour with regard to different data sources, measurement errors in wages and employment, as well as assumptions imposed and approaches employed for the simulation of employment effects. The aim is to get a clear picture of the likely consequences of a federal minimum wage in Germany, in particular of the magnitude of negative effects on the demand for labor. We use data from the latest wave of the German Socio-Economic Panel (SOEP) and the 2006 wave of the German Structure of Earnings Survey (GSES, "Gehalts- und Lohnstrukturerhebung") provided by the German Statistical Office to compare different assumptions and data sources. We find that labor demand effects are sensitive to measurement errors in wages, the representativeness of the sample with respect to several types of labor – especially marginally employed – as well as estimated and assumed labor demand elasticities. Interdependencies of those determinants may lead to substantial differences in simulation outcomes.

The paper is structured as follows: section 2 briefly reviews the methodological issues of simulating the effects of a statutory minimum wage on the distribution of wages and the demand for labor and identifies critical determinants for the magnitude of the estimated effects. Section 3 compares the existing minimum wage studies for Germany with respect to the data sets used, the assumptions imposed, and the wage and employment effects found. Section 4 presents the empirical results. Section 5 concludes.

3.2 Methodological remarks

The simulated effects on the demand for labor are determined, first, by the wage and employment levels on which the simulations are based. Depending on the data set chosen measurement errors with respect to low wages or certain types of employment may occur. Second, it is crucial which theoretical and empirical framework is employed to calculate the effects on labor demand with the most obvious choice regarding labor demand elasticities. In this section we will briefly touch on both methodological points.

3.2.1 Data: measuring low wages and employment

In previous studies three different data sets have been used to calculate wage and employment changes induced by the minimum: the German Socio-Economic Panel (SOEP), the BA-Employment Panel (BAP) and the German Structure of Earnings Survey (GSES). Representativeness is assured by using the population weights of the respective data set. The *SOEP* is a household survey which is representative for dependent employees but suffers from a small number of observations in special segments of the labor market (Haisken-DeNew and Frick, 2005; Wagner et al., 2007). People report wage income on a monthly basis but working hours on a weekly basis which may induce measurement errors for calculated hourly wages, especially at the bottom of the wage distribution. The number of jobs is underrepresented in individual-specific analyses that focus on the first job reported by the SOEP respondent. This happens as soon as a person holds several jobs, e.g. has a secondary (often marginal or part-time) employment contract.

The *BAP* is representative only for employment subject to social security contributions (Schmucker and Seth, 2008). Information about marginal employment is also included but may be overrepresented in this case-based data set, if individuals have several short-term contracts over the course of the calendar year. The main restriction of this data set for a minimum wage analysis is the lack of information about working hours. Papers like Freier and Steiner (2007b,b) or Jacobi and Schaffner (2008) where labor demand elasticities are estimated on the basis of the BAP impute hourly wages on the sectoral level from the German Micro Census. Bachmann et al. (2008); Bauer et al. (2008, 2009) use the BAP only to measure employment levels.

The *GSES* is a linked employer-employee data set provided by the German Federal Statistical Office (Hafner, 2006). The 2001 wave does not include employees in firms with less then 10 employees and several sectors of the economy (e.g. agriculture, public services, health care and social services). For the empirical comparison with the SOEP of this paper we use the latest wave of this data set from the year 2006 (Statistisches Bundesamt, 2009). The large sample size (> 1 million observations) enables precise estimations for sub-groups of employees. The GSES's greatest advantage is that the hourly wage measures are more reliable than in household surveys like the SOEP, since the information comes directly from the firm and is based on the employment contract. Measurement errors due to incomplete memory of the respondent, discrepancies between reported working hours and wage income are therefore less of a problem. On the other hand several drawbacks of the data have to be acknowledged. First and foremost firms with less than or equal to 10 employees are not represented in the sample. Second, certain sectors (agriculture, public sector and household services) are still not included in the latest wave. Both gaps lead to a systematic underrepresentation of certain individuals. Marginally employed, e.g., work more often in small firms (Müller and Steiner, 2009). Third, the GSES is not a panel data set and lacks information about the household context.[53] In the simulations of this paper wage data for the SOEP and GSES is extrapolated up to the year 2008 with a constant realized growth rate for the year 2007 and a constant predicted growth rate for the year 2008.[54]

Since the omission of small firms in the GSES would lead to a downward bias of the wage and employment effects of the minimum wage, we use the SOEP data to adjust the GSES data. On the basis of the SOEP we calculate correction factors for each wage and employment indicator as well as for every sub-group and simulation scenario in the following way:

$$corr_i = m_i^{all}/m_i^{nofirm<10}, \tag{3.1}$$

with $corr_i$ being the adjustment factor and m_i being any wage or employment

[53]For 30% of male and 50% of female individuals in marginal employment "actual" and "contracted" working hours are missing in the GSES and were filled in by hot-deck imputation using nearest-neighbor propensity score matching. Estimation and matching results are available from the author upon request.

[54]Like in Müller and Steiner (2008b, 2009) SOEP data are used for wage information of the previous calendar year. Müller and Steiner (2009) show that simulation results do not change significantly if wages are extrapolated on the basis of individual growth rates within a dynamic wage growth model.

measure for the full sample and the restricted sample without small firms for a given sub group i. Since we only observe $m_i^{nofirm<10}$ in the GSES data we adjust this measure be pre-multiplying $corr_i$. We will show and discuss the magnitude of this adjustment by robustness tests for the GSES data without information on small firms in section 4 below.

3.2.2 Calculating wage effects

To simulate effects of the minimum wage on the wage distribution one compares the empirical distribution of hourly wages to a hypothetical distribution under the proposed minimum wage (MW). Most studies work with MW =7.50 €/hour since this is frequently proposed in the public debate. We will use this value throughout the paper. For the hypothetical distribution hourly wages below or equal to the federal minimum are replaced by MW. One can then readily calculate the wage adjustment for the empirical mean of all observations, certain percentiles or groups of the labor market:

$$\%\Delta w_{it}^{MW} = \frac{w_{it}^{MW} - w_{it}^{SQ}}{w_{it}^{SQ}}. \tag{3.2}$$

Here $\%\Delta w_{it}^{MW}$ is the percentage change in wages for certain types of jobs or segments of the labor market i in period t. The change depends on the average level of wages under the status quo (w_{it}^{SQ}) and the hypothetical mean wage after the minimum wage is introduced (w_{it}^{MW}).

Measuring hourly wages determines the degree of wage compression induced by the minimum and in turn the simulated effects on labor demand. Therefore the choice of the data set and potential measurement errors at the bottom of the hourly wage distribution in those data sets may account for differences in the results. All papers compared in section 3 in principle follow this simple approach. The studies differ, however, with respect to i and t: while some papers only consider the overall wage distribution, others differentiate between skill groups and types of employment, others also between West and East Germany and women and men. Not all analyses extrapolate wages up to the current year, although nominal wages from earlier years do not represent the wage effects of a minimum wage in the current year.

Note that in this simple approach spill-over effects on wages are ruled out which leads to a pile-up of wages at the minimum wage with hourly wages above the threshold remaining constant after the introduction of the minimum. There are theoretical approaches modeling spill-over effects explicitly (see e.g. Dickens et al., 1998) as well as empirical papers providing evidence for wage effects on higher quantiles of the wage distribution (see Autor et al., 2010 for a recent example). Under these more general assumptions the magnitude of wage and ultimately employment effects might be higher than in the simulations we consider in this paper.

3.2.3 Simulating labor demand effects

The ex ante evaluation of labor demand effects can be based on different labor market models. Fitzenberger (2009b) gives an excellent brief review of the theoretical and empirical debate on the employment effects and relates it to the German situation. Within the neoclassical textbook-model of a competitive labor market employment effects of the introduction or increase of a statutory minimum wage above the market equilibrium wage results in lower employment levels (see overview in Brown, 1999. In this case employment is solely determined by the downward-sloping labor demand curve with the magnitude of employment losses depending on the labor demand elasticity. If there is imperfect competition on the labor market (or in some segments), e.g. firms have market power, the effects depend on further assumptions. In a standard monopsony model without wage discrimination a minimum wage set between the wages paid by the employer and the competitive market equilibrium leads to higher wages and employment. If the minimum is set above the equilibrium, employment decreases similar to the competitive market model (Neumark and Wascher, 2008). Some new papers show that even when the minimum is set below the competitive-market equilibrium negative employment effects occur under heterogeneous skills in the labor force (Cahuc and Laroque, 2009). Positive employment effects of the minimum wage can also be explained by models of segmented labor markets (Lang and Kahn, 1998) or within general equilibrium search models (Flinn, 2006; Ahn et al., 2011).

There are two main approaches to simulate ex ante employment effects of a minimum wage in Germany. The first which is used by Ragnitz and Thum (2007b) as well as Knabe and Schöb (2009) is based on the textbook neoclassical model with a decreasing iso-elastic labor demand function of the form $L(w) = (w^{SQ})^{\epsilon}$ with ϵ being an assumed labor demand elasticity of -0.75. Employment losses ($\%\Delta L^{MW}$) result from the difference between the proposed minimum wage (MW) and w^{SQ} cumulated over all employees affected by the minimum:

$$\%\Delta L^{MW} = \left(\frac{MW}{w^{SQ}}\right)^{\epsilon}. \tag{3.3}$$

The approach does not distinguish between different types of labor, although heterogeneity is incorporated by individual-specific w^{SQ} as a measure of productivity. Substitution between different labor market groups is ruled out in this framework, though. The second approach which is employed by Bachmann et al. (2008); Bauer et al. (2008, 2009) and Müller and Steiner (2008b) explicitly takes labor-labor substitution into account. For a given capital stock labor demand effects for group i (ΔL_i) are thus determined not only by group-specific relative wage changes ($\%\Delta w_{it}^{MW}$) and the group's share of total wage costs (c_{it}), but also by wage elasticities of labor demand.[55] Regarding demand elasticities direct and indirect effects can be distinguished. For given wages and production factors as well as a given demand for goods the direct effect results from the substitution that follows the increase in the cost of labor compared to other factors. Indirect effects result from the substitution between different labor categories that are all, but to a different degree, affected by the minimum wage. These effects are captured in the model by the (Hicks/Allen-) substitution elasticities (σ_{ij}). Labor demand is further reduced by a decreasing demand for goods as a result of higher production costs and prices which is depicted by the

[55] Müller and Steiner (2008b) distinguish between skilled (secondary-school education or vocational training) and unskilled (neither secondary-school education nor vocational training) full-time workers, part-time workers and marginally employed; highly skilled workers are assumed to be a quasi-fix factor in the short run. The groups are divided by gender yielding 8 different categories. Bachmann et al. (2008); Bauer et al. (2008, 2009) distinguish high-, semi-, and low-skilled full-time workers, part-time and marginal employment. In all studies elasticities are also estimated separately for West and East Germany.

price elasticity of the demand for goods (η).[56] The index runs from $i = 1, .., J$ according to the distinguished groups (see footnote 4). The partial minimum wage effect could be positive for certain groups if they were substitutes for other employees:

$$\Delta L_i =_{j=1}^{J} c_j(\sigma_{ij} + \eta)(\%\Delta w_{it}^{MW})L_i. \tag{3.4}$$

To sum up the methodological discussion differences in simulation results are determined by the choice of the data set which influences the induced wage changes ($\%\Delta w_{it}^{MW}$), the level of employment in total and for different groups (L_i) and the relative size of wage costs (c_j). Depending on the labor demand model chosen the estimated or assumed labor demand and output price elasticities ($\epsilon, \sigma_{ij}, \eta$) also affect simulation results. We will now compare the existing studies with respect to those determinants.

3.3 Comparison of existing studies

The discussion of the last section showed that differences in simulation results may be attributed to discrepancies in the measurement of wages and employment levels as well as the framework under which labor demand effects are calculated. Table 3.1 points out and compares key differences in existing empirical minimum wage studies for Germany that help to explain the wide range of simulation results.[57] First, the analyses are based on various data sets. Some studies – like Müller and Steiner (2008b) or Knabe and Schöb (2009) – work solely with household survey data from the SOEP. All SOEP based studies adjust population weights for missing items in the wage and employment variables. In addition, Knabe and Schöb (2009) re-weight the data to conform to aggregate figures for full-, part-time and marginal employment reported by the Federal Statistical office of Germany. Others papers, like Bachmann et al. (2008) or Bauer et al. (2008, 2009) combine the SOEP with administrative

[56] Adjustments of the capital stock are usually not considered in this framework. In the long run it is likely that low-skilled labor is substituted by capital.

[57] Table 3.1 lists only ex ante evaluations of the labor demand effects for the whole German economy. Therefore König and Möller's (2008) paper which is an ex post evaluation of the sectoral minimum wage in the German construction sector is not included in this comparison.

data from the BAP. Ragnitz and Thum (2007b) use data from the GSES 2001. In this paper we employ the GSES 2006 wave.

Second, depending on the data set and restrictions on the wage distribution (imposed in some, not all of the papers) the measured wage levels in the first decile are markedly different. Bauer et al. (2009), for instance, report an average wage of 4.38 €/hour in the bottom decile, whereas Müller and Steiner (2008b) who exclude wages below 3 €/hour because they consider them to be unreliable[58] find a mean of 5.95 €/hour in the first decile of their sample, similar to Bauer et al. (2009). The average hourly wage in the data set Ragnitz and Thum (2007b) use amounts to about 5.00 €/hour for the year 2001. The mean in the first decile is in all data sets influenced by very low wages at the bottom of the distribution which, for many observations, are below 1 €/hour.

The SOEP is more affected by implausibly low hourly wages. We will come back to this in the next section and discuss which assumptions are more realistic. Measured wage levels do not only affect the average wage growth induced by a federal minimum wage but also the share of people affected. In Bauer et al. (2009) the share of people affected amounts to 25%, in Knabe and Schöb (2009) as well as Ragnitz and Thum (2007b) the share is about 13% of all employees. Müller and Steiner (2008b) report an average incidence of only about 10%.

Third, the various data sets not only yield diverse wage levels but also differ with respect to the number of employees represented. For those studies that differentiate between different types of employment the quantities of marginally employed are of particular interest as their mean hourly wages are lower compared to other types of employment. Using data from the BAP the studies by Bachmann et al. (2008); Bauer et al. (2008, 2009) are based on nearly 26 million employees in total, among them ca. 4 million marginally employed persons. They assume that wage changes calculated with SOEP data translate to the BAP employment figures. After reweighting their sample Knabe and Schöb (2009) even start with nearly 33 million employees (also about 4 million marginally employed) whereas Ragnitz' & Thum's

[58]Unemployment benefit recipients who work to boost their transfer income (so-called "Aufstocker") may exhibit hourly wages below 3 €/hour. These cases are not excluded from their sample.

(2007) calculations are based on only about 18 million employees. This is explained by the above-mentioned gaps in the GSES data with regard to certain sectors and firms with less than 10 employees. Müller and Steiner (2008b) work with a more restricted SOEP sample[59] that represents about 24 million people and 2.7 million marginally employed.

Fourth, the studies diverge with respect to the assumed labor demand and output price elasticities. Ragnitz' & Thum's (2007) like Knabe's & Schöb's (2009) calculations are based on a uniform labor demand elasticity of -0.75. They do not analyze different types of employment and substitution between these groups. Bachmann et al. (2008) and Bauer et al. (2008, 2009) are based on empirical labor demand elasticities for different skill groups and types of employment (estimated by Jacobi and Schaffner, 2008). The substitution patterns depend on cross-price elasticities and relative wage changes between the groups. Bauer et al. (2009) also explicitly assume a production function with constant returns to scale, i.e. an elasticity of one with respect to output changes. Moreover they work with an elasticity of -0.2 with respect to the increase in wage costs. Müller and Steiner (2008b) also apply the latter approach on the basis of estimated labor demand elasticities (Freier and Steiner, 2007b, 2010). They simulate employment effects for different output price elasticities of 0, -0.5 and -1.

Against the background of the factors compared and how those factors are related it becomes clear why the results of the labor demand simulations exhibit such glaring differences. The large employment loss of 1.2 million jobs predicted by Bachmann et al. (2008) is driven by very low wages measured with SOEP data which lead to a steep increase in average wages as a consequence of the minimum wage. Since their numbers of employees are based on the BAP, the quantity of marginally employed is larger compared to the levels found with SOEP data. The estimated elasticities are also somewhat larger compared to those used by Müller and Steiner (2008b). The

[59] The age restriction of 18-65 years is due to the fact that the data is used in a microsimulation model investigating the income effects of the minimum wage including the adaption of labor supply and demand. The analysis of employment effects focuses on the core working age population. Moreover, the results are based on the first jobs of the respondents. In another paper Müller and Steiner (2009) discuss the robustness of the wage effects with respect to the inclusion of secondary jobs. We will address this issue in the next section.

Table 3.1: Wage and employment effects of a minimum wage of 7.50 €/hour in Germany – a comparison of different empirical studies

Study	Data source	Restriction on wage distribution/ forward projection of wages	Wage effects			Labor demand elasticities		Employment effects	
			avg. wage 1st decile	avg. wage growth (%)	affected by MW (%)	(comp.) price elasticities	elasticities with respect to change of output and price of input	Number employees overall (marginal employment)	Δ employment (% Δ employment)
Bachmann et al. (2008)	SOEP, wave 2006; BAP, wave 2005	no restrictions on wage distribution, wages not extrapolated	4.38 €/h	5.72%	25.3%	estimated, 5 skill groups (Jacobi and Schaffner, 2008)	[1]	25,936,867 (3,973,570)	-1,189,430 (-4.59%)
Bauer et al. (2008, 2009)	SOEP, wave 2007; BAP, wave 2006	2.5% of hourly wages distribution cut off at bottom and top, wages not extrapolated	6.05 €/h[2]	[1]	19.5%	estimated, 5 skill groups (Jacobi and Schaffner, 2008)	output: 1; input of labor: -0.2	25755439[3] (4,039,309)[3]	-860,000 (-3.34%)
Ragnitz and Thum (2007b)	GSES, wave 2001	no restrictions on wage distribution, wages not extrapolated	4.59 €/h[4]	5.72%[4]	12.8% (West: 12.8%, East 26%)	assumed constant labor demand elasticity: -0.75	assumed constant labor demand elasticity: -0.75	18500000[5]	-1,100,000 (-6.08%)
Knabe and Schöb (2009)	SOEP, wave 2007	hourly wages < 2.75 €/h set to 2.75 €/h, extrapolated to 2010	[1]	[1]	12.8%	assumed constant labor demand elasticity: -0.75	assumed constant labor demand elasticity: -0.75	32,869,740 (3,926,480)	-842,033 (-2.6%)
Müller and Steiner (2008b)	SOEP, wave 2007	hourly wages < 3 €/h and > 150 €/h excluded, extrapolated to 2008	5.95 €/h	1.01%	10.0%	estimated, East/West, 4 skill groups (Freier and Steiner, 2007b, 2010)	different scenarios: 0, -0.5, -1.0	24,100,000 (2,666,401)	-141,405 (-0.59%)
Present study	GSES, wave 2006	hourly wages < 3 €/h and > 150 €/h excluded, extrapolated to 2008	7.03 €/h	0.39%	5.6%	estimated, East/West, 4 skill groups (Freier and Steiner, 2007b, 2010)	different scenarios: 0, -0.5, -1.0	25,019,000 (2,408,000)	-290,653 (-0.48%)

Notes: [1] Not reported. [2] Refers to the hourly wage in 10th percentile, not the average hourly wage in the first decile. [3] Full-time equivalents. [4] Figure not reported; the author's own calculations with data from GLS 2001 after eliminating observations with negative hourly wages. [5] Figure not reported; the author's own calculation on numbers reported in the study with respect to absolute figures and the share of people affected by the minimum wage as reported.

restriction of the observed wage distribution at the bottom and top in the follow-up study by Bauer et al. (2008, 2009) in itself reduces the negative employment effects by more than one percentage point from about -4.5% to -3.3% of the labor force. Knabe and Schöb (2009) also find considerable negative effects of -0.85 million jobs. They restrict the sample at the bottom of the wage distribution and also report a markedly lower share of people affected by the minimum wage. They re-weight their SOEP sample to represent nearly 33 million employees which is by far the largest number of all studies compared. Moreover, they assume homogeneous labor as well as a constant labor demand elasticity. With that same approach Ragnitz and Thum (2008) simulate an even larger decrease in employment of 1.1 million people. Although they report an identical share of people affected by the minimum, their GSES sample represents only about 18 million employees. The resulting relative employment loss of 6% is highest among all analyses of Table 3.1. The comparably steep average increase in wages is driven by apprentices who are included in their sample. All other papers exclude apprentices because minimum wage laws in all likelihood would not apply to them. On the opposite the moderate negative effects of -150,000 employees found by Müller and Steiner (2008b) can be explained by a narrower sample leading to markedly lower average wage increases, a lower total labor force represented, a smaller number of marginally employed as well as substitution effects between marginal and predominantly part-time employment. Moreover the labor demand elasticities used for the simulation are smaller then those used by Bachmann et al. (2008); Bauer et al. (2008, 2009).

The preceding comparison showed why simulation results may diverge and that similar findings occasionally are based on very different data sets. The questions to be answered in the empirical analysis of this paper are: Which factors are most crucial to explain the differences in the simulation results? Are very low hourly wages at the bottom of the wage distribution realistic or can they be attributed to measurement error? How should observations with low wages at the bottom of distribution be treated? To tackle these questions empirically we will test some of the assumptions on the basis of the latest wave of SOEP data and compare the results with newly available data from the GSES 2006.

3.4 Empirical results

This section presents results of a robustness analysis for wage and employment effects of the minimum wage with respect to the measurement of hourly wages and employment levels, the identification of people affected by the minimum wage and some central assumptions made for the simulation of labor demand effects. First, we discuss the issue of measuring hourly wages. Second, we compare the total numbers of employed as well as labor demand effects. We use the latest wave of the SOEP from the year 2007 and compare different simulations with results from the 2006 wave of the GSES.

3.4.1 Wage effects

Table 3.2 shows how many employees would be affected and how the wage distribution would change after the introduction of a minimum wage of 7.50 €/hour when employment effects are ignored. The upper part of Table 3.2 is based on SOEP data under different sample restrictions. As in Müller Steiner (2008a) the standard scenario (1) is based only on wages and working hours of the first reported job (secondary wage income is neglected), restricted to individuals 18-65 years of age and hourly wages between 3 €/hour and 150 €/hour.[60] Simulations (2) to (5) relax different assumptions at a time: in (2) the complete wage distribution is analyzed as long as wages are positive; in (3) hourly wages lower than 3 €/hour are set to the margin of 3 €/hour and remain in the sample; in (4) no age restrictions are imposed; and (5) uses the assumptions from (1) but takes also hourly wages from secondary jobs into account.

The lower part of Table 3.2 is based on the GSES where simulation (6) imposes the same restrictions as in the SOEP standard specification (1); in scenario (7) the wage distribution is not restricted similar to (2); and in (8) wages below 3 €/hour are set to the margin if 3 €/hour as it is done in (3). Note that in simulations (6)

[60]Like in Müller & Steiner (2008a, b) benefit recipients that have a marginal job to top up their income are excluded from this restriction, see footnote 3 above.

Table 3.2: Wage distribution before and after the introduction of a legal minimum wage of 7.50 €/hour, currently employed people only, 2008

	SOEP									
	(1) Standard		(2) No restriction on distribution		(3) Wages < 3 €/h set to 3 €/h		(4) No age restriction		(5) Secondary jobs included	
	No MW	MW	No MW	MW	No MW	MW	No MW	MW	No MW	MW
Affected (%)										
overall		9.39		11.14		11.14		9.92		11.66
1st decile		95.00		100.00		100.00		100.00		100.00
1st-10th	6.02	7.50	5.20	7.50	5.40	7.50	5.97	7.50	5.45	7.50
percentile	(1.48; 24.58)		(2.30; 44.23)		(2.10; 38.89)		(1.53; 25.63)		(2.05; 37.61)	
1st-5th	5.09	7.50	3.82	7.50	4.23	7.50	5.07	7.50	4.42	7.50
percentile	(2.41; 47.35)		(3.68; 96.34)		(3.27; 77.30)		(2.43; 47.93)		(3.08; 69.68)	
6th-10th	6.98	7.50	6.57	7.50	6.57	7.50	6.95	7.50	6.49	7.50
percentile	(0.52; 7.45)		(0.93; 14.16)		(0.93; 14.16)		(0.55; 7.91)		(1.01; 15.56)	
11th-15th	8.12	8.12	7.86	7.88	7.86	7.88	8.09	8.09	7.72	7.77
percentile	(0.00; 0.00)		(0.02; 0.25)		(0.02; 0.25)		(0.00; 0.00)		(0.05; 0.65)	
16th-25th	9.62	9.62	9.39	9.39	9.39	9.39	9.60	9.60	9.15	9.15
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Median	14.50	14.50	14.50	14.50	14.49	14.49	14.41	14.41	14.22	14.22
	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Mean	15.94	16.09	15.80	16.03	15.82	16.03	15.89	16.04	15.89	16.10
	(0.15; 0.94)		(0.23; 1.46)		(0.21; 1.33)		(0.15; 0.94)		(0.21; 1.32)	
	GSES									
	(6) Standard (with small firms)		(7) No restriction (with small firms)		(8) Wages < 3 €/h set to 3 €/h (with small firms)		(9) Without small firms		(10) With apprentices (without small firms)	
	No MW	MW	No MW	MW	No MW	MW	No MW	MW	No MW	MW
Affected (%)										
overall		7.11		7.61		7.61		5.58		8.86
1st decile		76.90		66.89		66.89		59.93		88.79
1st-10th	6.52	7.64	6.14	7.69	6.16	7.69	7.03	7.73	5.83	7.52
percentile	(1.12; 17.14)		(1.55; 25.30)		(1.53; 24.76)		(0.70; 9.96)		(1.69; 28.99)	
1st-5th	5.71	7.50	4.97	7.50	5.02	7.50	6.13	7.50	4.66	7.50
percentile	(1.79; 31.24)		(2.53; 50.97)		(2.48; 49.43)		(1.37; 22.35)		(2.84; 60.94)	
6th-10th	7.41	7.79	7.21	7.87	7.21	7.87	7.97	7.98	7.00	7.54
percentile	(0.39; 5.20)		(0.66; 9.15)		(0.66; 9.15)		(0.01; 0.13)		(0.54; 7.71)	
11th-15th	8.37	8.37	8.28	8.30	8.28	8.30	8.98	8.98	8.32	8.32
percentile	(0.00; 0.00)		(0.02; 0.25)		(0.02; 0.25)		(0.00; 0.00)		(0.00; 0.00)	
16th-25th	9.67	9.67	9.54	9.54	9.54	9.54	10.60	10.60	9.98	9.98
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Median	15.01	15.01	14.98	14.98	14.98	14.98	15.95	15.95	15.61	15.61
	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Mean	16.91	17.03	16.92	17.07	16.93	17.07	17.91	17.98	17.44	17.60
	(0.11; 0.68)		(0.15; 0.89)		(0.14; 0.82)		(0.07; 0.39)		(0.17; 0.97)	

Notes: Wage data for 2006 are extrapolated to 2008 using average growth rates (2007: 1.02, 2008: 1.025). Only employed people aged 18-65 are included. Percentiles are defined for the wage distribution without the minimum wage. Means are calculated within the range of given percentiles. The numbers in parentheses refer to absolute and relative differences in the two wage measures. Weighted data using sample weights to obtain population means.
Source: Own calculations based on SOEP (wave 2007) and GSES (wave 2006).

through (8) the GSES sample is adjusted for the missing information on small firms (see section 2 above). Scenario (9) simulates the wage effects without this adjustment for small firms and variant (10) adds apprentices to the sample as in Ragnitz and Thum (2007b).

Under the standard assumptions in simulation (1) nearly 10% of all employees would be affected by the minimum wage with the share reaching almost 100% in the bottom decile. Minimum wage effects are concentrated at the bottom of the wage distribution where the wage change induced by the minimum amounts to 1.48 €/hour which is about 25%. Women are more strongly affected than men and workers in East Germany more than West German employees (see Tables 3.5 and 3.6 in the Appendix).

Although the GSES data are corrected for missing information on small firms the same indicators are somewhat lower under the standard scenario (6): only about 7% of employees are affected by a minimum wage of 7.50 €/hour. Wage effects are also limited on the first decile of the distribution where the average wage without the minimum is about 6.50 € leading to a wage increase of about 17% following the introduction of the minimum wage. Since all assumptions are identical to the SOEP sample (1) the discrepancies in results can be explained by differences in the data sets. First, employees in certain sectors are omitted in the GSES. As Tables 3.7 and 3.8 in the appendix show, the share of people affected by the minimum for employees in agriculture and forestry that are missing in the GSES lies above the average. In addition, marginally employed people (40%) who often work in those sectors are more strongly affected by the minimum compared to part-time (11%) and full-time workers (5%). Second, although the sample under scenarios (1) and (6) is restricted between 3 €/hour and 150 €/hour the observed wages at the bottom of the distribution seem to be clearly higher in the GSES. This discrepancy becomes clearer when several sample restrictions are relaxed.

How do the wage effects change under different assumptions? Not restricting the wage distribution at all in (2), setting very low wages to 3 €/hour in (3), or considering in addition secondary jobs in (5) has notable consequences for the percentage of workers affected in the SOEP sample. The share of employees affected by the minimum wage jumps highest from 10% to more than 11.5% under simulation (5). Relaxing the age constraints in (4) shows only minor effects. Differently restricted SOEP samples yield also substantially lower average wages in the bottom decile triggering stronger minimum wage effects. The largest average wage increase occuring with 2.30 €/hour (about 44%) in variant (2) nearly doubles the findings from the standard simulation. This shows how sensitive wage effects react to restrictions of the simulation sample at the bottom.

Relaxing the restrictions on the hourly wage distribution in the GSES sample has much smaller consequences for the simulation results. When the distribution is not restricted at all in simulation (7), the share of people affected increases only slightly to about 7.6%. The relative change in the average wage of the bottom decile is pushed from 17% in (6) to about 25% in (7) showing that very low wages below 3 €/hour are rarely found in the GSES sample. This seems to be much more of a problem in the SOEP data. Therefore the wage distribution from the SOEP sample should be restricted at the bottom.

Simulation (9) shows the wage effects for the GSES sample without adjusting the data for missing information from employees in small firms. All indicators are significantly smaller compared to the standard scenario (6): the share of people affected is only about 5.5% and the average wage change in the bottom decile induced by the minimum amounts to 0.70 €/hour or about 10%. Tables 3.7 and 3.8 in the appendix demonstrate on the basis of SOEP and GSES data that the share of people affected by the minimum decreases monotonically with the firm size and is about twice as high in companies with less than 10 employees compared to firms with 100-200 employees and more than five times higher than in large companies with over 2000 employees. It is thus crucial to correct for missing information on small firms, if wage effects are simulated on the basis of the GSES sample. The consequences for the simulation of labor demand effects are discussed below.

Finally, including apprentices in the GSES data in (10) has a huge effect on the percentage of employees affected as well as the average wage increase in the bottom decile. The downward bias in wage effects compared to the SOEP from simulation (9) is completely reversed. The inclusion of apprentices in (10) pushes the empirical mean in the bottom decile to 5.80 €/hour which lies below the GSES scenario (6) and even below the SOEP simulation (1). The effect would be even higher, if the sample in (10) was not restricted at 3 €/hour because apprentices commonly earn very low hourly wages. Since they would in all likelihood not be subject to a statutory minimum wage, leaving apprentices in the GSES sample substantially biases the wage measures in the low wage segment downwards. All this explains findings based on GLS data which are comparable to SOEP findings, albeit on the basis of a completely different sample of individuals.

To conclude this sub-section we have shown that the simulation of wage effects crucially depends on the chosen sample and how this sample is restricted at the bottom of the wage distribution. Due to the omission of small firms and sectors with an above-average share of low wage employment raw samples from the SOEP and GSES are not directly comparable. As mentioned above it is likely that wage information in the GSES is better. The fact that the share of wages below 3 €/hour is markedly smaller than in the SOEP seems to support the practice to restrict the sample at the bottom as is done by the majority of existing studies. How these differences in wage effects translate into employment effects will be discussed in the following sub-section.

3.4.2 Employment effects

The calculation of employment effects is based on the approach by Müller and Steiner (2008b) (see section 2 above). Table 3.3 therefore breaks down employment levels as well as wage levels and wage increases by different types of employment and skill levels (skilled and unskilled full-time, part-time and marginal employment).[61] As substitution elasticities (see Table 3.9 in the Appendix) are estimated for men and women as well as West and East Germany, we also report separate results for these groups. The standard SOEP sample (1) represents about 24 million employees in total, among them 4 million in East Germany. If secondary jobs are included in variant (5), the size grows to about 26.5 million employment relationships in total. Secondary jobs are predominantly based on marginal employment contracts leading to a jump in employment levels of this group from 2.7 million to 4.7 million. The

[61]Since highly-skilled full-time employment is assumed to be a quasi-fix input factor by Freier and Steiner (2007b, 2010) we do not report them in Tables 3.3 and 3.4.

rest of the difference is made of part-time jobs which make out less then 300,000 additional employed; we do not find full-time employees in this group.[62] This kind of sample restriction has thus a significant impact on simulated labor demand effects not only by means of wage changes but also through employment levels on which the simulations are based. The sample restrictions (2) through (4) yield no or only minor effects for the estimated employment levels.

The standard GSES data sample (6) including the adjustment for small firms represents about 25.5 million workers (about 4 million in East Germany) which means that the GSES employment levels are slightly above those from the SOEP. There are several divergences to the SOEP figures: the levels for skilled and unskilled full-time employment in West Germany are higher in the GSES whereas in the East the full-time employment is rather similar in both samples. On the other hand - except for men in West Germany - the level of marginal employment is clearly higher in the SOEP data. These differences can be explained by missing sectors in the GSES sample (e.g. agriculture and forestry with above-average share of people affected, see table 3.7 in the appendix) that are not added here.

The robustness tests under (9) and (10) where the GSES sample is not corrected for missing information from small firms show that simulated employment levels react very sensitive to this sample definition. This leads not only to a decline in the overall employment levels from 25.5 million workers in (6) to about 20.2 million in (9). More importantly employment figures for certain groups are clearly underrepresented in the unadjusted GSES sample: marginally employed total about 1.6 million compared to 2.7 million in the corrected sample. Levels for part-time employment are also markedly lower without the small-firm adjustment whereas levels of full-time employment are only slightly below the unadjusted data.

Looking briefly at relative wage levels and increases induced by the minimum we find common patterns for both data sets: marginally employed persons have the lowest hourly wages of all groups and thus experience the steepest increases followed

[62]Since employment status is not reported for secondary jobs we use the legally defined threshold of 400 €/month for employee's exemption from social security contributions. Moreover we assume a threshold of 30 hours per month worked in a secondary job to distinguish full- and part-time employment.

Table 3.3: Number of employed people and changes in wages, West & East Germany, 2008

West Germany			**(1) SOEP**				**SOEP reobustness**				**(6) GSES with small firms**[1]				**GSES robustness**			
			Em-ployed (1,000)	Avg. wage (€/hour)	Wage change (Δ€)	Wage change (Δ%)	(2) No restrict-tion	(3) < 3 = 3€/h	(4) No age restr.	(5) Sec. jobs	Em-ployed (1,000)	Avg. wage €/hour	Wage change (Δ€)	Wage change (Δ%)	(7) No restric-tion[1]	(8) < 3 = 3€/h[1]	(9) no small firms	(10) appren-tices
Full-	S	*W*	3,543	14.85	0.06	0.41	3,543	3,543	3,543	3,555	3,655	16.63	0.04	0.25	3,657	3,657	2,918	2,918
time		*M*	7,180	17.79	0.03	0.19	7,180	7,180	7,188	7,180	8,777	21.39	0.01	0.05	8,783	8,783	7,694	7,694
	U	*W*	584	11.33	0.10	0.90	584	584	584	584	646	13.25	0.06	0.45	647	647	557	557
		M	1,013	16.36	0.04	0.27	1,013	1,013	1,036	1,013	1,293	14.41	0.18	1.22	1,294	1,294	1,120	1,120
Part-		*W*	4,824	14.14	0.17	1.22	4,824	4,824	4,882	4,904	4,431	15.40	0.03	0.17	4,433	4,433	2,833	2,833
time		*M*	537	14.56	0.30	2.06	537	537	548	716	1,042	22.07	0.09	0.42	1,044	1,044	694	694
Marg.		*W*	1,909	8.99	0.74	8.27	1,909	1,909	2,014	2,966	1,271	9.02	0.44	4.85	1,297	1,297	957	957
empl.		*M*	428	10.48	0.58	5.56	428	428	526	1,221	548	9.16	0.46	5.06	561	561	428	428
Sum			20,018				20,018	20,018	20,357	22,135	21,663				21,718	21,718	17,199	17,199
East Germany			**(1) SOEP**				**SOEP reobustness**				**(6) GSES with small firms**[1]				**GSES robustness**			
			Em-ployed (1,000)	Avg. wage (€/hour)	Wage change (Δ€)	Wage change (Δ%)	(2) No restrict-tion	(3) < 3 = 3€/h	(4) No age restr.	(5) Sec. jobs	Em-ployed (1,000)	Avg. wage €/hour	Wage change (Δ€)	Wage change (Δ%)	(7) No restric-tion[1]	(8) < 3 = 3€/h[1]	(9) no small firms	(10) appren-tices
Full-	S	*W*	892	11.53	0.17	1.45	892	892	892	896	917	14.15	0.14	1.02	918	918	773	773
time		*M*	1,652	13.20	0.10	0.78	1,652	1,652	1,652	1,652	1,543	14.65	0.08	0.55	1,544	1,544	1,288	1,288
	U	*W*	56	11.37	0.23	2.01	56	56	56	56	66	12.70	0.30	2.33	66	66	54	54
		M	136	11.05	0.12	1.12	136	136	138	136	103	10.84	0.20	1.84	104	104	74	74
Part-		*W*	795	12.11	0.27	2.21	795	795	796	817	968	12.64	0.19	1.53	968	968	546	546
time		*M*	169	11.22	0.36	3.25	169	169	173	184	158	16.22	0.13	0.82	158	158	123	123
Marg.		*W*	208	7.68	1.00	13.05	208	208	210	366	147	8.72	0.93	10.61	157	157	104	104
empl.		*M*	123	9.01	0.44	4.87	123	123	154	231	102	8.10	1.00	12.37	109	109	68	68
Sum			4,030				4,030	4,030	4,070	4,337	4,003				4,021	4,021	3,031	3,031

Notes: Qualification categories according to Freier and Steiner (2007a, 2010): S – 'skilled' = secondary-school education or vocational training, U – 'unskilled' = neither secondary-school education nor vocational training, M – men, W – women. [1] Extrapolated for firms <10 employees using group-specific correction factors on the basis of SOEP data.
Source: Own calculations based on SOEP 2007 and GSES 2006.

Table 3.4: Changes in labor demand (heads), West & East Germany, 2008

West Germany			**(1) SOEP**							**GSES**				
			Output price elasticities				Sample restrictions[1]			Output price elasticities			Sample restrictions[1]	
			(1a) 0	(1b) -1	(1c) -2	(2) No restriction	(3) wages < 3 =€/h set to 3 €/h	(4) no age restriction	(5) sec. jobs included	(6a) 0	(6b) -1	(6c) -2	(9) without small firms[2]	(10) apprentices included
Full-time	Skilled	*Women*	-13,433	-32,772	-52,110	-45,818	-42,341	-31,732	-29,159	-4,514	-39,735	-74,956	-11,942	-11,970
		Men	14,874	-24,316	-63,505	-34,449	-31,936	-24,547	-23,250	65,239	-19,345	-103,928	-6,239	-6,242
	Unskilled	*Women*	-907	-4,097	-7,286	-7,037	-6,228	-4,211	-3,983	1,851	-4,374	-10,600	-1,501	-1,503
		Men	4,010	-1,521	-7,053	-2,671	-2,359	-1,773	-1,741	-33,961	-46,425	-58,888	-869	-866
Part-time		*Women*	31,887	5,557	-20,773	17,186	13,388	3,565	159	29,793	-12,908	-55,609	6,673	6,711
		Men	5,132	2,198	-735	-7,090	-4,231	1,551	3,323	-16,675	-26,718	-36,760	-90	-103
Marginally Employed		*Women*	-81,463	-91,880	-102,297	-152,576	-134,777	-92,239	-123,380	-48,335	-60,587	-72,840	-26,948	-27,047
		Men	-10,024	-12,362	-14,699	-27,862	-23,369	-16,141	-27,315	-24,838	-30,118	-35,397	-6,704	-6,735
Sum			-49,924	-159,191	-268,459	-260,318	-231,852	-165,527	-205,346	-31,440	-240,209	-448,978	-47,621	-47,755

East Germany			**(1) SOEP**							**GSES**				
			Output price elasticities				Sample restrictions[1]			Output price elasticities			Sample restrictions[1]	
			(1a) 0	(1b) -1	(1c) -2	(2) No restriction	(3) wages < 3 =€/h set to 3 €/h	(4) no age restriction	(5) sec. jobs included	(6a) 0	(6b) -1	(6c) -2	(9) without small firms[2]	(10) apprentices included
Full-time	Skilled	*Women*	-1,684	-13,689	-25,694	-21,290	-19,386	-13,900	-13,339	-3,898	-14,196	-24,494	-10,088	-10,103
		Men	2,517	-19,717	-41,952	-31,051	-28,925	-20,064	-19,091	3,261	-14,070	-31,400	-9,401	-9,404
	Unskilled	*Women*	787	31	-725	2,363	1,826	92	-153	1,410	672	-66	330	336
		Men	-6	-1,838	-3,670	-4,091	-3,709	-1,911	-1,599	-229	-1,390	-2,550	-671	-672
Part-time		*Women*	1,468	-9,230	-19,927	-7,132	-7,681	-9,032	-9,787	11,835	963	-9,910	-1,487	-1,469
		Men	-64	-2,336	-4,607	-10,743	-9,335	-2,772	-2,109	57	-1,716	-3,489	-831	-833
Marginally Employed		*Women*	-7,810	-10,607	-13,403	-25,202	-21,107	-10,766	-14,484	-13,518	-15,175	-16,832	-6,644	-6,691
		Men	-2,305	-3,960	-5,616	-14,113	-11,464	-5,523	-8,068	-4,388	-5,532	-6,676	-4,312	-4,316
Sum			-7,098	-61,346	-115,594	-111,259	-99,781	-63,875	-68,629	-5,470	-50,444	-95,418	-33,104	-33,153

Notes: Own- and cross-wage elasticities are taken into account. Demand changes in numbers of employees ("heads"). Qualification categories according to Freier and Steiner (2007a, 2010): 'skilled' = secondary-school education or vocational training, 'unskilled' = neither secondary-school education nor vocational training. [1] Robustness checks use an output price elasticity of -1. [2] Extrapolated for firms <10 employees using group-specific correction factors on the basis of SOEP data.
Source: Own calculations based on elasticities by Freier and Steiner (2007b, 2010)), SOEP 2007, and GSES 2006.

by part-time employees, unskilled and part-time workers. Apart from marginally employed in East Germany the change of wages in all groups is in most cases lower in the GSES compared to the SOEP.

The results for the labor demand simulations are presented in Table 3.4. All calculations are based on the elasticities shown in Table 3.9 in the Appendix, the group-specific wage and employment values of Table 3.3, and three different price elasticities for the demand for goods (0, -1, -2).[63] The overall employment effects depend on the assumed price elasticity of demand. If the demand for goods was perfectly inelastic, labor demand in the standard SOEP simulation (1a) would decrease only by about 57,000 persons. In this scenario the loss of marginal employment would partially be compensated for by an increase in demand especially for part-time employed women. If the demand for goods was extremely elastic with respect to price changes (assumed elasticity of -2, scenario (1c) in Table 3.4), the decrease in demand for labor would in total amount to almost 400,000 persons. The lion's share of employment losses concerns marginal employment. Under this scenario the demand for skilled full-time labor would also shrink considerably. We will use scenario (1b) with an assumed price elasticity of the demand for goods of -1 which is also quite elastic but still plausible for the German economy as our standard simulation. In this case labor demand decreases by about 220,000 jobs.

The simulations on the basis of GSES data in (6) exhibit a similar pattern: The total employment losses range from 35,000 jobs under a completely inelastic demand for goods in (6a) to about 545,000 jobs under an extremely elastic demand for output goods (6c) showing again that the simulation results crucially depend on the underlying elasticities. The standard simulation with an output elasticity of -1 yields a job loss of 290,000 which is somewhat higher than the figures on the basis of the SOEP in (1b) because of higher simulated employment levels (see Table 3.3 above). The largest employment losses occur for marginally employed people and are partially compensated for by gains for part-time employed women.

Columns 4 to 7 in Table 3.4 present the robustness checks for the SOEP sample

[63] No empirical elasticity estimates at the required level of aggregation are currently available for Germany.

that were already presented for the wage effects assuming a price elasticity for the demand of goods of -1. Except for scenario (4) where age restrictions on the sample are relaxed and findings remain virtually unchanged, different sample restrictions lead each to considerable changes in results. The largest decrease in employment is induced in (2) when observed wages are not restricted at all at the bottom of the distribution. In this case the employment losses increase by the amount from 220,000 in (1) to more than 370,000 individuals. If very low wages were set to 3 €/hour as it is done in simulation (3) the decrease of employment would still amount to about 310,000 employees. Leaving sample restrictions as they are in the standard simulation (1) but also considering secondary jobs in variant (5) leads to a simulated decrease in labor demand of nearly 275,000 employees. Again, this substantial variation between different SOEP simulations result from the fact that enlarging the sample affects the wage level and the number of employees represented in the sample. If several simulation parameters differ, e.g. larger assumed elasticities are combined with a larger sample or lower measured wage levels and thus larger increases of wages, results will diverge considerably.

The robustness checks with the GSES data confirm the sensitivity of the simulation results as well. If the data is not adjusted for the missing information on small firms with less then ten employees in (8), simulated employment effects would be much lower: the total job loss is estimated at about 81,000 (48,000 in the West and 33,000 in the East). These relatively large differences result from the fact that employment levels as well as wage changes are adjusted in scenario (6) and enter the simulation of employment effects multiplicatively.

3.5 Conclusion

The aim of the paper was to investigate the robustness of wage and labor demand effects of a minimum wage of 7.50 €/hour with respect to the data sets used and different labor demand models. This should help to understand the variation in the results of existing studies and ultimately get a clearer picture of the likely consequences of a federal minimum wage in Germany. In the empirical analysis we used data from the SOEP and compared the findings with the newly available 2006 wave of the German Structure of Earnings Survey (GSES) which is provided by the German Statistical Office.

The methodological discussion showed that the choice of the data set influences the wage changes induced by the minimum as well as the level and structure of employment. Depending on the labor demand model chosen for the simulation the estimated or assumed labor demand elasticities also affect the results. Since those factors enter the calculation of employment effects multiplicatively, differences in the simulation parameters can entail considerable differences in the outcome of the simulation exercise. This proved to be true, both in the comparison of existing studies and the own robustness checks conducted in this paper.

The comparison of published studies showed that they are based on a number of data sources (SOEP, BAP, GLS) with different restrictions imposed on the sample (low wages, apprentices etc.) which has consequences for the wage effects and the representativeness with respect to different segments of the labor force. The range of findings in the studies becomes understandable against this background. Maybe even more strikingly, sometimes quite similar results are based on calculations with completely different samples and parameters. Our own empirical robustness checks reiterate these points. One has to be very careful with measurement errors at the bottom of the wage distribution. The comparison with the GSES 2006 showed that calculated hourly wages below 3 €/hour in the SOEP are not very reliable. Therefore the sample should be restricted at the lower end of the wage distribution which is common practice in the more recent studies for Germany.

Another crucial point is the representativeness with respect to the labor force, especially with respect to certain types of employment like marginal jobs. Looking only at first reported jobs in the SOEP or using the GSES without correcting for the omission of small firms leads to an under-representation of marginal employment and thus an understatement of the minimum wage effect. The solutions which are proposed in existing SOEP studies (using employment data from the BAP, re-weighting the data to represent aggregate statistics) assume that the wage changes calculated with the SOEP also hold for the additional marginal jobs. We showed that this might not be true in any case. It seems to be more consistent to identify marginally employed directly in the SOEP using the existing information about secondary jobs and calculate wage changes induced by the minimum for each individual observation.

From a methodological standpoint approaches that take heterogeneous labor and substitution effects explicitly into account seem to be more fruitful. Existing studies and our own simulations have shown that the incidence and likely employment effects are markedly different for various types of employment. The GSES data set with its large sample size and reliable information about hourly wages might prove useful for more complex approaches that model spill-over effects into other parts of the wage distribution. This has so far been a neglected topic in empirical minimum wage studies for Germany.

Appendix

Table 3.5: Wage distribution before and after the introduction of a legal minimum wage of 7.50 €/hour, currently employed people only, Germany, 2008, SOEP simulation (1)

	Total		**Men**				**Women**			
	Germany		West		East		West		East	
	No MW	MW	No MW	MW	No MW	MW	No MW	MW	No MW	MW
1st-10th	6.02	7.50	7.68	8.34	6.28	7.50	5.44	7.50	5.52	7.50
percentile	(1.48; 24.58)		(0.66; 8.59)		(1.22; 19.43)		(2.06; 37.87)		(1.98; 35.87)	
1st-5th	5.09	7.50	6.26	7.56	5.73	7.50	4.60	7.50	4.57	7.50
percentile	(2.41; 47.35)		(1.30; 20.77)		(1.77; 30.89)		(2.90; 63.04)		(2.93; 64.11)	
6th-10th	6.98	7.50	9.12	9.12	6.89	7.50	6.27	7.50	6.47	7.50
percentile	(0.52; 7.45)		(0.00; 0.00)		(0.61; 8.85)		(1.23; 19.62)		(1.09; 17.00)	
11th-15th	8.12	8.12	10.81	10.81	7.76	7.80	7.52	7.65	6.99	7.50
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.04; 0.52)		(0.13; 1.73)		(0.51; 7.30)	
16th-25th	9.62	9.62	12.47	12.47	8.87	8.87	8.67	8.67	7.68	7.73
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.05; 0.65)	
Median	14.50	14.50	17.43	17.43	12.34	12.34	13.11	13.11	11.86	11.86
	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Mean	15.94	16.09	19.16	19.22	13.72	13.85	13.97	14.18	12.79	13.03
	(0.15; 0.94)		(0.07; 0.37)		(0.12; 0.87)		(0.21; 1.50)		(0.23; 1.80)	
Affected (%)										
overall		9.75		4.10		12.01		12.75		19.04
1st decile		97.56		41.06		100.00		100.00		100.00

Notes: Only employed people aged 18-65 are included. Percentiles are defined for the wage distribution without the minimum wage. Means are calculated within the range of given percentiles. The numbers in parentheses refer to absolute and relative differences in the two wage measures. Weighted data using sample weights to obtain population means.

Source: Own calculations based on SOEP, wave 2007.

Table 3.6: Wage distribution before and after the introduction of a legal minimum wage of 7.50 €/hour, currently employed people only, Germany, 2008, GSES simulation (6) including small firms

	Total		**Men**				**Women**			
	Germany		West		East		West		East	
	No MW	MW	No MW	MW	No MW	MW	No MW	MW	No MW	MW
1st-10th	6.52	7.64	7.48	8.08	6.10	7.50	6.33	7.64	5.54	7.50
percentile	(1.12; 17.14)		(0.60; 7.97)		(1.40; 22.89)		(1.31; 20.67)		(1.96; 35.38)	
1st-5th	5.71	7.50	6.33	7.53	5.35	7.50	5.63	7.50	4.90	7.50
percentile	(1.79; 31.24)		(1.20; 18.94)		(2.15; 40.27)		(1.87; 33.13)		(2.60; 53.15)	
6th-10th	7.41	7.79	8.64	8.64	6.88	7.50	7.05	7.78	6.18	7.50
percentile	(0.39; 5.20)		(0.00; 0.00)		(0.62; 9.01)		(0.73; 10.30)		(1.32; 21.31)	
11th-15th	8.37	8.37	10.26	10.26	7.61	7.65	7.92	8.05	6.73	7.50
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.04; 0.52)		(0.14; 1.73)		(0.77; 11.37)	
16th-25th	9.67	9.67	12.21	12.21	8.58	8.58	9.10	9.10	7.63	7.70
percentile	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.08; 1.03)	
Median	15.01	15.01	17.77	17.77	11.43	11.43	13.71	13.71	11.62	11.62
	(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)		(0.00; 0.00)	
Mean	16.91	17.03	19.96	20.01	14.19	14.34	14.67	14.81	12.81	13.06
	(0.11; 0.68)		(0.05; 0.26)		(0.15; 1.06)		(0.14; 0.93)		(0.25; 1.95)	
Affected (%)										
overall		7.11		3.94		11.38		7.77		19.16
1st decile		76.90		39.31		100.00		63.46		100.00

Notes: Only employed people aged 18-65 are included. Percentiles are defined for the wage distribution without the minimum wage. Means are calculated within the range of given percentiles. The numbers in parentheses refer to absolute and relative differences in the two wage measures. Weighted data using sample weights to obtain population means.
Source: Own calculations based on GSES, wave 2006.

Table 3.7: Comparison of SOEP and GSES, Germany, 2008: People affected by a minimum wage of 7.50 €/hour in %, overall and within first decile of the hourly wage distribution

	SOEP		**GSES**		**GSES with apprentices**	
	Overall	1st decile	Overall	1st decile	Overall	1st decile
Germany overall	9.75	97.56	5.59	55.95	8.86	88.79
Region						
West Germany	8.50	98.07	4.22	50.68	7.74	89.10
East Germany	15.57	96.29	13.36	68.78	15.36	87.89
Gender						
Men	5.50	55.13	3.65	36.55	7.07	70.81
Women	13.86	100.00	8.13	81.48	11.22	100.00
Age						
18-25 years	24.12	97.63	15.46	61.73	39.88	94.92
26-35 years	8.48	98.25	5.62	55.97	6.42	84.14
36-45 years	9.44	98.52	4.05	52.63	4.14	82.35
46-55 years	7.21	95.31	4.37	53.83	4.40	82.42
56-65 years	7.99	97.48	5.65	56.87	5.65	84.95
Qualification						
High	4.04	92.62	2.05	84.46	2.64	94.68
Medium	10.07	98.25	3.25	55.73	3.52	81.10
Low	17.73	97.19	7.31	49.80	24.44	93.95
Employment status						
Employed full-time	5.15	96.19	2.84	55.30	2.84	78.00
Employed part-time	11.18	97.56	4.36	49.17	4.36	81.19
Marginally employed	39.97	98.90	34.46	59.28	34.45	87.95
Sector						
Agriculture, forestry	22.34	100.00	0.00	0.00	0.00	0.00
Mining, energy	0.04	100.00	0.50	63.27	6.39	98.77
Chemic., synthetics, wood, paper ind.	4.61	98.52	3.15	55.93	6.18	89.18
Building industry	7.97	94.79	1.98	46.48	6.44	92.39
Iron, steal, and heavy industry	4.77	94.19	2.36	49.52	5.93	91.30
Engineering, electric, light industry	2.25	96.93	1.07	56.47	4.51	94.86
Textile, food industry	17.75	100.00	12.95	60.20	15.39	84.78
Wholesale and retail trade	14.79	98.52	7.32	58.96	11.68	88.61
Railways, postal service, transport.	13.32	97.51	7.65	63.42	10.15	88.72
Public services	5.76	97.16	3.88	65.86	6.87	92.63
Private services	15.35	97.20	11.03	47.98	13.99	84.70
Missing, not assignable	13.51	96.98	9.06	66.98	10.89	88.55
Firm size						
$<$ 5 employees	21.10	98.06	0.00	0.00	0.00	0.00
5-10 employees	17.15	98.74	0.00	0.00	0.00	0.00
10-20 employees	17.74	97.58	8.94	61.20	12.64	88.34
20-100 employees	10.61	98.78	8.84	57.01	12.20	86.57
100-200 employees	7.79	93.98	6.43	55.75	9.56	87.33
200-2000 employees	4.28	95.91	3.04	45.42	6.65	90.71
$>$ 2000 employees	3.49	95.49	2.55	78.85	4.92	97.70

Notes: Wage data for 2006 are extrapolated to 2008 using average growth rates (2007: 1.02, 2008: 1.025), Sample: individuals aged 18-65 years, hourly wages 3 €/h-150 €/h, no apprentices, weighted data using sample weights to obtain population means.
Source: Own calculations based on SOEP wave 2007 and GSES, wave 2006.

Table 3.8: Comparison of SOEP and GSES, Germany, 2008: Mean hourly gross wage (in €/hour) with and without a minimum wage of 7.50 €/hour within first decile of the hourly wage distribution

	SOEP			**GSES**			**GSES with apprentices**		
	MW: €/h	Δ €	%Δ	MW: €/h	Δ €	%Δ	MW: €/h	Δ €	%Δ
Germany overall	7.50	1.48	24.58	7.73	0.70	9.96	7.52	1.69	28.99
Region									
West Germany	7.50	1.62	27.55	7.77	0.62	8.67	7.52	1.78	31.01
East Germany	7.50	1.11	17.37	7.65	0.91	13.50	7.52	1.42	23.28
Gender									
Men	7.12	0.76	10.67	8.16	0.47	6.11	7.66	1.49	24.19
Women	7.50	2.20	36.86	7.54	1.10	15.31	7.50	1.93	34.65
Age									
18-25 years	7.50	1.35	21.95	7.69	0.83	12.10	7.51	2.37	46.11
26-35 years	7.50	1.39	22.75	7.73	0.69	9.80	7.53	1.21	19.15
36-45 years	7.50	1.63	27.77	7.76	0.61	8.53	7.53	0.98	14.94
46-55 years	7.50	1.41	23.15	7.75	0.65	9.15	7.53	1.01	15.49
56-65 years	7.50	1.56	26.26	7.74	0.77	11.05	7.53	1.15	18.03
Qualification									
High	7.51	1.32	21.36	7.57	1.13	17.55	7.51	1.60	27.07
Medium	7.50	1.52	25.42	7.72	0.67	9.50	7.53	1.08	16.74
Low	7.50	1.39	22.75	7.77	0.57	7.92	7.51	2.31	44.42
Employment status									
Employed full-time	7.50	0.99	15.21	7.71	0.60	8.44	7.54	0.84	12.56
Employed part-time	7.50	1.74	30.21	7.79	0.55	7.60	7.53	0.90	13.57
Marginally employed	7.50	1.77	30.89	7.73	0.85	12.34	7.52	1.26	20.13
Sector									
Agriculture, forestry	7.50	1.21	19.24	0.00	0.00	0.00	0.00	0.00	0.00
Mining, energy	7.50	0.24	3.31	7.71	1.02	15.25	7.50	2.68	55.49
Chemic., synthetics, wood, paper ind.	7.50	1.61	27.33	7.72	0.72	10.29	7.52	1.82	31.93
Building industry	7.50	1.33	21.56	7.80	0.62	8.65	7.52	2.46	48.62
Iron, steal, and heavy industry	7.51	2.08	38.31	7.77	0.55	7.61	7.52	2.03	36.98
Engineering, electric, light industry	7.50	1.41	23.15	7.72	0.71	10.13	7.51	1.96	35.32
Textile, food industry	7.50	1.05	16.28	7.69	0.68	9.71	7.53	1.33	21.49
Wholesale and retail trade	7.50	1.70	29.31	7.71	0.72	10.30	7.52	1.85	32.57
Railways, postal service, transport.	7.50	1.10	17.19	7.69	0.92	13.59	7.52	1.71	29.43
Public services	7.50	1.43	23.56	7.67	0.96	14.31	7.51	1.86	32.86
Private services	7.50	1.48	24.58	7.80	0.53	7.30	7.53	1.33	21.45
Missing, not assignable	7.50	1.44	23.76	7.66	0.96	14.33	7.52	1.57	26.39
Firm size									
< 5 employees	7.50	1.67	28.64						
5-10 employees	7.50	1.55	26.05						
10-20 employees	7.50	1.20	19.02	7.70	0.81	11.77	7.52	1.79	31.18
20-100 employees	7.50	1.32	21.36	7.72	0.68	9.66	7.52	1.59	26.81
100-200 employees	7.50	1.28	20.58	7.73	0.67	9.49	7.52	1.60	27.03
200-2000 employees	7.50	1.78	31.12	7.82	0.57	7.86	7.52	1.82	31.93
> 2000 employees	7.50	1.54	25.80	7.62	1.27	20.00	7.50	1.88	33.45

Notes: Wage data for 2006 are extrapolated to 2008 using average growth rates (2007: 1.02, 2008: 1.025), Sample: individuals aged 18-65 years, hourly wages 3 €/h-150 €/h, no apprentices, weighted data using sample weights to obtain population means.
Source: Own calculations based on SOEP wave 2007 and GSES, wave 2006.

Table 3.9: Compensated own and cross wage elasticities (number of workers)

West Germany	FT,U,M	FT,S,M	PT,M	ME,M	FT, U,W	FT,S,W	PT,W	ME,W
FT, U, M	**-0.510**	0.419	0.003	-0.001	0.050	0.034	-0.048	0.055
FT, S, M	0.085	**-0.200**	0.001	0.004	0.032	0.062	0.002	0.017
PT, M	0.023	-0.001	**-0.070**	-0.110	0.031	-0.268	0.204	0.186
ME, M	-0.019	0.316	-0.246	**-0.130**	-0.093	0.187	0.148	-0.162
FT, U, W	0.108	0.367	0.012	-0.013	**-0.370**	-0.055	-0.081	0.030
FT, S, W	0.020	0.136	-0.014	0.005	-0.009	**-0.160**	0.071	-0.051
PT, W	-0.044	0.007	0.033	0.011	-0.044	0.196	**-0.260**	0.099
ME, W	0.255	0.495	0.144	-0.058	0.056	-0.805	0.483	**-0.570**
East Germany	FT,U,M	FT,S,M	PT,M	ME,M	FT, U,W	FT,S,W	PT,W	ME,W
FT, U, M	**-0.300**	-0.086	-0.076	0.028	-0.036	0.487	-0.008	-0.008
FT, S, M	-0.002	**-0.110**	-0.008	0.005	0.006	0.091	0.015	0.005
PT, M	-0.135	-0.235	**-0.290**	0.006	0.114	0.235	0.302	-0.002
ME, M	0.172	0.476	0.019	**-0.300**	0.152	-0.778	0.332	-0.073
FT, U, W	-0.060	0.099	0.116	0.041	**-0.250**	-0.273	0.237	0.091
FT, S, W	0.044	0.128	0.012	-0.011	-0.014	**-0.230**	0.076	-0.010
PT, W	-0.010	0.063	0.055	0.018	0.040	0.245	**-0.440**	0.032
ME, W	-0.038	0.323	-0.008	-0.053	0.248	-0.582	0.437	**-0.330**

Notes: FT, U, M - Full-time unskilled men; FT, S, M - Full-time skilled men; PT, M - Part-time men; ME, M - Marginally employed men; FT, U, W - Full-time unskilled women; FT, S, W - Full-time skilled women; PT, W - Part-time women; ME, W - Marginally employed women.
Numbers in italics are own-wage elasticities.
Source: Freier and Steiner (2007a, 2010).

Chapter 4

Employment Effects of a Sectoral Minimum Wage in Germany. Semi-parametric Estimations from Cross-Sectional Data

4.1 Motivation

The majority of empirical studies that estimate the effect of minimum wages on employment applies one of two methodological approaches. Either regional and longitudinal variation in the nominal or real value of the minimum wage is exploited in panel data models, or quasi-experimental situations provide variation in the minimum wage between federal states or sectors that is utilized within a difference-in-difference (DiD) framework (see Neumark and Wascher, 2008 for an overview).[64] Recent papers combine features of both estimation strategies (Dube et al., 2010). All these approaches require variation in the minimum wage level that affects a treatment but not – or to a different degree – a control group. Moreover, individuals must be observed before and after the change of the minimum wage.

[64] The different methods are also mirrored in the debate about the employment effects of minimum wages in the U.S. that started in the early 1990s. The predominantly negative effects estimated in "traditional" panel studies (see, e.g., Card, 1992; Neumark and Wascher, 1992) were challenged by case studies that found no or even positive employment effects (Katz and Krueger, 1992; Card and Krueger, 1994, 1995).

An alternative identification strategy is pursued by several structural models. Meyer and Wise (1983a,b) laid the foundation for this type of research. Dickens et al. (1998) extended the approach using data for the UK. The basic idea is to parameterize the observable wage distribution under an existing minimum wage with available covariates and under certain distributional assumptions. Based on the structural estimates the counterfactual hourly wage distribution for a scenario without a minimum wage is predicted. The employment effects can then be deduced from the differences between the observed and counterfactual distributions.[65] Compared to the reduced form studies stricter identifying assumptions have to be satisfied, regarding, e.g., the functional form of the (underlying) distribution or the selection of a censoring point for the estimation. On the other hand the data requirements are less demanding. The structural models can be estimated on a single cross-section of hourly wages under a generally binding minimum wage. Neither a control group nor longitudinal variation in wages and minimum wage levels is needed for identification.

In this paper we apply the models of Meyer and Wise (1983a,b) and Dickens et al. (1998) to German data for a specific sector. Contrary to the rest of the economy a sectoral minimum wage was introduced in the main construction trade already in 1997.[66] The main contribution of the paper is to address the restrictive functional form assumptions of these parametric models. We suggest to estimate a series of censored quantile regressions that do not rely on symmetry and normality of the residual distribution. Based on this semi-parametric approach we predict the conditional wage distribution for the counterfactual situation without a minimum wage and simulate the employment effects analogously to the parametric models. Data from the German Structure of Earnings Survey (GSES) is utilized that contains reliable and precise information about hourly wages and includes a sufficient number of observations to conduct semi-parametric estimations at the sectoral level.

We also contribute to the empirical literature about the employment effects of

[65] Donald et al. (2000) suggest an alternative paramterization of the original model. Following the tradition of Meyer and Wise (1983a,b) a couple of (equilibrium) search models have been developed that refine this structural approach (Flinn, 2002, 2006; Ahn et al., 2011). The studies of DiNardo et al. (1996), Lee (1999), Dickens and Manning (2004), or Autor et al. (2010) also stand in this tradition, but are focused more on wage inequality.

[66] Several sectoral minimum wages have been introduced since 1997; see sub-section 4.2.4 below.

minimum wages in Germany by providing an alternative, more structural approach that complements the existing reduced-form studies. In the first study for the German construction sector König and Möller (2009) had to impute hourly wages into the administrative data set they used. They find negative employment effects for East Germany and insignificant results for the West. Rattenhuber (2011) uses several waves of the GSES. According to her findings the wage gains in the East German construction sector were substantial whereas West German employees did not experience a significant increase of their wages. Recently several ex post evaluation studies were intitiated by the German government to analyze the employment effects of different sectoral minimum wages.[67] Appropriate data, especially information on actual working hours, are still not available for most sectors. Finding reliable control groups (e.g. non-covered sectors or non-affected employees within a covered sector) proved also to be problematic in most of these studies. For the construction sector the effects on the level and outflow of employment are not statistically significant and slightly negative for the inflow into employment in East Germany (Apel et al., 2012; Bachmann et al., 2012). All in all these evaluation studies do not provide much empirical evidence for significant employment effects of the sectoral minimum wage in the construction sector.

We find theoretically consistent patterns of employment effects for the parametric and the semi-parametric models. The sectoral minimum wage led to negative employment effects in East Germany. For the West German main construction trade where the minimum wage hardly bit we find only small negative effects. We also reveal robustness issues of the parametric models: they prove to be sensitive with respect to the choice of a censoring point and yield implausibly large employment effects. We get more reasonable magnitudes with the semi-parametric estimator. Negative employment effects of the minimum wage vary between 4 and 5% in the East German and 1-2% in the West German construction sector. Employment losses are mostly borne by young construction workers, employees not covered by collective bargaining agreements and individuals working in small establishments.

[67] See Aretz et al. (2012); Boockmann et al. (2012); Bosch et al. (2012); Gürtzgen et al. (2012); Harsch and Verbeek (2012); Mesaros and Weinkopf (2012) for an overview of the results.

The paper proceeds as follows. After outlining the parametric models of Meyer & Wise and Dickens et al. we show how semi-parametric censored quantile regression estimators can be applied to estimate the underlying structural labor demand model without strong functional form assumptions. We then discuss the application to the sectoral minimum wage in the German main construction sector trade. Then the data set and our sample is described and the variables are defined. We first present estimation results for the parametric models and compare these to the employment effects on the basis of our semi-parametric models. We decompose the results by observable characteristics, conduct several robustness checks and discuss the plausibility of our findings. The last section summarizes and concludes.

4.2 Theoretical and econometric framework

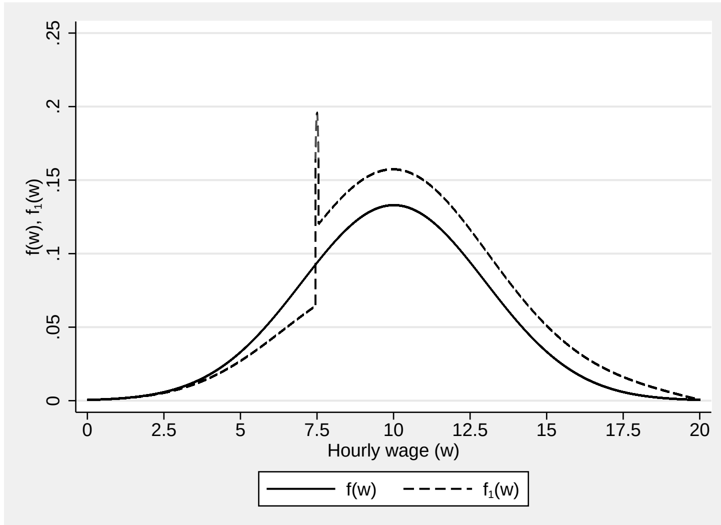
4.2.1 The Meyer & Wise approach

Based on the ingenious model of Meyer and Wise (1983a,b) wage and employment effects of a minimum wage can be estimated from a single cross-section of individual hourly wages.[68] The starting point of the one-equation version of the model (Meyer and Wise, 1983a) is an 'underlying wage distribution' without a minimum wage which could be written as a latent variable $w_i^\star$: $f(w_i^\star)$. For a given minimum wage M, Meyer & Wise assume that because of non-coverage and non-compliance some workers with underlying wages $w_i^\star < M$ remain employed at wages $w_i < M$ with probability P_1. Moreover, they assume that a fraction of persons with $w_i^\star < M$ are now paid at $w_i = M$ with probability P_2. Therefore the probability of people with $w_i^\star < M$ to be without work after the introduction of a minimum wage is $1 - P_1 - P_2 = 1 - P$ with $P = P_1 + P_2$. Probabilities P_1 and P_2 are constant for all $w_i^\star < M$, i.e. they do not depend on the individual wage. Meyer & Wise explicitly rule out spillover effects of the minimum on individuals with $w_i^\star \geq M$. The underlying (latent) distribution is specified as follows:

$$w_i^\star = X_i\beta + \epsilon_i \qquad \epsilon_i \sim N(0, \sigma^2) \tag{4.1}$$

[68] Dolado et al. (1997) apply this model to Spanish data.

Figure 4.1: Underlying and observed wage distribution



Source: Own illustration.

where X_i is a matrix containing individual and regional attributes and ϵ_i is a normally distributed error term with variance σ^2.[69] The underlying distribution $f(w)$ and the observed wage distribution $f_1(w)$ are exemplarily displayed in Figure 4.1 for hourly wages between zero and 20 €/hour with the minimum wage being fixed at 7.50 €/hour. The solid line marks the underlying, the dashed line the observed wage distribution. In this illustration some individuals earn wages below the minimum wage (non-coverage or non-compliance). Several workers with an underlying wage below M get paid exactly the minimum wage which induces the spike in the wage distribution. There are no spillover effects in the distribution above the minimum wage level M.

For $f_1(w)$ being the likelihood of observed wage rates, $w^\star$ or, e.g., $logw^\star$ normally distributed, and Φ the standardized normal distribution, Meyer & Wise write the likelihood of observed hourly wages w as:

$$f_1(w) = \begin{cases} \frac{f(w) \cdot P_1}{D} & if \quad w_i < M \\ \frac{\Phi[(M - X\beta)/\sigma] \cdot P_2}{D} & if \quad w_i = M \\ \frac{f(w)}{D} & if \quad w_i > M \end{cases} \tag{4.2}$$

[69]Meyer & Wise discuss the robustness of their results with respect to this functional form assumption. They use a Box-Cox transformation as an alternative without getting significantly different results.

where $D = 1 - Pr[w_i^\star < M](1 - P_1 - P_2) = 1 - \Phi[M - X_i\beta/\sigma] \cdot (1 - P)$ which is the probability that an individual who is employed without the minimum is also employed after its introduction. The distribution $f_1(w)$ is the conditional distribution of observed hourly wages in terms of the underlying distribution – given that wages are observed. The first part of the likelihood with $w_i < M$ is observed with probability P_1 times the likelihood for $w_i^\star = w_i$. The second part of the likelihood for observed wages $w_i = M$ is given by probability P_2 times the likelihood that $w_i^\star < M$ is raised by the minimum to $w_i = M$. The third part refers to observed wages above the minimum and is equal to the underlying distribution except for the fact that the share of people with $w_i > M$ might be higher than the share with $w_i^\star > M$ which is expressed in the denominator. Meyer & Wise use an interval around M as in their data the pile-up of hourly wages varies around the nominal minimum due to measurement error and potential spillover effects.

Note that this specification is quite similar to a standard Tobit model with censoring at M. In addition to common censored data there is also the case where wages below the 'censoring point' are observed which is mirrored in the first term of the likelihood as well as the denominator of all terms in the likelihood function. For N persons with observed wage rates, among them N_1 with hourly wages below, N_2 at, and N_3 above M, the full log-likelihood is given as follows:

$$\begin{aligned} logL &= \textstyle\sum_{i=1}^{N_1} lnf_1(w_i) + \sum_{i=1}^{N_2} lnf_1(w_i) + \sum_{i=1}^{N_3} lnf_1(w_i) \\ &= \textstyle\sum_{i=1}^{N_1} \frac{f(w)\cdot(P_1)}{D_i} + \sum_{i=1}^{N_2} \frac{\Phi[(M-X_i\beta)/\sigma]\cdot(P_2)}{D_i} + \sum_{i=1}^{N_3} \frac{f(w)}{D_i} \end{aligned} \tag{4.3}$$

The parameters in β as well as P_1 and P_2 are estimated by maximizing (4.3) for the sample of observed people in employment. The employment effects are calculated by way of simulation. Intuitively, the number of employed people earning less than M in the scenario without a minimum wage which is predicted on the basis of the underlying distribution is compared with the number of observed people with $w_i < M$. To be more precise, the employment effects of the minimum wage are simulated using the estimated parameters for (4.3). Remember that (conditional on X_i) D_i is the individual's probability to be still employed under the minimum given that he or she would be in employment under a minimum wage at $w_i < M$. Conversely the inverse $1/D_i$ is the expectation that a person would be in employment without a minimum wage.[70] For a sample of N persons the total expected number of employed people without the minimum amounts to:

$$T = \sum_{i=1}^{N} \frac{1}{D_i} \tag{4.4}$$

The percent increase in employment is therefore $(T - N)/N$. In the one-equation specification of the model that we have discussed so far the employment effect is estimated consistently, if there is by assumption no unemployment without the minimum wage. Alternatively, conditional on the minimum wage and observed covariates individual hourly wages are assumed to be uncorrelated with the employment probability. Meyer and Wise (1983b) relax these restrictions in a model extension that includes a wage and an employment equation:

$$\begin{aligned} E_i &= X_i\alpha + \epsilon_i^1 \\ w_i^\star &= X_i\beta + \epsilon_i^2 \end{aligned} \tag{4.5}$$

where the variances ϵ_i^1 and ϵ_i^2 are assumed to be distributed bivariately normal. In this specification people are allowed to be out of employment for causes other than the minimum wage. If ϵ_i^1 and ϵ_i^2 are not correlated, the model reduces to the one-equation specification from above. Since we want to use the model for data sets that contain only cross-sectional wage distributions of currently employed people and no information about non-employed people, we stick to the one-equation model.

Furthermore, identification in the Meyer and Wise (1983a,b) models rests on assumptions about the censoring point and the distribution of the error term. Meyer & Wise argue that robustness tests show that their results are not overly sensitive to these assumptions. These points were taken up by Dickens et al. (1998). We will discuss their model in the following sub-section.

[70] A brief derivation for this relationship is given in the Appendix.

4.2.2 Critique by Dickens, Machin, and Manning

Dickens et al. (1998) apply the Meyer & Wise approach to UK data to test its robustness with regard to the selection of the censoring point as well as the functional form assumption. They start from a simple version of the Meyer & Wise model with $P_1 = 0$ which means that people are not employed at $w_i < M$ with a minimum wage being in effect. Therefore only the probability $P_2 = P$ of remaining employed at $w_i = M$ under the minimum wage is part of the model. In order to point out the critical assumptions, Dickens et al. begin with the following reformulation of the Meyer & Wise model: In the absence of a minimum wage employment L_0 is reached with the distribution of wages given by $f(w;\theta)$ with θ being a set of parameters to be estimated. When a minimum is introduced the density function changes to $f_1(w;\theta)$ which leads to employment L_1.

While f_1 can be estimated from observed wages, one has to assume that there is a wage w_1 above which wages are not affected by the minimum in order to infer on the underlying distribution f and L_0. Dickens et al. point out that Meyer & Wise assume w_1 to be very close to the minimum wage. They show that the choice of w_1 will be crucial for the estimated employment effect if spillover effects are present. Under the assumptions made the distribution of observed wages and the underlying wage distribution are related as follows:

$$\begin{aligned} f_1(w;\theta) &= \tfrac{L_0}{L_1} f(w;\theta) \\ &= \gamma f(w;\theta) \quad \text{for} \quad w > w_1 \end{aligned} \tag{4.6}$$

The ratio γ of employment without and with the minimum serves as a measure of the employment effect. Equation (4.6) states that for wages above the censoring point w_1 the observed and the underlying distribution are equal up to the scaling factor γ. This holds because of the assumption that wages are not affected by the minimum above w_1.[71] Since they assume that employment above w_1 remains constant under

[71] Explanations of the assumptions and the derivation of the concentrated likelihood is given in the Appendix.

the minimum it holds that

$$\begin{aligned} L_1(1 - F_1(w_1;\theta)) &= L_0(1 - F(w_1;\theta)) \\ F_1(w_1;\theta) &= 1 - \gamma(1 - F(w_1;\theta)) \end{aligned} \tag{4.7}$$

Specifying a tobit model for the wage equation with the censoring point at w_1 and plugging in (4.6) and (4.7) the log-likelihood becomes:

$$\begin{aligned} logL &= \sum_{i=1}^{j} logf_1(w_i;\theta) + (L_1 - j) \cdot logF_1(w_1;\theta) \\ &= \sum_{i=1}^{j} logf(w_i;\theta) + j \cdot log\gamma + (L_1 - j) \cdot log[1 - \gamma \cdot (1 - F(w_1;\theta))] \end{aligned} \tag{4.8}$$

Note that this tobit model is estimated only on those people who are observed to be employed with $N = L_1$ as the total number of observations. Moreover, j denotes the number of persons with $w_i \geq w_1$ and $L_1 - j$ comprises those who are below the truncation point. As in the Meyer & Wise model there is no unemployment without a minimum wage. Parameters γ and θ are estimated by maximizing (4.8) which yields the following Maximum Likelihood estimator of γ:

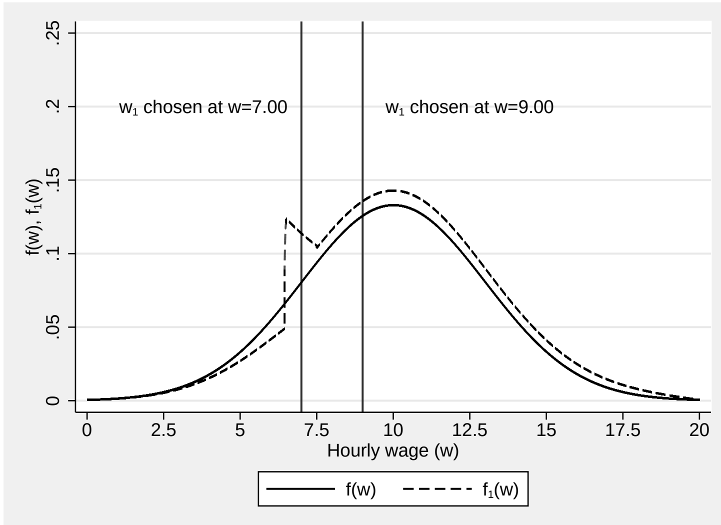
$$\gamma_{MLE} = \frac{j}{L_1 \cdot [1 - F(w_1;\theta)]} \tag{4.9}$$

The intuitive interpretation is that employment will decrease (increase) under the minimum wage if the observed fraction of workers below w_1 is smaller (larger) than it is predicted on the basis of the distribution of those paid above w_1. Inserting this estimator in (4.8) yields the concentrated likelihood which is equal to a likelihood from a sample of workers with observations truncated at w_1:

$$logL = \sum_{i=1}^{j} logf(w_i;\theta) - j \cdot log[(1 - F(w_1;\theta))] + \text{constant} \tag{4.10}$$

Having estimated θ from the truncated regression model in (4.10) γ can be obtained from (4.9). Dickens et al. apply this model to UK Wage Council data between 1987-90 for the retail and wholesale sector and estimate it separately for men and women. Their findings markedly differ from those of Meyer & Wise with their own employment effects being implausibly large for most specifications. Dickens et al.

Figure 4.2: Choosing different censoring points



Source: Own illustration.

show that for their data the estimates of the employment effect are very sensitive with respect to two identifying assumptions - the chosen cut-off point for the truncated regression and the assumed functional form for the wage distribution.

Differently from the Meyer & Wise model the truncated regression is identified for different trunction points w_1 above the level of the minimum wage. Choosing different *cut-off points* (at the 10th, 20th, 30th and 40th decile) yields vastly different results. It is obvious that setting w_1 too high results in inefficient estimates of γ whereas setting it too low may yield inconsistent estimates. The latter might happen if the minimum affected higher parts of the wage distribution above the chosen censoring point ('spillover effects'). This clearly violates the assumption of (4.7) as is demonstrated in Figure 4.2.

The solid line marks the underlying and the dashed line the observed wage distribution for a minimum wage set at 6.50 €/hour. If the first censoring point at 7.00 €/hour was chosen, estimates would be inconsistent as the observed distribution is influenced by spillover effects of the minimum. The second cut-off point at 9.00 €/hour does not suffer from this problem. Dickens et al. thus emphasize that the Meyer & Wise model could yield inconsistent estimates when spillover effects of the minimum wage to higher parts of the wage distribution occur. Since Meyer & Wise only consider w_1 values close to the minimum, spillover effects are rather likely.[72] We will check the robustness of our results specifying a range of different censoring points.

Regarding the *functional form* of the wage distribution Dickens et al. experiment with two different parametric distributions for $F(w_1;\theta)$: first, they assume a log-normal wage distribution as have Meyer & Wise. Second, they specify the Singh-Maddala distribution ($F(w_1;\theta) = 1 - \left[1 + w_1/\theta_1)^{\theta_2}\right]^{\theta_3}$ with $\theta_1, \theta_2, \theta_3 > 0$). They demonstrate that with their data the choice of the *functional form* is crucial for the estimated employment effects. Intuitively, as soon as one assumes a symmetric distribution and then infers from the right part of a left-truncated observed (e.g. log-normal) wage distribution to an underlying distribution, estimates will become inconsistent if the underlying distribution is indeed asymmetric. In this instance results are driven by the non-truncated part of the distribution which might be fundamentally different from the truncated part which occurs regularly with income data. Dickens et al. reject the symmetry assumption for their data and find markedly different results for the asymmetric Singh-Maddala compared to the log-normal distribution.

The main result of Dickens et al.'s paper is that they revealed the sensitivity of the Meyer & Wise approach to its identifying assumptions. We will subsequently adress those issues as we relax the functional form assumption by specifying semi-parametric models for the observed wage distribution in the following section. We then discuss the selection of a cut-off point for our application in section 4.2.4.

4.2.3 Semi-parametric estimators

As outlined, the parametric models of Meyer and Wise (1983a,b) and Dickens et al. (1998) rely on a functional form assumption for the residual wage distribution (e.g. $\epsilon \sim N(0,\sigma)$) to identify the parameter of the observed distribution and infer on the underlying wage distribution. If the parametric assumptions are not met by the data, the maximum likelihood estimator will be inconsistent and the underlying

[72] One other difference between the Meyer & Wise approach and Dickens et al. is that the former estimate the probability P to remain employed after the minimum whereas the latter specify the employment ratio $\gamma = L_0/L_1$. Dickens et al. discuss how both measures are related ($P = (\gamma^{-1} - 1) \cdot F(W_1;\theta)^{-1}$) and what the advantage is to estimate γ rather than P.

distribution is not correctly estimated. Both Meyer and Wise (1983a,b) and Dickens et al. (1998) apply alternative parametric distributions in their papers (Box-Cox transformation, Singh-Maddala distribution). We will take another route here by using semi-parametric estimators for the observed wage distribution that put less strict assumptions on the error term.

Our estimation framework corresponds to the parametric model of Dickens et al. (1998). Employment effects are simulated based on the comparison of the observed (censored) wage distribution with the estimated underlying wage distribution. Several semi-parametric regression models for censored data have been suggested over the last few years (see Chay and Powell, 2001 for an overview), among them censored quantile regression (Powell, 1984, 1986a), symmetrically censored least squares (Powell, 1986b), or pairwise difference estimators for truncated or censored regression models (Honore and Powell, 1994). In those models the regression function is parameterized with observable covariates, yet the assumptions on the error term are weaker than, e.g., in the Tobit or truncated regression model. In the following we focus on the *censored quantile regression* (CQR) which is reviewed extensively by Buchinsky (1994).

The τ-th quantile of a wage distribution is defined as the inverse of the cumulative distribution function at τ: $Q_\tau(w_i) = F_w^{-1}(\tau)$.[73] Quantile regression is based on the conditional quantile function of the distribution of wages w_i given a set of covariates X_i: $Q_\tau(w_i|X_i) = F_w^{-1}(\tau|X_i)$. The conditional quantile can also be written in terms of a minimization problem (see Koenker, 2007):

$$Q_\tau(w_i|X_i) = \arg\min_{q(X)} E\left[\rho_\tau(w_i - q(X_i))\right] \tag{4.11}$$

where $\rho(u)$ is the check function that puts asymmetric weights on the positive and negative terms as $\rho(u) = 1(u > 0)\tau|u| + 1(u \leq 0)(1-\tau)|u|$, unless $\tau = 0.5$ which leads to the simple least absolute deviations estimator. Substituting a linear function of X_i for $q(X)$ gives:

$$\beta_\tau = \arg\min_{b} E\left[\rho_\tau(w_i - X_i'\beta)\right] \tag{4.12}$$

[73] Q_τ means a share of τ observations are smaller then Q with $0 \leq \tau \leq 1$.

There is no closed-form solution to this problem. The model is estimated by solving the linear programming representation of the minimization problem (Koenker and Bassett, 1978). Since the observed distribution of w_i is censored in our application, we rely on censored quantile regression (Powell, 1986a). As long as the τ-th quantile is in the uncensored region of the distribution it is not affected by the censoring. If the quantile lies in the censored region, it is equal to the censoring point. $Q_\tau(w_i|X_i) = max[w_1, X_i'\beta_\tau]$ then denotes the conditional quantile function of the observed wages w_i censored at w_1 given the regressors X_i with the parameter vector β_τ. The parameter vector β_τ is estimated by minimizing the weighted sum of the absolute deviations of w_i from $max[w_1, X_i\beta_\tau]$ over all β_τ in the following objective function:

$$Q_\tau(w_i|X_i, \beta_\tau) = \sum_{w_i > X\beta_\tau} \tau|w_i - max[w_1, X_i\beta_\tau]| + \sum_{w_i < X_i\beta_\tau} (1-\tau)|w_i - max[w_1, X\beta_\tau]| \quad (4.13)$$

For the CQR Buchinsky (1994) suggested the Iterative Linear Programming Algorithm (ILPA) which alternates between two steps: In the first step, the model applies the quantile regression estimator to all observations. In the second step, the data set is re-censored by excluding all those observations for which the predicted values are below the censoring point. Then, step one is repeated with the re-censored data. These steps are iterated until convergence is achieved.[74] The CQR neither requires additional distributional assumptions about the error term, nor homoscedasticity (since β_τ are allowed to vary with τ). The CQR estimator thus handles non-normal, heteroskedastic and asymmetric errors which is important for the analysis of empirical wage distributions. The lone assumption for a correctly specified CQR model is that the conditional quantile of the error term given regressors X_i and the quantile-specific parameter vector β_τ is zero.

We use the relationships between the observed and underlying wage distributions from equations (4.6) and (4.7) above. Exploiting the connection between the

[74] The ILPA is not guaranteed to converge; if a certain number of observations is censored and the respective quantile lies in the censored region, the CQR-estimator will not converge. In this case this quantile has to be approximated by a higher quantile where convergence is achieved. Standard errors have to be bootstrapped.

condititional CDF and the conditional quantile function:

$$F_{w_i|X_i}(w|X) \equiv \int_0^1 1\left\{Q_{w_i|X_i}(u|X) \leq w\right\} du \tag{4.14}$$

we can re-write (4.7) in terms of conditional quantiles:

$$\int_0^1 1\left\{Q_{w|X}(u|X) \leq w_1\right\} du = 1 - \gamma\left(1 - \left[\int_0^1 1\left\{Q_{w^\star|X}(u|X) \leq w_1\right\} du\right]\right) \tag{4.15}$$

The conditional wage distribution above the cut-off point w_1 is approximated by a series of CQR regressions at different quantiles in a very flexible way. Similar procedures that estimate conditional distributions are used in the literature on the decomposition of distributions to analyze sources of wage inequality (Gosling et al., 2000; Machado and Mata, 2005; Melly, 2005; Chernozhukov et al., 2012)[75] or the estimation of unconditional distributions and quantile treatment effects (Firpo et al., 2009; Firpo, 2007). Most of those papers also estimate CQR models since wage or income distributions are censored, mostly at the top. In this case the censoring is from below and the censored part of the distribution is approximated by the lowest estimable quantile. We use a relatively narrow grid of 0.02 for the quantiles near the cut-off point; for higher quantiles we use a coarser grid of 0.1. We utilize Buchinsky's ILPA implemented in Stata (Jolliffe et al., 2000) in a slightly modified version. Having estimated the parameters of the conditional distribution the employment effects are simulated analogous to equation (4.4). We compare the probability mass below the cut-off point with its counterpart under the density of the observed wages. The simplest way to do this is to compare the number of predicted observations below the chosen cut-off point with the number of observed observations:

$$\Delta E = (\hat{N}_{below} - N_{below})/L_1 \tag{4.16}$$

This difference standardized by the observed employment level is the percentage change of employment that would result if the minimum wage was not in effect.

[75] Albrecht et al. (2006) estimate counterfactual distributions and account for sample selection between different groups. Donald et al. (2000) use hazard based estimators to estimate conditional wage distributions.

4.2.4 Application to the German construction sector

The structural approaches discussed in the last sub-sections cannot be applied to the German economy as a whole as no federal minimum wage is in place. However, sectoral minimum wages have been implemented in several industries (including the construction sector, the waste industry, among roofers and electricians, the laundry industry as well as among painters, varnishers, and the caring industry) over the last ten plus years. The most controversial issue in the ongoing debate about the introduction of a federal minimum are the potential ramifications for aggregate employment (see, e.g., Franz, 2007; Fitzenberger, 2009b).[76] The German government initiated a large-scale evaluation to gain insight into the employment effects. In his review Möller (2012) concludes that most of these DiD studies did not find disemployment effects. He points out some methodological issues such as the lack of adequate longitudinal data that contain precise information on hours worked or the availability of suitable control groups.

Our paper contributes to this literature as it exploits the first sectoral minimum wage in Germany that was introduced in 1997 in the construction sector and has been amended repeatedly. The legislation covers only blue-collar workers (so-called "gewerbliche Arbeitnehmer") in large parts of the main construction trade ("Bauhauptgewerbe"). Minimum wage levels were set and kept differently for West and East Germany. It is by far the most important sectoral minimum wage in Germany as it covers more employees than the other sectoral minima combined. With the GSES an adequate data base covers this sector with a sufficient sample size (see section 4.3). There are further reasons why the minimum in the German construction sector constitutes an intriguing empirical case for the models we estimate:

– The minimum wage creates a situation like in the reference studies of Meyer and Wise (1983a,b) and Dickens et al. (1998), yet for a specific sector. The minimum is binding for a sizeable proportion, but not all of the construction workers in the data set. Therefore the models can be replicated and their

[76] Several ex ante evaluations try to estimate the effect of a federal minimum wage on aggregate employment (Bauer et al., 2009; Müller and Steiner, 2008a; Müller, 2009a; Kalina and Weinkopf, 2009; Knabe and Schöb, 2009; Ragnitz and Thum, 2007b, 2008).

results can be compared with the evidence for Germany.

- Although the minimum was fixed at a lower level in East compared to West Germany, we show that its "bite" was much stronger in the East. According to theory the effects should hence be more pronounced in the East; the West serves as a quasi-control group. We thus estimate separate models for East and West Germany.

- The minimum wage was mainly binding for blue-collar workers in the greater part of the main construction trade. Barring labor-labor substitution, employment effects should not be detectable for white-collar workers or in other branches of the construction sector. On the other hand, electricians and roofers had their own minimum wages. We will estimate similar models for those sub-samples to test the robustness of our main findings and discuss potential substitution effects.

On the other hand the application of our structural approach to a sectoral minimum wage entails some limitations. We conduct a partial analysis of the construction sector which is different from other studies where the minimum wage covered the whole economy. The labor demand models cannot explicitly analyze substitutional or complementary employment effects with other sectors and between covered blue-collar workers and non-covered white-collar workers within the main construction trade. The direction of this potential bias is a priori indetermined. We will use separate estimations for non-covered sub-groups of construction workers to discuss such effects, though. We also do not explicitly consider the output price elasticity for the construction sector. Increasing the price of one production factor likely reduces the demand for construction tasks to some degree. Capital-labor-substitution may occur to some degree in the construction sector as the price of labor increases under the sectoral minimum wage which we do not estimate here. The two latter mechanisms lead to an overall reduction of employment across the wage distribution regardless of the distance to the minimum wage which our model does not capture. We would then underestimate the employment effects of the sectoral minimum wage.

4.3 Data, sample, variables

The empirical analysis is based on data from the German Structure of Earnings Survey (GSES). We exploit data from 2001. This is the first wave available after the introduction of the minimum wage.[77] The GSES is a linked employer-employee data set provided by the German Federal Statistical Office (Hafner, 2006; Statistisches Bundesamt, 2009). The large sample size (about 1 million observations in total) enables precise estimations for sub-groups of employees. This is indispensable especially for the semi-parametric estimators and for sub-samples like the German construction sector. Another important advantage of the GSES data is that it contains cardinal information on working hours. Comparable administrative data for Germany lack those information (König and Möller, 2009; Apel et al., 2012). In addition, the hourly wage measures are more reliable than in household surveys like, e.g., the German Socioeconomic Panel (SOEP), since the information comes directly from the firm and is based on the employment contract. Measurement errors due to incomplete memory of the respondent, discrepancies between reported working hours and wage income are therefore less of a problem (Müller, 2009a).

On the other hand several drawbacks of the GSES have to be acknowledged. For establishments with less than 11 employees no data is collected at all. Apel et al. (2012) show that this is relevant for the construction sector where small establishments play an important role in certain areas like skilled crafts and trades. Furthermore, it lacks information on the household context (family status, children, etc.).

The sample is restricted to the main construction trade of the German construction sector where the minimum wage covered a sizeable proportion of workers. In order to get a more homogeneous sample, the estimations are further constrained to male blue-collar workers and employees who are not in vocational training since the minimum only covers blue-collar workers and males clearly dominate this industry.

[77] There is only one later wave available for 2006. By then minimum wages in the construction sector had been differentiated by region and skill level. This complicated the estimation of the semiparametric models as the number of observation is smaller for those sub-groups. We discuss the findings for the 2006 wave in the robustness analysis.

Note that in this sample there is non-coverage (some sectors in the main construction trade were exempted) and there might also be some non-compliance. In 2001 coverage amounted to about 39% of all workers in the East and 35% of all workers in the West German construction sector. Rattenhuber (2011) provides also detailed information on the development of the minimum wage for the German construction sector. We will show below that for the majority of employees in the West the minimum was not binding. All models are estimated separately for East and West Germany.

The hourly wage measure is based on reported gross income from work in the month of the survey. Any payments for additional (overtime) work in the observed month are subtracted from this amount. Hourly wages are calculated by dividing this number by reported monthly working hours which are also diminished by overtime hours if applicable. Wages used in the analysis thus refer to regular payments and actual working hours (sans overtime) as opposed to contractual wages and hours. Given the reliability of the GSES data we are confident that this gives a precise wage measure which can be related to the legal minimum wage levels.

The selection of explanatory variables is constrained by the GSES data set. The specification is guided by the Mincerian wage equation which explains earned wages on the basis of human capital (Mincer, 1974). We therefore include polynomials for *age* and the *level of education* which should approximate human capital accumulation. We also distinguish different types of *employment contracts* (full-time, part-time, and marginal employment). Furthermore, as the literature on internal labor markets suggests, additional years of *tenure* in a firm lead to an increase in wages (Medoff and Abraham, 1981). As we have this information in the data we include tenure in our wage regressions. We have no information on the entire labor market career of the individuals, though, and cannot account for the potential depreciation of human capital over past periods of unemployment or inactivity. In addition to observable individual and job characteristics factors on the labor demand side are also important for the wage. We therefore add characteristics measured at the establishment level. We include dummy variables for the *establishment size* and the *industry* where the individual works as different firms can pay different wages for equally skilled and productive people. We also have information on the type of *collective bargaining* agreement (sectoral, firm, or no agreement) which varies widely between East and West Germany and we control for the influence of the *public sector* in the firm.

The descriptive statistics of the log wage and all explanatory variables used are reported in Table 4.1. They reveal first the differences in the average wage level between West and East Germany. Second, an important institutional discrepancy which is crucial for the bargained wages as well as the agreed minimum wage levels concerns the degree of unionization (Rattenhuber, 2011). In West Germany almost 80% of all individuals in the sample work under a collective bargaining agreement (CBA) whereas this share is only about half that size in the East. Since firm CBAs did not play a significant role in the German construction sector at that time the majority of East German workers is not directly covered by any CBA.

Table 4.1: Descriptive statistics: wages & explanatory variables

	East Germany		**West Germany**	
	mean	[s.d.]	mean	[s.d.]
Log wage	2.3338	[0.1722]	2.6405	[0.1755]
Age	39.1049	[9.5005]	40.5143	[10.7692]
Tenure	81.5588	[95.0811]	115.2525	[112.7403]
Dummy 'Abitur'	0.0036	[0.0600]	0.0044	[0.0665]
Dummy no CBA	0.6188	[0.4858]	0.2008	[0.4006]
Dummy firm CBA	0.0233	[0.1509]	0.0110	[0.1044]
Dummy sector CBA	0.3579	[0.4795]	0.7882	[0.4086]
Dummy no public	0.9509	[0.2161]	0.9746	[0.1574]
Dummy limited public	0.0236	[0.1518]	0.0148	[0.1207]
Dummy high public	0.0255	[0.1577]	0.0106	[0.1026]
Dummy establishment size $10-20$	0.1615	[0.3680]	0.1553	[0.3622]
Dummy establishment size $20-50$	0.2209	[0.4149]	0.2514	[0.4338]
Dummy establishment size $50-100$	0.2630	[0.4403]	0.2114	[0.4083]
Dummy establishment size $100-250$	0.2372	[0.4254]	0.2500	[0.4330]
Dummy establishment size $250-500$	0.0824	[0.2750]	0.0835	[0.2767]
Dummy establishment size > 500	0.0350	[0.1837]	0.0484	[0.2147]
Observations	3,604		10,343	

Source: Own calculations based on GSES, wave 2001.

With respect to other individual characteristics construction workers are slightly older in the West compared to the East. Their average tenure in the job is 35 weeks longer and the share of people with a higher school degree is slightly higher. Concerning firm characteristics the public sector has a slightly larger influence in East German firms whereas establishment sizes are rather similar between the West and East German construction firms. The sample comprises about 3,600 East German cosntruction workers whereas the sample size for the West is more than 10,300 employees.

4.4 Results

All wage regressions are estimated on log hourly wages to reduce the asymmetry in the distributions. We do not discuss the results for the regression coefficients of the explanatory variables in the paper.[78] Except for space restrictions parameter estimates for the explanatory variables are not the focus of our analysis, since we are mainly interested in the (underlying) conditional distribution. Direction and size of the coefficients are in line with theoretical expectations (Tables 4.7 and 4.8 in the appendix). First, we present descriptive graphical evidence for East and West Germany. Second, we discuss the parametric estimates from the models of Meyer & Wise as well as Dickens et al. Third, we present semi-parametric censored quantile regression results and relate them to the previous evidence. Finally, employment effects are differentiated by individual and establishment characteristics, robustness checks are carried out and the results are related to previous findings.

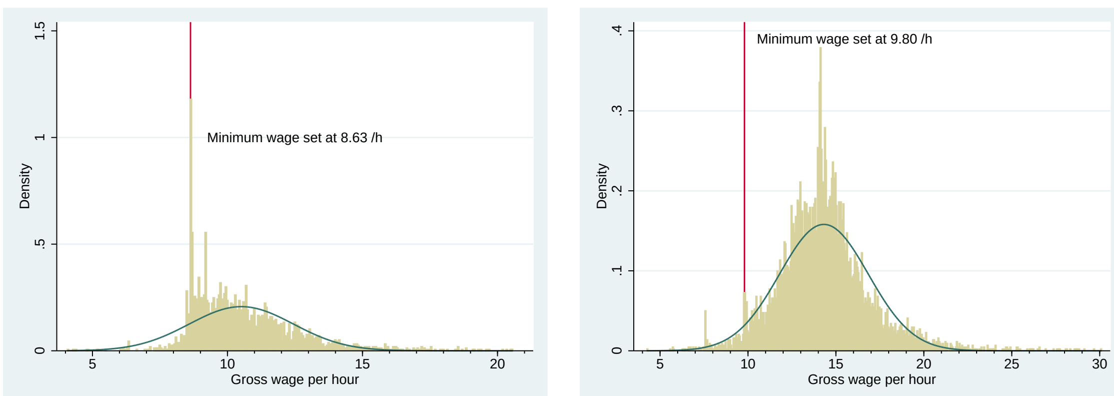
4.4.1 Descriptive evidence

After the minimum in the German construction sector was introduced in 1997 it was amended several times. We apply data gathered in September 2001 and use therefore minimum wage levels set in September 2001 at 8.63 €/hour in East and 9.80 €/hour in West Germany. The histograms of Figure 4.3 show the empirical distributions of log hourly wages for the sample of the construction workers in 2001 separately for East (left panel) and West Germany (right panel). The same graphs for log hourly

[78] A large number of different models for sub-groups and several censoring points was estimated, especially for the censored quantile regressions. Complete estimation results are available from the author upon request.

wages are reported in Figure 4.4 in the Appendix. The respective minimum wage levels are also included in every chart. For both regions the expected pattern for the wage distribution under a minimum wage arises (compare with Figure 4.1 above). A clear spike of wages at the legal minimum wage level is visible, although much more pronounced in East Germany. One also observes hourly wages below the defined minimum indicating non-coverage (and potentially some non-compliance). There is slight descriptive evidence for some spillover effects directly above the minimum wage; this cannot be tested formally, though.

Figure 4.3: Hourly wages, main construction trade, East & West Germany



Notes: Normal distribution in graphs for comparison.
Source: Own calculations based on GSES, wave 2001.

The main result of the descriptive analysis is that the minimum wage in the construction sector was binding for a considerably higher share of employees in East compared to West Germany: The nominal minimum wage level is far closer to the median of the wage distribution as the Kaitz index of 0.85 for East shows in comparison to 0.69 in the West. This is important for the interpretation of the regression results below. We expect larger employment effects for the East German construction sector whereas the results should be less clear for West Germany. The differential effects should be mirrored in the estimates of the employment effects that are carried out separately for the East and the West.

4.4.2 Parametric estimates

As mentioned the parametric models of Meyer & Wise and Dickens et al. are estimated separately for East and West Germany (Table 4.2). All results refer to a percentage change in employment that would result if there was no minimum wage, i.e. positive values indicate negative effect on employment of the minimum wage and vice versa. Bootstrapped 95-percent-confidence-bands are reported in parentheses. We analyze the sensitivity of the models with respect to the choice of the censoring point by estimating the models for the cut-off points given in the first column. The horizontal lines within the table mark the minima set for the East and West.

Table 4.2: Employment change without minimum wage in %: parametric models

	East Germany			
Cut-off (€/h)	Meyer & Wise		Dickens et al.	
8.5	15.21	[7.41;23.02]		
8.6	9.49	[3.70;15.28]		
8.7			19.19	[18.60;19.77]
8.8			20.79	[20.03;21.54]
8.9			22.25	[21.24;23.24]
9.0			20.92	[19.45;22.34]
9.1			23.68	[21.71;25.56]
9.2			27.38	[24.71;29.87]
9.3			20.01	[14.81;24.61]
9.4			25.95	[18.14;32.40]
9.5			29.68	[22.26;35.80]
	West Germany			
Cut-off (€/h)	Meyer & Wise		Dickens et al.	
9.7	0.02	[-0.01;0.05]		
9.8	0.01	[-0.01;0.04]		
9.9			-2.64	[-2.69;-2.59]
10.0			-2.97	[-3.02;-2.92]
10.1			-3.03	[-3.08;-2.98]
10.2			-3.30	[-3.35;-3.25]
10.3			-3.65	[-3.70;-3.60]
10.4			-3.84	[-3.89;-3.79]
10.5			-4.15	[-4.20;-4.10]

Notes: The models are estimated for varying censoring points according to 1st column. The horizontal line marks the level of the nominal minimum wage. Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSES, wave 2001.

The findings for *East Germany* are consistent with our theoretical expectations. We estimate negative employment effects for the East German construction sector in 2001 in the interpretable range of cut-off points for both parametric models. Yet those findings are sensitive to different model assumptions as well as the selection of the cut-off points. The Meyer & Wise model can only be estimated around the nominal minimum wage level of 8.63 €/hour, since the spike at the minimum (see Figure 4.3 above) is explicitly modeled. We use an interval of 0.20 €/hour above the stated censoring point; therefore only the reported cut-off points 8.50 €/hour and 8.60 €/hour cover the observed spike. We find negative employment effects for those two cut-offs. According to these estimates employment would be 10-15% higher without the minimum wage which is a quite large effect. Meyer & Wise's approach hinges on this narrow region of cut-off points which makes this model potentially vulnerable to spillover effects.

In the Dickens et al. approach the cut-off point is set above the nominal minimum wage and can be varied providing an informal robustness check against spill-over effects. We find negative employment effects over the whole range of estimates for East Germany. Employment would be about 20% higher without a sectoral minimum wage. This result is even higher than for the Meyer & Wise model and hardly convincing. The estimates are of similar size between cut-off points of 8.7 €/hour and 9.0 €/hour. For censoring points further above the distribution (where decreasingly less information of the observed distribution is used to estimate the underlying distribution) the effects become even larger. It is noteworthy that Dickens et al. (1998) report even estimates of even higher magnitude in their paper.

The parametric results for *West Germany* also mostly fit our hypotheses as we get insignificant or only very small positive employment effects of the sectoral minimum wage in the construction sector. For the Meyer & Wise model the estimates are zero which would confirm the hypothesis that the minimum was hardly binding in the West and therefore should have only minor implications for employment. The Dickens et al. model yields even slight positive effects. This is not very plausible and rather hints to slightly inconsistent estimates for the West.

Overall the findings of the parametric models replicate the result patterns of the studies of reference and are qualitatively consistent with our theoretical expectations.

We do find negative employment effects for the East German construction sector whereas estimates tend to zero for the West. On the other hand the problems of the parametric approaches become obvious. The results are apparently sensitive to the choice of a cut-off point. Moreover, the size of the employment effects indicates that the parametric assumptions are too restrictive and lead to inconsistent estimates. It is rather inconceivable that the still moderate sectoral minimum wage would lead to employment losses of 10-20% in the medium term. It seems that the Dickens et al. model is more vulnerable with respect to violations of these assumptions as it relies on a smaller part of the observed distribution compared to Meyer & Wise's approach. We turn now to the semi-parametric estimates.

4.4.3 Semi-parametric estimates

Do the findings change if we relax the functional form assumption? The models are again estimated separately for East and West Germany and a range of cut-off choices (Table 4.3). The figures in the table again refer to a percentage change in employment which would result if there was no minimum wage with positive numbers indicating negative employment effects and vice versa. Bootstrapped 95-percent-confidence-bands are given in parentheses. As in the Dickens et al. framework we report estimates for different cut-offs above the nominal minima as an informal test for the existence of spillover effects. The caveat is that identification rests on an increasingly smaller part of the distribution for higher censoring points.

Table 4.3: Employment change without minimum wage in %: semi-parametric models

Cut-off (€/h)	**East Germany**		Cut-off (€/h)	**West Germany**	
8.7	5.99	[4.33;7.66]	9.9	1.40	[0.78;2.03]
8.8	5.63	[3.49;7.77]	10.0	1.44	[0.78;2.11]
8.9	4.91	[2.35;7.48]	10.1	1.57	[0.90;2.24]
9.0	4.08	[1.78;6.37]	10.2	1.46	[0.80;2.12]
9.1	4.77	[2.63;6.91]	10.3	1.37	[0.52;2.22]
9.2	4.08	[1.93;6.23]	10.4	0.59	[-0.07;1.25]
9.3	1.89	[-0.21;3.98]	10.5	0.60	[-0.08;1.28]

Notes: The models are estimated for varying censoring points according to 1st column. Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSES, wave 2001.

Overall the semi-parametric estimates are qualitatively consistent with the parametric model results and theoretical expectations. We find again negative employment effects for the East German construction sector whereas estimates are only slightly negative for West Germany. Regarding the size of the effect we estimate that employment would be about 4-5% higher in the East German construction sector if there was no minimum wage. This seems to be a more reasonable magnitude compared to the 10-20% range for the parametric models and suggests that functional form assumptions might indeed have biased those results. According to these estimates employment in the West German construction sector would have been 1-2% higher without the minimum wage. So we also find minor employment losses for West Germany induced by the minimum. The censored quantile regression model seems to work better when it is based on a smaller part of the observable distribution compared to the parametric models.

The semi-parametric estimates are relatively robust with respect to the choice of a cut-off point up to 9.2 €/hour in the East and 10.3 €/hour in the West. Nevertheless there is some evidence for spillover effects for East Germany since estimates directly above the minimum wage levels are markedly larger. At around 9.0 €/hour they are reduced to about 4% which is consistent with the descriptive findings of Figure 4.3 above. The density above the spike at the set minimum wage level of 8.63 €/hour is clearly higher than around 9.0 €/hour. Although the difference is not very large this would suggest that employment effects of the minimum wage in the East German construction sector are between 4 and 5%. A look at Figure 4.3 may also explain that estimates differ for higher censoring points. At a cut-off point of 9.5 €/hour for East Germany the model is based essentially only on half of the observable distribution.

Since the estimations are based on individual data we are able to break down the average employment effects by *individual and firm characteristics* (see Table 4.4). The detailed analysis helps to uncover heterogeneity in the overall effects of the minimum wage. Note that we still work with the estimated underlying distributions from the pooled models of all construction workers in the respective samples for the East and the West. The employment effects are calculated as described above by comparing the observed and underlying distribution, but now separately for different sub-groups of individuals. We chose our preferred cut-off points of 9.0 €/hour for East and 10.0 €/hour for West Germany which lie not directly above the legally set minima to reduce the bias of potential spillover effects. The first line in the table represents the aggregate estimate and corresponds to Table 4.3.

Table 4.4: Employment change without minimum wage in % by sub-groups: semi-parametric models

Characteristics		**East Germany**		**West Germany**	
All		4.05	[1.72;6.39]	1.44	[0.73;2.15]
Age	18 – 25 years	27.40	[21.25;33.54]	10.46	[7.14;13.78]
	26 – 30 years	17.66	[11.98;23.35]	5.46	[3.42;7.50]
	31 – 35 years	6.98	[3.04;10.93]	0.84	[-0.24;1.93]
	36 – 40 years	-0.15	[-3.78;3.49]	0.00	[-1.16;1.16]
	41 – 45 years	-5.76	[-9.30;-2.23]	-0.07	[-1.20;1.06]
	46 – 50 years	-4.48	[-7.30;-1.66]	-0.57	[-1.60;0.47]
	51 – 55 years	0.68	[-3.99;5.36]	0.00	[-0.71;0.71]
	56 – 65 years	5.11	[-1.88;12.10]	-1.05	[-1.88;-0.21]
CBA	no agreement	9.60	[6.47;12.72]	11.36	[8.33;14.40]
	sectoral agreement	-5.12	[-7.34;-2.89]	-1.25	[-1.66;-0.84]
	firm agreement	-2.38	[-5.44;0.68]	13.16	[5.44;20.88]
Qualif.	primary school no voc. educ.	-2.38	[-8.69;3.93]	1.73	[0.41;3.04]
	prim. school and voc. educ.	4.30	[1.88;6.71]	1.14	[0.51;1.76]
	secondary school	4.18	[0.50;7.85]	2.56	[0.79;4.32]
Size	10 – 20 employees	12.37	[6.95;17.80]	3.55	[1.56;5.54]
	20 – 50 employees	14.20	[8.92;19.47]	3.12	[1.68;4.55]
	50 – 100 employees	1.37	[-1.57;4.32]	0.37	[-0.51;1.25]
	100 – 250 employees	-3.86	[-7.26;-0.46]	-0.08	[-0.82;0.66]
	250 – 500 employees	-5.39	[-7.96;-2.81]	0.23	[-0.84;1.30]
	> 500 employees	-2.38	[-5.11;0.35]	0.60	[-1.21;2.41]

Notes: The models are estimated for cut-off points of €9.0/h and €10.0/h for the East and West respectively. Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSES, wave 2001.

Several clear patterns emerge from Table 4.4. Young construction workers' employment chances are worst hit by the minimum wage in the main construction trade. We find that employment of workers between 18 and 25 years of age would be about 27% higher without a minimum wage in East Germany. For the age group 26-30 this figure is still more than 17% whereas the average effect is about 4%. The two youngest age groups in West Germany also exhibit negative employment effects which are also 6 and 3 times higher compared with the modest average effect. On the contrary employment effects are slightly positive for the age groups between 36 and 50 years which might indicate some substitution of older for younger workers within the main construction trade. We altogether replicate previous findings that younger employees with usually below-average wages suffer most from a statutory minimum wage. Results concerning qualification levels are of limited meaning since qualification for blue-collar construction workers does not vary much. Most of them possess a primary school education and some vocational degree. Therefore the effect for this group is close to the average estimate for East and West Germany.

Of more interest are the effects by type of collective bargaining agreement (CBA). Table 4.4 shows that employees which are not covered by any form of CBA are most adversely affected by the legal minimum wage. This can be explained by the wage premium that covered employees receive. The statutory minimum wage is more often binding for workers with labor contracts not covered by collective bargaining. One of the main objectives for this sectoral minimum wage was to avoid wage dumping outside of collective agreements. Finally there are large differences with respect to the establishment size. Employment effects are about three times more negative for establishment sizes between 10 and 50 employees compared with the mean effect. This holds equally for East and West Germany. The minimum wage is thus more relevant for small firms confirming results from previous studies (Müller, 2009a). Remember that establishments below 10 employees are de facto not included in this sample. This means that the overall employment effects in the construction sector were worse in all likelihood. Overall there is considerable heterogeneity in the employment effects of the sectoral minimum wage in the German construction sector. Employment losses are mostly borne by young construction workers, employees which are not covered by CBAs and individuals working in small establishments.

4.4.4 Discussion of results

How do our estimates relate to previous findings? We reproduce some of the patterns that are reported in other studies. Although Meyer & Wise's model is only consistent for a very small range of cut-off points, it apparently gives more reasonable estimates than the Dickens et al. model. The reason could be that Dickens et al. utilize a smaller amount of information from the observable distribution by choosing higher cut-off points. The parametric assumptions may result in biased estimates in both cases; this seems to be more of a problem for the Dickens et al. model. The semi-parametric estimator yields more reasonable effects and we argue that it better approximates the underlying distribution.

We interpreted West Germany as a quasi-control group for the employment effects of the sectoral minimum wage finding that estimates are substantially lower as the theoretical predictions and the descriptive evidence suggest. As indicated above the way the sectoral minimum wage was introduced allows testing the robustness of the results and gaining some evidence on potential substitution effects within the industry. On the one hand three sub-samples can be distinguished within the construction sector that were not covered by the minimum wage: white-collar workers within the main construction trade, blue-collar workers in building installations (without electricians) and blue-collar workers in other construction industries. The minimum in the main construction trade may have influenced wage negotiations and triggered the adaption of employment in those other sub-sectors. In addition some of the volume of work done in the main construction trade could have been shifted to other sub-sectors to avoid higher wage costs induced by the minimum wage. On the other hand two sub-sectors had their own minimum wage of a similar magnitude: electricians and roofers. The data set allows isolating these groups and estimating the model in order to test the robustness of the findings for the main construction trade. All sensitivity tests remain within the construction sector to hold other (macro) variables as equal as possible.

Descriptive evidence for *white-collar workers* in the main construction trade can be found in Figure 4.5 in the Appendix. White-collar workers have higher wages than blue-collar workers (Figure 4.4), i.e. the minimum wage would have been hardly binding. There is no graphical evidence that white-collar workers were affected by the minimum. The distributions for *building installations* and *other building sector* industries are depicted in Figure 4.6 and Figure 4.7 in the Appendix. Minimum wage levels are clearly higher up the distribution for both East and West Germany without any visible effect on the shape of the distribution. These findings suggest that we should not expect sizeable effects for any of those sub-groups from the model estimates.

Semi-parametrically estimated employment effects for the three sub-groups are reported in Table 4.5 with figures again referring to the percentage change in employment without a minimum wage. For white-collar workers in the East German main construction trade we estimate that employment levels would be moderately higher without a minimum wage, yet none of the estimates is significantly different from zero. For West Germany we find very small positive employment effects. Considering the statisical uncertainty and small effect size, we conclude that there is not sufficient evidence for substitution effects between blue- and white-collar workers.

Table 4.5: Employment change without minimum wage in %: robustness of semi-parametric models

			East Germany			
Cut-off (€/h)	White-collar workers main construction trade		Building installation		Other building sector	
8.7	-0.17	[-2.02;1.67]	-5.57	[-9.53;-1.61]	-0.36	[-12.73;12.01]
8.8	0.35	[-1.73;2.42]	-6.82	[-12.07;-1.57]	-1.17	[-11.97;9.63]
8.9	0.52	[-1.71;2.76]	-6.98	[-15.23;1.27]	-3.46	[-23.66;16.74]
9.0	0.70	[-1.62;3.01]	-4.63	[-12.67;3.41]	-4.64	[-31.06;21.79]
9.1	1.74	[-0.87;4.35]	-2.71	[-10.75;5.33]	-4.58	[-13.59;4.42]
9.2	1.74	[-0.43;3.91]	-3.92	[-22.21;8.47]	-5.15	[-14.38;4.09]
9.3	1.57	[-0.78;3.91]	-7.69	[-20.27;6.84]	-6.27	[-11.89;-0.64]
			West Germany			
Cut-off (€/h)	White-collar workers main construction trade		Building installation		Other building sector	
9.9	-0.63	[-1.25;-0.01]	-0.47	[-2.21;1.26]	-0.11	[-0.98;0.76]
10.0	-0.63	[-1.26;0.01]	-0.03	[-1.41;1.36]	-0.32	[-1.10;0.46]
10.1	-0.83	[-1.37;-0.29]	0.16	[-1.22;1.54]	-0.30	[-1.52;0.92]
10.2	-0.87	[-1.50;-0.23]	-0.73	[-2.16;0.70]	-0.22	[-1.62;1.17]
10.3	-0.83	[-1.40;-0.26]	-0.76	[-1.99;0.47]	-1.06	[-2.02;-0.11]
10.4	-0.79	[-1.35;-0.23]	-0.24	[-1.93;1.45]	-0.75	[-1.62;0.13]
10.5	-0.87	[-1.44;-0.29]	-1.18	[-2.71;0.36]	-0.75	[-2.06;0.57]

Notes: The models are estimated for varying censoring points according to 1st column. Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSES, wave 2001.

The estimates for the other control groups differ by region. For West Germany we find that employment effects are essentially zero. Similar to the main construction trade the minimum does not affect employment in the West. The effects for East Germany are very imprecisely estimated and not robust for different censoring points.

As seen in Figures 4.6 and 4.7 the minimum wage level is close to the middle of the distribution, i.e. the estimation of the underlying distribution is based on merely half of all observations which complicates identification. This problem is slightly worse for other building sector industries as wages are a tad lower there. The point estimates suggest positive employment effects of the minimum wage for both sub-sectors in the East. Labor-labor substitution might have occured between the main construction trade and other construction industries. Yet definitive conclusions cannot be drawn as the estimates are not statistically significant. Altogether these results emphasize that the negative employment effects found for the main construction trade in East Germany are unique for all construction industries and can thus in all likelihood be linked with the sectoral minimum wage there.

The second robustness check is based on two sub-sectors which had their own minimum wage. The wage distributions for *electricians* are depicted in Figure 4.8 and those for *roofers* in Figure 4.9 in the Appendix. The picture looks similar to that of the main construction trade (see Figure 4.3 above): there is a clear spike at the minimum wage level in the graphs for East Germany with only few observations to the left of this threshold. The respective minima seem to have influenced both wage distributions. Observations below the minimum wage levels imply non-compliance and/or non-coverage.[79] Effects are much smaller (electricians), if altogether visible (roofers) for West Germany. We thus expect clearly negative employment effects for East and only minor effects for West Germany out of the model estimations.

The estimated employment effects are reported in Table 4.6. Cut-off points and minimum wage levels differ by region and sub-sector. The number of observations is limited, especially for East Germany ($N = 753$ for electricians and $N = 466$ for roofers), since we now do not consider larger branches but specific sub-sectors. The effects are therefore not precisely estimated, most notably at higher cut-off points where identification rests on merely one half of the distribution. We find significantly negative effects for electricians in East Germany; employment would have been between 7 and 10% higher without the minimum wage. The effect for West Germany

[79] We cannot isolate roofers in the data; the analyzed group includes carpenters and scaffold builders.

is also significantly negative, but markedly smaller as point estimates vary between 1.8 and 2.9%. The results for roofers show a similar pattern, i.e. they are mostly negative in East and effectively zero in West Germany, but smaller in magnitude and not significant. This test confirms the findings for the main construction trade. We get similar effects for these specific minimum wages when they bind a sizeable part of the wage distribution.

Table 4.6: Employment change without minimum wage in %: robustness of semi-parametric models

East Germany					
Cut-off (€/h)	Electricians		Cut-off (€/h)	Roofers	
7.3	7.44	[4.05;10.82]	8.5	3.43	[-2.08;8.95]
7.4	7.70	[3.57;11.83]	8.6	4.51	[-0.75;9.76]
7.5	8.37	[3.64;13.09]	8.7	-0.64	[-7.10;5.82]
7.6	9.03	[3.31;14.75]	8.8	0.43	[-7.34;8.20]
7.7	9.30	[3.38;15.21]	8.9	3.00	[-4.65;10.65]
7.8	10.49	[3.69;17.29]	9.0	1.07	[-6.95;9.10]
7.9	9.83	[1.99;17.66]	9.1	0.21	[-7.74;8.17]
8.0	12.22	[5.01;19.43]	9.2	-2.58	[-11.80;6.65]
West Germany					
Cut-off (€/h)	Electricians		Cut-off (€/h)	Roofers	
8.7	1.79	[0.58;3.00]	9.0	0.52	[-0.54;1.59]
8.8	2.03	[0.87;3.19]	9.1	0.66	[-0.57;1.89]
8.9	2.19	[0.89;3.49]	9.2	0.85	[-0.38;2.08]
9.0	2.63	[1.23;4.03]	9.3	-0.52	[-2.08;1.03]
9.1	2.87	[1.50;4.24]	9.4	-0.79	[-2.13;0.55]
9.2	1.43	[-0.18;3.04]	9.5	-0.72	[-2.07;0.63]
9.3	1.43	[-0.29;3.15]	9.6	-0.20	[-1.49;1.09]
9.4	1.95	[0.21;3.69]	9.7	-0.46	[-1.74;0.83]

Notes: The models are estimated for varying censoring points according to 1st column. Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSES, wave 2001.

A final robustness issue concerns institutional features of the German economy. We argued elsewhere (Müller and Steiner, 2009) that the German tax-and-transfer system constitutes an *implicit minimum wage* which is defined by the level of social assistance (nowadays called unemployment benefit (UB) II) for those who are able and willing to work. Individual labor supply decisions and thus the observed wage distribution are therefore not only influenced by the statutory minimum but also by the implicit minimum wage. Whether the implicit is below the sectoral minimum wage in the main construction trade – and is thus binding and relevant for the labor supply decision – depends on individual and household characteristics. The labor demand models of Meyer & Wise and Dickens et al. abstract from those considerations: any person whose productivity is below the minimum wage and who has become unemployed would work if there was no minimum wage. This is not necessarily true as, for example, married individuals with high-income spouses will face a combination of high marginal tax rates, and high opportunity costs of working. Those people will not be on the labor market if their productivity is below their implicit minimum regardless of a statutory minimum wage. The observed wage distribution is therefore not only affected by the sectoral minimum, but also by individual reservation wages which are themselves determined by a number of factors (gender, human capital, children, marital status, unobservable individual time preferences, etc.).

We are not able to integrate the institutional and household features in the labor demand models because the data set lacks necessary individual and household information. All we can do is to indirectly test the robustness of our estimates with respect to implicit minimum wages. The main problem for the validity of the results arises from the following scenario: imagine we estimate a negative employment effect of the sectoral minimum wage based on an underlying distribution like in Figure 4.1 which is not bounded to the left. This assumes that workers would accept hourly wages close to zero without a statutory minimum. If implicit minima are below the legal minimum wage, not every wage below the sectoral minimum will be realized depending on individual reservation wages. A first measure of pre-caution is to exclude wages below 3€/hour right away from our sample as noted above. Second, as a robustness check predicted underlying wages below this threshold are excluded from all simulations of the employment effects as those wages in all likelihood would not exist in the absence of the sectoral minimum. All results reported in this paper do not change when this is done; the underlying wages which are estimated based on observable characteristics are always above this threshold. This may not fully dispel the concern about this problem as implicit minimum wages can of course be higher than 3€/hour. We are confident that results would not change substantially if we could deal with the problem explicitly.

How do our findings relate to other evaluations for the German construction sector? Other reduced-form studies use a different methodology and data base. König and Möller (2009) employ a DiD framework. Their construction of the treatment and control group rests on the imputation of working hours which is based on a probability model. Apel et al. (2012) extend this analysis and evaluate the effect of the introduction and subsequent amendments of the minimum wage in the German construction sector for different outcome variables (stock and flows of employment, re-employment probabilities). The main methods are DiD and linear panel data models at different levels of aggregation (individuals, firms, sectors, regions) and with a variety of control groups. A crucial deficiency is that the administrative data used in these studies lack information on working hours. The hours information is needed to calculate hourly wages and has to be imputed from other sources. This is especially problematic when control groups are defined on the level of the hourly wage. Identification in the regional panel data models is not fully clear, since the sectoral minimum wage levels do only vary between East and West Germany. The common trend assumption is shown to be shaky in several of the DiD estimations, especially over a longer period under observation. Finally spillover effects or labor-labor substitution could lead to selection between some of the treatment and control groups used.

Qualitatively we almost reproduce the findings of König and Möller (2009), although our semi-parametric estimator yields also slightly negative effects for West Germany whereas König and Möller (2009) report insignificant employment effects. The second and more important point is that the negative effects for East Germany are markedly higher. If their estimated employment loss is translated to the whole main construction trade (i.e. to an average treatment effect), it becomes smaller than 0.5% compared to the amount of 4-5% estimated here. The overall findings of Apel et al. (2012) point to even smaller and mostly insignificant or inconclusive employment effcets also for East Germany. The problem of measurement error in the administrative data regarding hourly wages and the identification problems in the reduced-form studies as well as our structural models may all contribute to the differences in the estimates. Given that all studies agree on the higher intensity of the minimum wage in East Germany, the result pattern we obtained in this study seems rather plausible. The structural approach thus complements the empirical evidence for Germany drawing a more negative picture about employment for East Germany.

4.5 Conclusion

In this paper we applied different parametric and semi-parametric models to estimate the employment effects of a sectoral minimum wage in the German construction sector from a single cross-sectional wage distribution in 2001. The pattern of the employment effects is consistent throughout different models with clearly negative effects for East Germany and only slightly negative effects for West Germany. This result confirms our theoretical expectations which were based on the economic influence of differential minimum wage levels that were set much higher in the East German construction sector.

Concerning the size of the effect the results for the parametric models range between 10-20% and are thus implausibly high. We conclude that parametric functional form assumptions are overly restrictive for the observed wage distributions and drive those estimates. These results confirm previous findings and reservations about this approach in the literature. We therefore suggest an alternative way to relax the parametric assumptions by estimating a series of semi-parametric censored quantile regression models. We find smaller and more reasonable estimates with this approach. According to the semi-parametric estimates employment levels would be 4-5% higher without the sectoral minimum wage in East Germany. Moreover, we also estimate slightly negative effects for the West of about 1-2%. We conclude that this model is a meaningful extension to existing approaches that allows to estimate underlying wage distributions more adequately.

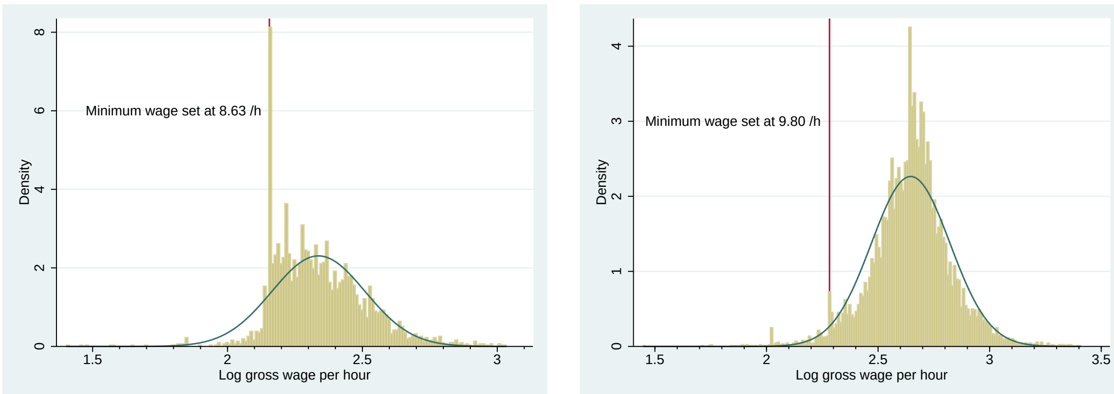
Since the models are estimated on individual data employment effects can be decomposed according to individual and firm characteristics. Employment losses are borne by young construction workers, those employees not covered by any collective bargaining agreement and individuals working in small establishments. The (re-)distributional dimension of a minimum wage is often neglected in public debates. The paper thus also contributes to the policy question about the employment effects of the sectoral minimum wage in the German main construction trade. Contrary to previous reduced-form studies there is evidence for negative employment effects of the sectoral minimum wage in East Germany. Regional variation in wage levels should be taken into account when the level of sectoral or a federal minimum wage(s) is discussed in the future.

The scope of results is limited by the fact that we account neither explicitly for substitution effects with other sectors nor for capital-labor substitution and overall output adjustments in the construction sector. Nevertheless, the results proved plausible in the light of findings for several robustness checks. We find similar effects for sub-sectors which had their own minimum wage – electricians and roofers – where the minimum was binding. None of the sub-sectors or groups that were not covered by a minimum wage yield negative employment effects. There is some evidence for labor-labor substitution with other construction industries, but this should not be overstated as these estimates are based on a comparably small share of observations and are not statictically significant.

Appendix

Additional figures

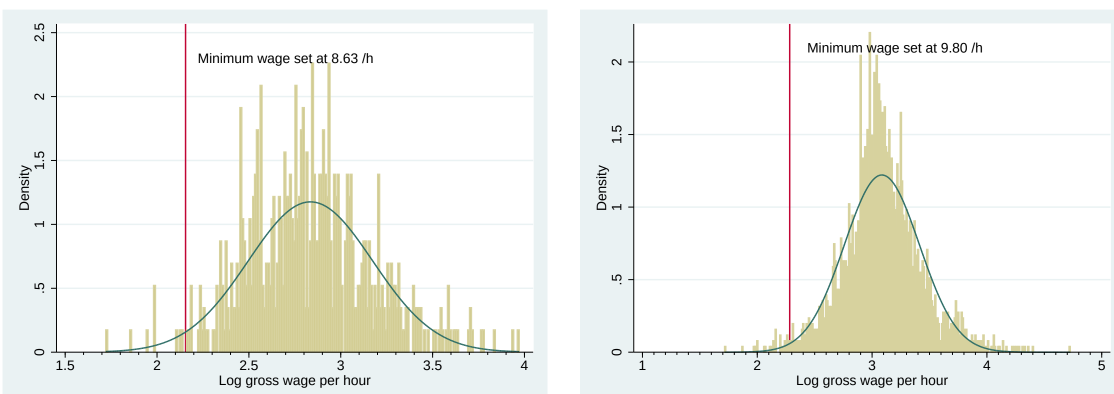
Figure 4.4: Log hourly wages, main construction trade, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

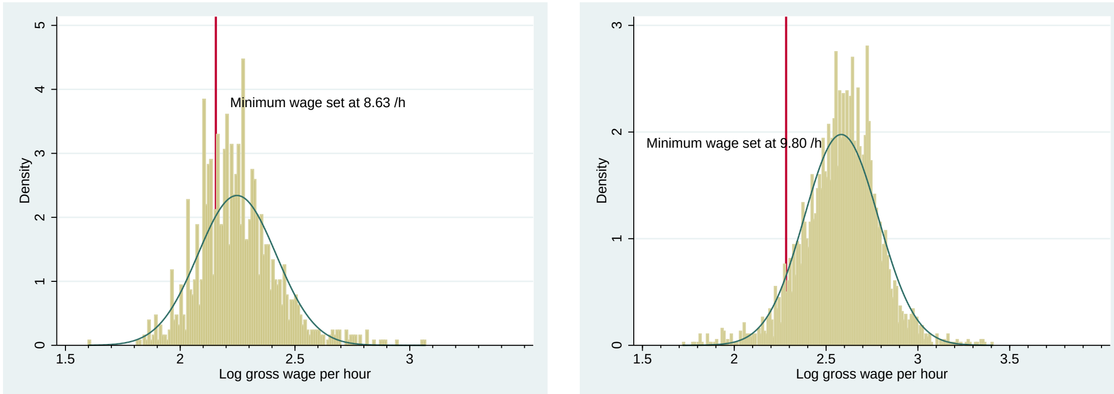
Figure 4.5: Log hourly wages, main construction trade, white-collar workers, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

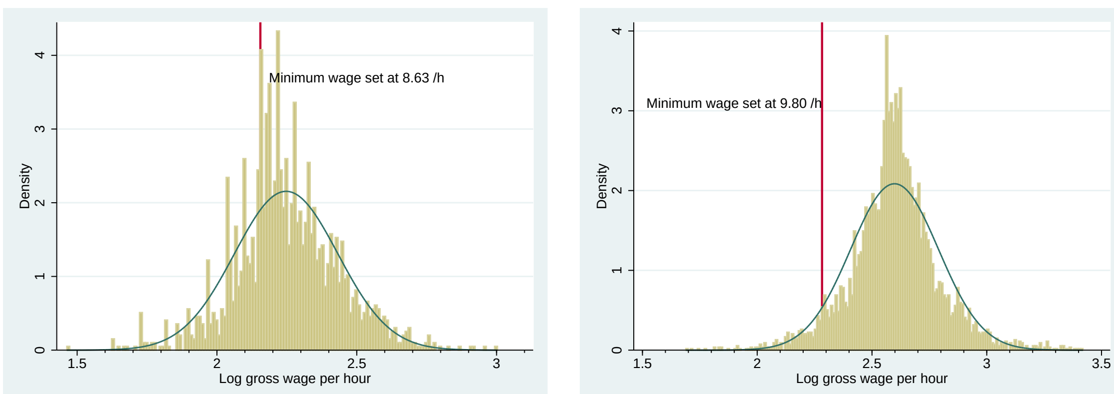
Figure 4.6: Log hourly wages, building installation, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

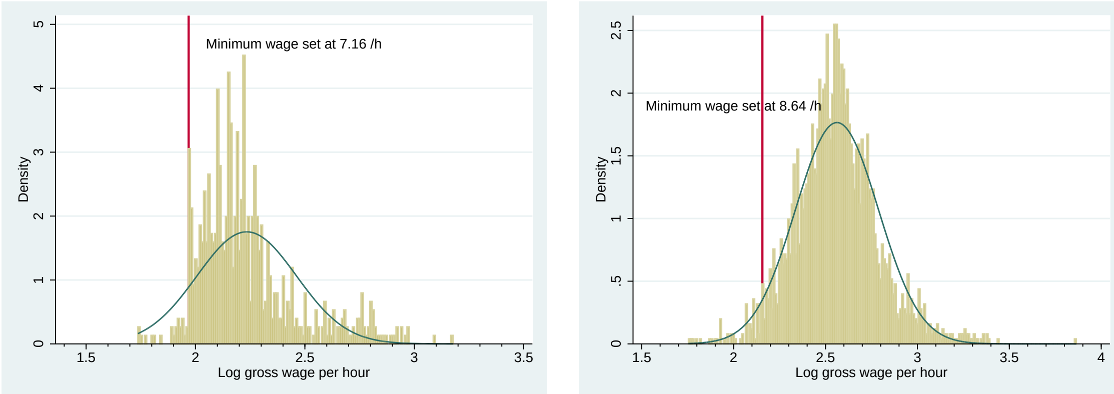
Figure 4.7: Log hourly wages, other building sectors, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

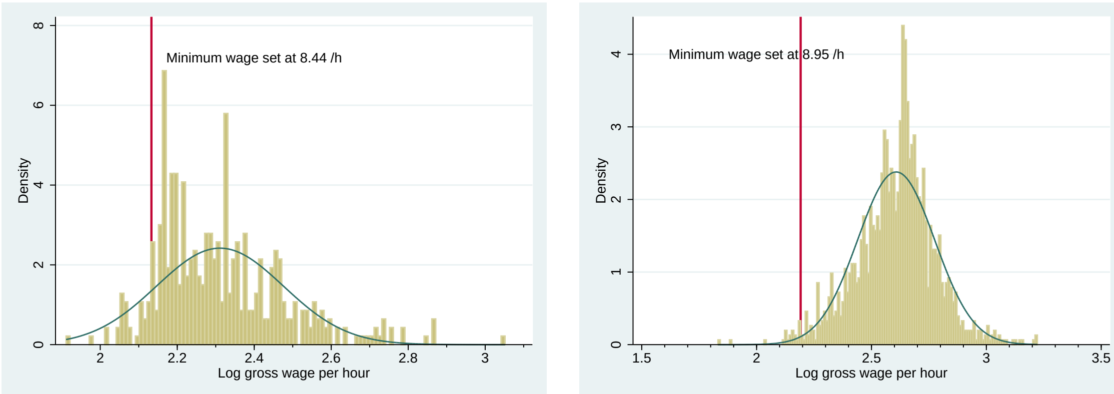
Figure 4.8: Log hourly wages, electricians, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

Figure 4.9: Log hourly wages, roofers, East & West Germany



Notes: Normal distribution in graphs for comparison.

Source: Own calculations based on GSES, wave 2001.

Additional tables

Table 4.7: Estimation results: East Germany

	Meyer &Wise		Dickens et al.		Cqreg	
Age	0.263	[0.027]	0.035	[0.004]	0.018	[0.003]
Age squared	-0.003	[0.000]	0.000	[0.000]	0.000	[0.000]
Tenure (months)	0.004	[0.000]	0.000	[0.000]	0.000	[0.000]
Education high	1.496	[0.573]	0.137	[0.062]	0.137	[0.065]
No collective agreement	-0.876	[0.084]	-0.099	[0.011]	-0.072	[0.007]
Firm collective agreement	-0.084	[0.243]	-0.025	[0.027]	-0.057	[0.017]
No public influence	0.245	[0.234]	0.011	[0.027]	0.012	[0.016]
Limited public influence	-0.477	[0.325]	-0.025	[0.047]	-0.021	[0.022]
Firm size: below 21	-1.647	[0.223]	-0.195	[0.027]	-0.119	[0.022]
Firm size: 21-50	-1.720	[0.217]	-0.197	[0.025]	-0.117	[0.020]
Firm size: 51-100	-1.374	[0.208]	-0.132	[0.023]	-0.081	[0.019]
Firm size: 101-250	-0.681	[0.205]	-0.049	[0.022]	-0.037	[0.020]
Firm size: 251-500	0.136	[0.224]	0.023	[0.023]	0.026	[0.022]
Constant	5.639	[0.611]	1.650	[0.097]	2.031	[0.063]
p1	0.208	[0.020]				
p2	0.320	[0.029]				
sigma	0.675	[0.017]	1.650	[0.005]		
Observations	3,604		3,052		3,517	
Log-likelihood	-7,242		2,264			

Notes: The models are estimated with a specific censoring point. Standard errors are given in parentheses. The censored quantile regression for the 0.5-quantile is reported. The sample size changes because not all observations are used for estimation due to censoring.
Source: Own calculations based on GSES, wave 2001.

Table 4.8: Estimation results: West Germany

	Meyer &Wise		Dickens et al.		Cqreg	
Age	0.218	[0.015]	0.015	[0.001]	0.015	[0.001]
Age squared	-0.002	[0.000]	0.000	[0.000]	0.000	[0.000]
Tenure (months)	0.006	[0.000]	0.000	[0.000]	0.000	[0.000]
Education high	0.292	[0.348]	0.021	[0.023]	0.027	[0.029]
No collective agreement	-0.708	[0.061]	-0.033	[0.004]	-0.051	[0.004]
Firm collective agreement	-3.130	[0.230]	-0.178	[0.018]	-0.210	[0.022]
No public influence	-0.397	[0.227]	-0.027	[0.014]	-0.036	[0.015]
Limited public influence	0.702	[0.294]	0.031	[0.019]	0.024	[0.021]
Firm size: below 21	-0.319	[0.122]	-0.027	[0.008]	-0.018	[0.011]
Firm size: 21-50	-0.581	[0.116]	-0.041	[0.008]	-0.034	[0.011]
Firm size: 51-100	-0.319	[0.117]	-0.017	[0.008]	-0.021	[0.011]
Firm size: 101-250	-0.065	[0.115]	0.000	[0.007]	-0.004	[0.011]
Firm size: 251-500	-0.344	[0.133]	-0.018	[0.009]	-0.023	[0.012]
Constant	9.692	[0.399]	2.337	[0.026]	2.354	[0.024]
p1	0.595	[0.049]				
p2	0.231	[0.026]				
sigma	0.847	[0.008]	0.147	[0.001]		
Observations	10,343		10,000		10,123	
Log-likelihood	-23,429		5,422			

Notes: The models are estimated with a specific censoring point. Standard errors are given in parentheses. The censored quantile regression for the 0.5-quantile is reported. The sample size changes because not all observations are used for estimation due to censoring.
Source: Own calculations based on GSES, wave 2001.

Simulated employment effects in Meyer & Wise model

D_i can be interpreted as the probability that an individual remains employed (with a wage either below or at the minimum wage) after the introduction of the minimum wage given that he had been employed without the minimum (M) and earned a wage below the minimum. Note that in Meyer & Wise's neoclassical labor market model there is no unemployment without a minimum wage. Moreover, they assume that an individual's wage and employment probability are not affected by the minimum when his or her underlying hourly wage (without a minimum) is above M. D_i can thus be written as follows:

$$\begin{aligned} D_i &= 1 - Pr[w_i^\star < M](1 - P_1 - P_2) \\ &= Pr\left[Emp|(M \cap Emp|NM \cap w_i^\star < M)\right] \end{aligned} \tag{4.17}$$

P_1 marks the probability that someone who earns a wage below M remains employed at this wage after the minimum is introduced. P_2 is the probability for individuals with $w_i^\star < M$ to remain employed under the minimum with a hourly wage of M. Therefore $1 - P_1 - P_2$ marks the probability of becoming unemployed under the minimum wage. $Pr[w_i^\star < M]$ is the probability of having an underlying wage below the minimum wage level. In the second line of (4.17) the expression is written as conditional probability: $Pr[Emp]$ is the probability of being employed as opposed to being unemployed ($Pr[Unemp]$). M denotes the event where a minimum wage is put in place whereas NM denotes the contrary situation without a minimum wage.

The claim is that the inverse of D_i is the expected number of individuals that would be employed at $w_i < M$ if there was no minimum wage:

$$\frac{1}{D_i} = E\left[Emp|NM \cap w_i^\star < M\right] \tag{4.18}$$

From the definition of conditional probabilities it follows that D_i can be written as probability of being employed given a minimum is put in place, the underlying wage is below the minimum and the individual would be employed without the minimum:

$$\begin{aligned} D_i = & \quad Pr[Emp|(M \cap Emp|NM \cap w_i^\star < M)] \\ = & \quad \frac{Pr[Emp \cap M \cap Emp|NM \cap w_i^\star < M]}{Pr[M \cap Emp|NM \cap w_i^\star < M]} \end{aligned} \tag{4.19}$$

The inverse of D_i is therefore:

$$\frac{1}{D_i} = \frac{Pr[M \cap Emp|NM \cap w_i^\star < M]}{Pr[Emp \cap M \cap Emp|NM \cap w_i^\star < M]} \tag{4.20}$$

Because of the above-mentioned assumptions about the labor market in the Meyer & Wise model, an individual can either remain employed or become unemployed when the minimum wage is introduced. Therefore the probability $Pr[M]$ is given by sum $Pr[M] = Pr[Emp \cap M] + Pr[Unemp \cap M]$. Hence the enumerator of (4.20) can be written as follows:

$$\frac{1}{D_i} = \frac{Pr[Emp \cap M \cap Emp|NM \cap w_i^\star < M] + Pr[Unemp \cap M \cap Emp|NM \cap w_i^\star < M]}{Pr[Emp \cap M \cap Emp|NM \cap w_i^\star < M]} \tag{4.21}$$

Again stressing the assumptions of the Meyer & Wise model it also holds that $Pr[Emp \cap NM] = Pr[Emp \cap M] + Pr[Unemp \cap M]$, since there is no unemployment without the minimum wage. The same holds for the joint probabilities in the enumerator of (4.21) as the other events ($Emp|NM$ and $w_i^\star < M$) are independent of M or NM. Therefore the inverse of D_i can be re-written with the follwoing probabilities

$$\begin{aligned} \frac{1}{D_i} &= \frac{Pr[Emp \cap NM \cap Emp|NM \cap w_i^\star < M]}{Pr[Emp \cap M \cap Emp|NM \cap w_i^\star < M]} \\ &= E\left[Emp|NM \cap w_i^\star < M\right] \end{aligned} \tag{4.22}$$

which equals the expected number of persons that would be employed without the minimum. The inverse is the expected number of individuals that would work without a minimum wage because $Pr[Emp \cap NM] \geq Pr[Emp \cap M]$. Both probabilities would be equal if the minimum wage caused no unemployment ($Pr[Unemp \cap M] = 0$).

To illustrate the argument consider a simple example: Assume that the probability in the numerator, i.e. the probability of being employed without the minimum wage and a wage below M, would be equal to 1/2, and the probability in the denominator, i.e. the probability of remaining employed under the minimum, would be 1/4. Then the inverse of D_i would yield 2. That means that one would expect for each individual who is employed under the minimum wage with an underlying wage below M that 2 individuals would work without the minimum because the probability is twice as high.

Assumptions and derivation of the concentrated likelihood function in the Dickens et al. model

The key assumption in the Dickens et al. model is that above the cut-off point of w_1 wages and employment are not affected by the minimum wage M which is set somewhere below w_1. Therefore the observed wage distribution $f_1(w)$ and the underlying distribution $f(w)$ are identical above w_1. Since both $f_1(w)$ and $f(w)$ are densities and integrate to one it must hold that above w_1 they are equal up to a scaling factor γ which is the assumption described in (4.6) above:

$$f_1(w;\theta) \quad = \gamma f(w;\theta) \quad \text{for} \quad w > w_1 \tag{4.23}$$

Depending on how employment changes due to the minimum γ is below or above one. For $\gamma < 1$ there is *relatively* more probability mass to the left of w_1 in $f(w;\theta)$ compared with $f_1(w;\theta)$ as some individuals become unemployed. For $\gamma > 1$ more people are employed with a wage below w_1 under the minimum wage compared to the counterfactual without a minimum. In that case more probability mass to the left of w_1 would be in $f_1(w;\theta)$ compared to $f(w;\theta)$. This scenario where the minimum wage creates additional jobs is not captured in Meyer & Wise's model. The scaling factor is determined by the employment change under the minimum wage which is given by the relation of total employment without the minimum wage L_0 and under the minimum wage L_1: $\gamma = L_0/L_1$.

By the same logic the number of employed individuals above w_1 is identical above and below the minimum wage. This is expressed in (4.7) above:

$$\begin{aligned} L_1(1 - F_1(w_1;\theta)) \quad &= L_0(1 - F(w_1;\theta)) \\ F_1(w_1;\theta) \quad &= 1 - \gamma(1 - F(w_1;\theta)) \end{aligned} \tag{4.24}$$

The derivation of the concentrated likelihood function is straightforward. It starts from a Tobit model for observed wages w_i with the censoring point $w_1 \geq M$, j

observations above and $L_1 - j$ observations below w_1:

$$\begin{aligned} logL &= \textstyle\sum_{i=1}^{j} logf_1(w_i;\theta) + (L_1 - j) \cdot logF_1(w_1;\theta) \\ &= \textstyle\sum_{i=1}^{j} logf(w_i;\theta) + j \cdot log\gamma + (L_1 - j) \cdot log[1 - \gamma \cdot (1 - F(w_1;\theta))] \end{aligned} \tag{4.25}$$

The maximization of (4.25) with respect to γ yields:

$$\begin{aligned} \frac{\partial lnL}{\partial \gamma} = \frac{j}{\gamma} + \frac{(L_1 - j)(-(1 - F(w_1;\theta))}{1 - \gamma((1 - F(w_1;\theta))} &= 0 \\ 0 = j - j\gamma(1 - F(w_1;\theta)) + \gamma(L_1 - j)(-1 + F(w_1;\theta)) & \\ j = \gamma[j(1 - F(w_1;\theta) + (L_1 - j)(-1 + F(w_1;\theta))] & \\ \gamma = \frac{j}{j - jF(w_1;\theta) + L_1 - L_1F(w_1;\theta) - j - jF(w_1;\theta)} & \\ \gamma = \frac{j}{L_1(1 - F(w_1;\theta))} & \end{aligned} \tag{4.26}$$

When this estimator is inserted back into in (4.25) one can derive the concentrated likelihood which boils down to the likelihood of a truncated regression model for a sample of workers with observations truncated at w_1:

$$\begin{aligned} logL &= \sum_{i=1}^{j} logf(w_i;\theta) + j \cdot log\gamma + (L_1 - j) \cdot log[1 - \gamma \cdot (1 - F(w_1;\theta))] \\ &= \sum_{i=1}^{j} logf(w_i;\theta) + j \cdot log\left[\frac{j}{L_1(1 - F(w_1;\theta))}\right] + (L_1 - j) \cdot log\left[1 - \frac{j(1 - F(w_1;\theta))}{L_1(1 - F(w_1;\theta))}\right] \\ &= \sum_{i=1}^{j} logf(w_i;\theta) + j \cdot [log(j) - (log(L_1) + log(1 - F(w_1;\theta))] + (L_1 - j) \cdot log\left[1 - \frac{j}{L_1}\right] \\ &= \sum_{i=1}^{j} logf(w_i;\theta) - j \cdot log[(1 - F(w_1;\theta))] + jlog(j) - jlog(L_1) + (L_1 - j) \cdot log\left[1 - \frac{j}{L_1}\right] \\ &= \sum_{i=1}^{j} logf(w_i;\theta) - j \cdot log[(1 - F(w_1;\theta))] + \text{constant} \end{aligned} \tag{4.27}$$

Therefore in the Dickens et al. framework a truncated regression model is estimated. All parameters of interest can then be derived as outlined. Note that this simplification to a concentrated likelihood does only work without parameterizing the distribution with respect to individual characteristics. If there are covariates the derivation is less elegant; the basic principle remains the same, though.

Chapter 5

A joint model of productivity, labor supply and rationing. Policy applications to a federal minimum wage for Germany

5.1 Introduction

In the majority of microeconometric labor supply models it is assumed that involuntary unemployment does not exist (Blundell and Macurdy, 1999; Creedy and Kalb, 2006; Mroz, 1987). Individuals only choose to work zero hours, if this is their optimal choice, i.e. inactivity has a higher utility than working. If labor demand was perfectly elastic, the assumption would hold and the estimated differences in labor supply would equal changes in employment. Yet the assumption has been found not to be in line with empirical reality (Hamermesh, 1993). Therefore the scenario where an individual would like to work but is not able to find a job, i.e. he or she is rationed due to demand side (or, e.g., institutional) restrictions on the labor market, is not captured by these empirical labor supply models.

The severity of this violation depends on the specific application as the effect on estimated labor supply elasticities is a priori ambiguous (Bargain et al., 2010). An individual who is observed not to work could actually prefer to have a job but may not be able find one. Then her preferences for leisure are overstated and estimated labor supply elasticities are downward biased ('preference bias'). If, on the other hand, individuals are falsely depicted as being voluntarily unemployed and a wage increase leads to predicted positive working hours for those people, the labor supply elasticities will be biased upwards when their rationing probability is ignored ('participation bias', see Ham, 1982). Finally, if the labor supply model (without rationing) is incorrectly specified, the direction of the resulting estimation bias is a priori unclear. The omission of labor demand constraints is particularly relevant when economic policies are analyzed that directly influence not only labor supply incentives but also labor costs. For Germany the introduction of a *federal minimum wage* would be such an example. The implied wage gain for workers bound by the minimum may raise their net income and thus labor supply. At the same time the rise in wage costs could lead to substitution away from (low-productivity) labor and also induce output demand effects because of cost shifting to consumers. In the same vein the effects of various types of wage subsidies for low wage employment are different with or without a federal minimum wage.

Several approaches consider demand side rationing in the context of structural labor supply models: microeconometric labor supply models linked with computable general equilibrium models (CGE) (Peichl, 2009; Davies, 2009), combined with estimated demand elasticities (Creedy and Duncan, 2005), or interacted with structural labor demand models (see Peichl and Siegloch, 2012 for an overview). Alternatively, a rationing probability is directly integrated in structural microeconometric labor supply models (see, e.g., Laroque and Salanié, 2002).

We follow the latter strand of the literature and estimate a labor supply model that incorporates demand side constraints. Extending previous papers for Germany that identify the rationing risk from exogenous labor demand factors (Bargain et al., 2010; Haan and Uhlendorff, 2013), we systematically relate an individual's productivity to the probability of not finding a job. This provides a structural interpretation of rationing and allows us to distinguish: (a) voluntary inactivity – the individual decides not to work because this yields the highest utility; (b) structural unemployment – the individual wants to work, but is constrained due to insufficient productivity; (c) cyclical/frictional unemployment – the individual prefers to work, her productivity is adequate, but she is constrained because of insufficient demand; (d) employment – the individual wants to work and finds a job. Estimating the wage/productivity, labor supply and rationing equation jointly helps to model the relationships between those processes caused by observed and unobserved characteristics. Identification of supply and demand is inter alia based on variation (conditional on individual productivity) generated by the tax and transfer system and labor market regulations that define minimum wage thresholds for employers (e.g. sectoral minimum wages, collective bargaining).

The following research questions will be addressed. How can a labor supply model with demand side constraints be formulated where the rationing risk depends among other things on individual productivity? Do labor supply elasticities change when rationing is taken into account? What are the consequences of a federal minimum wage for employment in Germany? Can different types of wage subsidies help to raise employment when a federal minimum wage is in place? The methodological contribution of the paper is to extend and refine existing labor supply models with demand constraints. In addition to exogenous demand side factors rationing is related to individual productivity and institutional wage thresholds. The model is suited to evaluate policy interventions that also affect wage costs. Therefore the empirical contributions include not only empirical labor supply elasticities for Germany. We are also able to analyze the consequences of a statutory minimum wage for labor supply and the rationing risk within a coherent framework. Moreover, we can assess the effectiveness of different wage subsidies when a general minimum wage is in place.

We find participiction elasticities to be upward biased in the unconstrained model; they are significantly smaller in the model with rationing. For men the same pattern holds for the hours elasticities. Women's hours elasticities in West Germany are higher than, and in East Germany identical to the unconstrained model. The participation bias in the unconstrained model dominates for men, whereas it is offset by the preference bias for women. We show that labor supply reactions to the implementation of a minimum wage which are estimated from the unconstrained model would be misleading. The labor supply model with constraints predicts negative participation effects which are larger in the East and for women compared to the West and men, respectively. The loss in total working hours would be considerably smaller. While certain people lose their jobs, others benefit from higher wages and expand their hours of work. Although reductions in the volume of employment as a result of a federal minimum might be relatively moderate, jobs from low-productive people might be substituted by more productive workers. According to our simulations, employee-oriented subsidies would be ineffective in expanding employment when a federal minimum wage is in place. On the other hand, subsidies paid to employers and targeted at low-productive workers could nearly offset the negative effects of a federal minimum wage on participation.

The paper proceeds with a review of the related literature. In section 5.3 the econometric model is outlined consisting of a labor supply, wage/productivity, and rationing equation. These elements are then combined in a constrained labor supply model and identification is discussed. In section 5.4 institutional details and the micosimulation model are described. The data sources and sample are characterized and descriptive statistics are provided. Section 5.5 presents the paramter estimates and labor supply elasticities. In the policy applications in section 5.6 the introduction of a federal minimum wage in Germany are simulated as well as employee- and employer-oriented wage subsidies under a federal minimum wage. The final section concludes.

5.2 Related literature

There are three different approaches that take account of labor demand restrictions in the estimation of structural labor supply models. First, microeconometric labor supply estimation is integrated into a *CGE model*. Bovenberg et al. (2000) use micro data and estimate the effect of tax reforms on labor supply within a general equilibrium framework. Bourguignon et al. (2005) simulate outcomes of a shock in a CGE model and use microsimulation techniques to analyze their distributional consequences. Arntz et al. (2008) as well as Boeters and Feil (2009) employ a discrete choice labor supply framework and use its aggregated outcomes to calibrate the labor supply module of an applied general equilibrium (AGE) model. The resulting adjustments of wages and (un-)employment are put back into the labor supply module and the whole model is iterated until it converges.[80] Peichl and Schaefer (2009) and Peichl (2009) follow a similar approach.[81]

Second, structural labor supply models are augmented on the basis of estimated labor demand elasticities.[82] Creedy and Duncan (2005) show how individual labor supply estimates are aggregated. Based on the average supply effect an equilibrium wage adjustment can be derived for given labor demand elasticities. Re-inserting adjusted wages into the microsimulation Creedy and Duncan calculate third round effects of a policy reform. Haan and Steiner (2005b) extend this approach in an application for Germany. They iterate the labor supply estimatation and wage adjustment steps until convergence is achieved and the equilibrium level of employment is found. Peichl et al. (2010) and Peichl and Siegloch (2012) employ a similar labor supply model, yet they also estimate a structural labor demand model with employer data and derive demand elasticities for three skill groups.

Third, several studies explicitly incorporate involuntary unemployment into a structural labor supply model. One of the first studies was conducted by Blundell et al. (1987) whose continuous labor supply model is complemented by a rationing risk equation. Functional form and independence assumptions on the unobserved error terms lead to a double hurdle specifiction (Cragg, 1971) with a tobit model for the labor supply decision and a probit model for the rationing equation.

Bingley and Walker (1997) estimate a discrete-choice multinomial probit labor supply model simultaneously with the participation decision towards in-work transfer schemes and a latent variable approach for the risk of involuntary unemployment à la Blundell et al. (1987). Blundell et al. (2000) analyze the labor supply decisions of

[80] In an earlier version labor supply estimates were used to calibrate the AGE model without feeding the outcome back to the labor supply model (Boeters et al., 2005).

[81] In a recent paper Benczúr et al. (2012) analyze tax reforms in Hungary with a combination of a simpler binary labor supply framework and a sparse general equilibrium model.

[82] Bingley and Lanot (2002) present an empirical model where tax effects on labor supply and on wages are separated. They argue that the wage adjustment has to be included to derive 'structural' labor supply elasticities.

women in couples also within a discrete choice framework. Their rich model entails a similar rationing equation based on a latent variable specification and allows them to discriminate between inactive people, discouraged workers and involuntarily unemployed. Hogan (2004) has involuntary unemployment in one of several specifications of a discrete choice labor supply model.

Bargain et al. (2010) set up a discrete choice household labor supply model for Germany. They also specify a latent rationing equation which is assumed to be independent from the labor supply decision and is being identified by exogenous labor market conditions. The resulting double hurdle model is estimated in two independent steps. Their paper extends previous work on two counts: first, they estimate the labor supply and rationing probabilities of both individuals in couple households. The labor supply decisions are made by maximizing the households unitary utility whereas labor demand constraints are estimated seperately for men and women. Second, in addition to information on active search for a job and eligibility to the labor market, Bargain et al. (2010) exploit information on desired hours for those willing to work. They are able to estimate preferences on working hours more adequately compared to the mere identification of the participation probability conditional on the desire to work. The resulting labor supply elasticities are smaller than those from the unconstrained model. Haan and Uhlendorff (2013) extend this model in two directions: first, they estimate an intertemporal labor supply and rationing model and analyze true state dependence in different states of the labor market.[83] Second, they allow the unobserved components of the labor supply and the rationing equation to be correlated.

The aforementioned papers exploit sample information to differentiate between involuntarily unemployed and self-reported non-participants. The rationing probability is identified by exogenous labor market and observed individual characteristics, but is not systematically related to individual productivity. This contention seems questionable given that the risk of unemployment is often found to be related to pro-

[83] Vatto and Zhiyang (2013) also specify a dynamic labor supply model with a notion of rationing: based on their labor market history people may have a more or less restricted set of job opportunities.

ductivity. Other labor supply models with demand side rationing are less restrictive in this regard. Institutional features of the labor market (e.g. a minimum wage) are exploited to identify the individual rationing probabilities also as a function of the wage. A wage and/or a productivity equation is jointly determined in those models.

Meyer and Wise (1983a,b) took a first step towards this direction: their extended model contains a wage and a participation equation that are estimated jointly and linked through correlated unobserved components. They are able to distinguish unemployment induced by the minimum wage from other sources of non-employment.[84] Their employment equation is not structurally grounded, though, and can hardly motivate voluntary non-participation. Laroque and Salanié (2002) estimate a static structural labor supply model for women in France. Their parsimonious model leaves out the intensive margin and the spouses' labor supply decision. It consists of jointly estimated wage and participation equations which are related by an unobserved random term. Laroque and Salanié take all features of the tax and transfer system into account. They are able to distinguish different types of non-employment: voluntary unemployment, classical unemployment (the minimum wage exeeds the estimated wage costs), and frictional or cyclical unemployment (as a residual category). The wage equation including an unobserved component is an argument of a highly nonlinear tax function in the participation equation. Based on parametric assumptions Laroque and Salanié integrate out the random component of the likelihood numerically.

Along these lines Nelissen et al. (2005) develop a more comprehensive approach. Latent productivity is the relevant quantity for labor demand. It is parameterized by observed individual characteristics, macro variables (regional unemployment rate and business cycle), and an unobserved random error term. The market wage is a function of productivity plus unemployment dynamics (level of unemployment in the preceding period) in certain segments of the labor market. Wages enter a tax function that determines net household incomes which together with leisure time are the main arguments in the utility function of a discrete choice labor supply model.

[84] The basic model rests solely on the observed wage distribution; the minimum wage is the only source of unemployment in this specification.

Information on desired hours are exploited to identify preferences for work of the involuntarily unemployed. Finally, an equation for the latent minimum wage relevant to the employer is specified as a function of the legal minimum plus observed characteristics and a random error component. This equation in relation to estimated productivity is used to identify whether an individual is rationed. This structural model of productivity, market wage, minimum wage, and preferences for work allows distinguishing between voluntary unemployment ('poverty trap'), involuntary unemployment ('productivity trap'), and employment. Less restrictive assumptions are needed in comparison to studies with a reduced-form rationing equation: unobserved and observed characteristics may influence productivity, wages and therefore labor supply as well as the probability of involuntary unemployment. The different equations are estimated jointly to identify the correlation parameters. Besides a more complex estimation this comes at the 'price' of additional structural and parametric assumptions for identification.

A comparable model is used by Euwals and van Soest (1999) to estimate the institutional constraints on desired working hours.[85] In the model by Aaberge et al. (1995) labor supply decisions are discrete choices among different packages of working hours, wage rates and other characteristics. Bloemen (2000) relates the labor supply model to the job search literature and considers different specifications for the distribution of job offers that put constraints on the labor supply decision.

We draw on elements from several of the aforementioned papers. The basic setup is similar to Bargain et al. (2010): we use the same information on observed labor market states, hours of work for employees, but also on involuntary unemployment and desired working hours. Exogenous variation in regional labor market conditions is exploited to identify the rationing risk. We also take up ideas from Nelissen et al. (2005) by giving the wage/productivity equation a structural interpretation and by

[85]People might not only be rationed with respect to their participation decision, but also with respect to their preferred working time. The first paper on hours restrictions by Moffitt (1982) extends the Tobit model to account for institutional restrictions on part time work. In another early paper van Soest et al. 1990 extend a Hausman (1980) type labor supply model with piecewise linear convex budget constraints to account for hours restrictions (see also Tummers and Woittiez, 1991). It is assumed that individuals choose from a finite set of work hours packages and either select one of those combinations or non-work.

relating the rationing risk also to the individual's productivity. The specification of the unobserved productivity components in the labor supply and rationing equation is inspired by Laroque and Salanié (2002). We also utilize variation in minimum wage thresholds created by institutional constraints on the wage setting for identification.

5.3 Econometric model

The empirical model consists of three equations. The first represents the individual's labor supply. We employ a discrete choice decision framework based on a household utility function with disposable income, leisure as well as (observed and unobserved) individual and household characteristics as arguments. A tax-benefit microsimulation model is used to arrive at net household incomes for different categories of working hours. Second, the model requires a wage/productivity equation for two reasons. It provides on the one side predicted market wages that are required to simulate household incomes for positive hours categories of non-employed individuals. Based on some structural assumptions it allows on the other side to predict an individual's productivity which is a crucial argument in the rationing equation of the model. This third equation represents the probability that an individual who decided to participate in the labor market is constrained by insufficient labor demand. The rationing risk depends ceteris paribus on an individual's productivity relative to some institutionally given minimum standard of pay (a minimum wage if applicable, collectively bargained wages, or the basic moral wage threshold as stated in the German Civil Code). Furthermore, a bunch of demand side indicators enter this equation as they also determine the rationing probability. We will subsequently describe the structure of the model and discuss the value of estimating the equations jointly.

5.3.1 Labor supply decision

We assume that individuals maximize household utility by choosing among $j = 1, 2, \ldots, m$ different labor market states. A discrete choice approach is conducive to modeling the joint labor supply decision of both spouses in couple households and to deal with non-linear budget sets (van Soest, 1995). To reduce the complexity of the model we take the spouse's decision as given (see Laroque and Salanié, 2002).[86] The utility of the individual i's household for alternative j can be written as a function of leisure l_{ij}, household income y_{ij}, observed characteristics $X_{ij}^{(LS)}$ and an unobserved component ϵ_{ij}:

$$U_{ij} = U\left(l_{ij}, y_{ij}, X_{ij}^{(LS)}, \epsilon_{ij}\right) \tag{5.1}$$

Leisure l_{ij} for the inividual considered is given as $l_{ij} = TE - h_{ij}$ with $TE = 80$ being the total time endowment and h_{ij} the hours of work. The discrete labor supply model captures the extensive (zero vs. positive hours) and the intensive margin (different positive hours categories). The number of alternatives in the choice set fits the empirical distribution of hours. For women we consider six labor market states (non-work, marginal employment, low part time, high part time, full time, overtime). For men the set consists of four alternatives (non-work, marginal employment, full time, overtime).[87]

The household net income y_{ij} depends on the individual's labor income, other household income (including the spouse's labor income for couple households), taxes and contributions, transfers (unemployment assistance, social assistance, child or housing benefits). The microsimulation model STSM (see Steiner et al., 2012; subsection 5.4.1 below) is employed to simulate available household incomes y_{ij} for different choices of labor supply. A sizeable component of household ressources is labor income. Hourly wages are calculated on the basis of reported monthly gross wage earnings and working time for those being in work. For non-employed individuals hourly wages $\hat{w}_i$ are predicted on the basis of parameters from a wage equation and then inserted into the labor supply equation. We assume throughout this paper hourly wages to be constant for different categories of working hours. In the unconstrained choice model the wage equation is estimated independently from

[86]The extension for couple households is straightforward: l_{ij} is replaced by lm_{ij} and lf_{ij} for men and women leading to a $m_m \times m_f$ choice set. Yet, the model becomes more complicated as additional wage and rationing equations are needed for the spouse.

[87]In applications with German data from the SOEP, results have found to be quite robust with respect to the number of states (Steiner et al., 2012).

labor supply (see sub-section 5.3.2 for a discussion). The available household income for alternative j can be written as:

$$y_{ij} = R\left[w_i \times (TE - l_{ij}), y_i^{(other)}, X_{ij}^{(LS)}\right] \tag{5.2}$$

$R(.)$ is a highly nonlinear tax function (including benefits for entitled households) with gross labor income $w_i * (TE - l_{ij})$, other household income $y_i^{(other)}$, and observed characteristics $X_{ij}^{(LS)}$ as arguments. Note that for couple households the spouse's gross income $w_i^{(spouse)} * (TE - l_i^{(spouse)})$ is part of $y_i^{(other)}$ but does not vary with j. When wages are taken to be exogenous y_{ij} can be simulated for each potential j and inserted into the labor supply equation. When the wage/productivity equation is jointly estimated in the extended model with labor demand constraints below, $R(.)$ becomes part of the labor supply equation resulting in a more complicated likelihood (see sub-section 5.3.6 below). Since there are no savings in this model, income y_{ij} equals consumption c_{ij} and the budget constraint is:

$$C_i = y_{ij} \tag{5.3}$$

We approximate the utility function with a quadratic specification for household i and choice j:

$$\begin{aligned} V_{ij} &= U\left(l_{ij}, y_{ij}, x_{ij}, \epsilon_{ij}\right) \\ &= \alpha_c + \alpha_y y_{ij} + \alpha_l l_{ij} + \alpha_{y^2} y_{ij}^2 + \alpha_{l^2} l_{ij}^2 + \alpha_{yl} l_{ij} y_{ij} + \epsilon_{ij} \end{aligned} \tag{5.4}$$

Preference heterogeneity is introduced by a number of household- or individual-specific taste shifters $X^{(LS)}$ with respect to labor supply (age, dummy for singles, dummies for small children, interaction of single and small kid dummies for lone parents, handicap, region). The matrix $X^{(LS)}$ also includes a choice-specific dummy variable for the part time category of men that improves the model fit of the empirical hours distribution (van Soest, 1995). Otherwise the part time category would be over-predicted by the model. This variable represents the men's distaste of working a low number of hours. The parameters in the utility function are thus functions of

$X^{(LS)}$:

$$\alpha_c = \alpha_{c0} + \alpha_{c1} X_1^{(LS)}$$

$$\alpha_l = \alpha_{l0} + \alpha_{l1} X_2^{(LS)}$$

Assuming that ϵ_{ij} are independently Type I Extreme Value distributed the probability of choosing the alternative k can be shown to be (McFadden, 1974):

$$Pr_{ik} = Pr\left(V_{ik} > V_{ij}, \forall j = 0, \ldots, m\right) = \frac{exp\{U(y_{ik}, l_{ik}, X_{ik})\}}{\sum_{j=0}^{m} exp\{U(y_{ij}, l_{ij}, X_{ij})\}} \tag{5.5}$$

The probability of choosing a given category results from the comparison of its utility with the utility of all alternatives. In expectation utility maximizing households will always choose the alternative which generates the highest utility. Assumptions about the independence and homoskedasticity of the error terms imply the independence of irrelevant alternatives (IIA) property. The ratio of probabilities for two given categories does not depend on other alternatives.[88]

In the labor supply model without demand side constraints the individuals' (households') preferences are assumed to be in line with the actual labor supply responses. Changes in labor supply are interpreted in terms of employment effects as demand is assumed to be perfectly elastic. In the following sub-sections we extend this choice model with a structural wage/productivity equation and a rationing equation leading to a labor supply model with demand side rationing.

5.3.2 Wages and productivity

In the unconstrained labor supply model wages are considered to be exogenous conditional on observed covariates. Since hourly wages are needed for all individuals regardless of their labor market status, a (log) wage equation is estimated in order to predict potential wages for non-employed individuals. The predictions (including randomly drawn error terms to emulate the variance of observed wages) are used to simulate the disposable household incomes for each category. Usually, a Heckman

[88] Several alternatives have been suggested in the literature, among them generalized extreme value, discrete choice probit or random coefficient models (Train, 2009).

type selection model is estimated to take selection into employment into account. In the unconstrained model a structural interpretation of the wage equation is hardly needed; it mainly serves to create consistent gross wage predictions for the decision model.

In the extended model with demand side rationing different states of non-employment are distinguished systematically. Potential market wages for non-employed individuals are needed here, too. In addition, we give different arguments in the wage equation a structural interpretation. The basic assumption is that observed market wages are a function of an individual's productivity p_i^*, i.e. more productive people earn higher wages. On the other hand market wages are influenced by the labor demand side denoted as ld_i^*. What a firm is willing or able to pay may depend on its productivity, its market power, or macro-economic shocks. Firms might also discriminate among different employees. The individual productivity and the labor demand (firm) wage components as such are not observable. We assume that both can be written as a function of observed covariates and an unobserved term:

$$\begin{aligned} p_i^* &= X_i'^{(w_p)}\beta^{(w_p)} + e_i^{(w_p)} \\ ld_i^* &= X_i'^{(w_{ld})}\beta^{(w_{ld})} + e_i^{(w_{ld})} \end{aligned} \tag{5.6}$$

The observed wage rate paid consists of those two components which are assumed to be linked additively[89]:

$$\begin{aligned} \ln w_i &= p_i^* + ld_i^* \\ &= X_i'^{(w_p)}\beta^{(w_p)} + X_i'^{(w_{ld})}\beta^{(w_{ld})} + e_i^{(w_p)} + e_i^{(w_{ld})} \\ &= X_i'^{(w_p)}\beta^{(w_p)} + X_i'^{(w_{ld})}\beta^{(w_{ld})} + e_i \end{aligned} \tag{5.7}$$

We cannot separately identify $e_i^{(w_p)}$ and $e_i^{(w_{ld})}$ as we rely on employee data in this paper.[90] Therefore we usually refer to the composite term of the wage/productivity

[89]This implies that both elements are separable and do not reinforce each other. Alternative specifications that make both components depend on each other could be equally plausible. Yet, the error terms would also be related with the other component and could not be separated as easily.

[90]If firm information were available, one could identify an unobserved firm-specific effect.

equation. Assumptions on these unobserved components, particularly on $e_i^{(w_p)}$, are crucial for the different specifications of the empirical model.

The matrix $X_i'^{(w_p)}$ contains various variables that can be interpreted as determinants of an individual's productivity: age, school and vocational education, previous labor market experience (years in full time and in part time employment), and the depreciation of human capital due to unemployment and other work interruptions. These variables are related to the individual and do not depend on the firm.

The second category of variables that influence the market wage is primarily related to the firm, i.e. the labor demand side. $X_i'^{(w_{ld})}$ thus contains sets of industry and firm size dummies to account for variation in pay along these dimensions. A set of dummies for the German federal states is included to mirror regional differences in wage scales. Moreover, a dummy variable for the German nationality controls for discrepancies in pay between natives and foreign nationals which may be due to discrimination. A further dummy for civil servants controls for the gap between public and private sector wages.

Since w_i is censored for non-working individuals, some form of selection correction has to be included in the wage equation when there are unobserved differences between working and non-working individuals that affect their (potential) wages conditional on $X^{(w)}$. When exclusion restrictions are available and under the assumption that the error terms in the wage and selection equation are distributed jointly normal, one can add the inverse Mills ratio from a first-step selection equation according to Heckman (1979) as a selection term. As indicated above this is the standard procedure for discrete choice labor supply models without rationing (van Soest, 1995; Creedy and Duncan, 2005; Steiner et al., 2012). We follow this procedure in the labor supply model with constraints when the equations are assumed to be independent and are estimated separately. Available exclusion restrictions are the degree of disability, marital status, the existence of children in the household, and other household income. An alternative specification is suggested below for the joint estimation of the extended model with rationing (see sub-section 5.3.5).

5.3.3 Demand side rationing

The unconstrained labor supply model consists of only two different labor market states: inactivity and employment (with different hours of work). The zero hours category is chosen voluntarily as it maximizes the household's utility. This setup does not capture situations where an individual prefers to work – as this would increase his utility – but is constrained by the labor market. An individual might either not be productive enough to find a job at going market wage rates (structural unemployment), or labor market frictions could create a mismatch between supply and demand (frictional, cyclical unemployment).[91]

In the extended model with rationing three basic labor market states are distinguished: (voluntary) inactivity, (involuntary) unemployment, and employment. For inactive people actual (h^a) and desired (h^d) working hours are equal to zero, i.e. $h^a = h^d = 0$. Inactive individuals do not intend to work and are not looking for a job. Unemployed people, on the other hand, would like to work, i.e. $0 = h^a < h^d$, and are actively searching for a job. For employed people desired working time equals their observed hours ($h^a = h^d$). In addition to observed working hours we thus exploit information about the desired working hours of non-employed people in the model with rationing. Individuals who are observed to work zero hours and are identified to be involuntarily unemployed are assigned to their preferred hours of work category in the labor supply estimation. Based on the assumption that employed individuals are not hours-constrained, i.e. $h^a = h^d$ for all $h^a > 0$,[92] the decision model of labor supply identifies the true preferences for work regardless of labor market rationing.

Besides the re-specification of the hours categories in the labor supply decision model, we introduce the risk of involuntary unemployment into the model. An equation is added that describes the probability of not finding a job when an individual

[91] See Laroque and Salanié (2002) for a similar categorization. They distinguish classical unemployment (individual's productivity is below the statutory minimum wage) from frictional or cyclical unemployment. The latter types are included in a residual category which can be identified with their data.

[92] In principle our model could be extended to capture not only employment constraints, but also restrictions for specific hours constraints. To keep the model simple in this regard we disregard hours constraints here. For models that consider hours constraints see the discussion in sub-section 5.2 above.

seeks work. To be identified as involuntarily unemployed in our data set, the individual must state that he or she is willing and able to work and is actively searching for a job without being in an employment relationship.[93] Note that for inactive individuals who are (currently) not searching for a job, we have no information on their rationing status. They might be rationed, if they decide to pursue employment. Inactive people thus cannot contribute to the identification of the rationing probability.

In our model the rationing risk depends on various factors. First, we assume that an individual's productivity p_i^* relative to some institutionally influenced minimum standard of pay mw_i determines the probability of being constrained. More productive persons have ceteris paribus a higher probability of finding a job. The determinants of productivity are detailed in sub-section 5.3.2 above. On the other hand this probability also depends on the wage level a firm has at the very least to pay for an employee. We contend that a firm only creates the job, if the employee's (perceived) productivity at least equals the wage costs. If productivity is below the institutionally defined lower wage cost threshold, the position will not be generated. This lower threshold mw_i is influenced by labor market regulations like a federal minimum wage, sectoral or regional minimum wages, collectively bargained wages where firms or employees are covered by those agreements, or the basic moral wage threshold.

Second, workers could be paid differently because of observed characteristics that are not directly related to their productivity. Therefore the wage equation includes variables that indicate potential reasons for wage discrimination. Third, the probability of rationing depends on labor demand factors that are independent from productivity. One can think of technological or structural change and also exogenous demand shocks that might vary over regions and also sectors or occupations. Since the unemployment risk of individual i is not directly observable, we specify a

[93] We apply the standard ILO definition: if the individual states that he or she has actively searched in the last 4 weeks and is ready to take up employment within 2 weeks without being currently employed we assign the state involuntary unemployment.

latent equation for the probability ue_i^* to be involuntarily unemployed:

$$ue_i^* = \beta^{(ue_p)}(p_i^* - \ln(mw_i)) + X_i'^{(ue_{dis})}\beta^{(ue_{dis})} + X_i'^{(ue_{ld})}\beta^{(ue_{ld})} + \eta_i \qquad (5.8)$$

The first term $(p_i^* - \ln(mw_i))$, the difference between the employee's productivity p_i^* and the lower wage threshold mw_i taken in logs, depicts a measure of productivity in relation to minimum wage costs.[94] Productivity as such is unobserved and identified in eq. (5.7). Different assumptions on the determinants of productivity lead to alternative specifications of the model. If we suppose that a worker's productivity can be fully explained by observed characteristics and the unobserved component $e_i^{(w_p)}$ to be purely random, we can estimate eq. (5.7) separately and put the expected value $\hat{p}_i$ into the rationing equation. Should unobserved factors systematically influence productivity and not be included in the rationing equation, the estimates could suffer from omitted variable bias. In an alternative specification (see sub-section 5.3.5 below) the residual e_i together with $\hat{p}_i$ from the wage/productivity equation represent individual productivity p_i^*.[95]

The variable mw_i approximates the minimum wage cost threshold that applies to the individual. Germany does not have a federal minimum wage, but several sectoral minima have been introduced over the last years. Therefore mw_i is set to the sectoral minimum wage for all covered employees. In all other cases we insert those wage rates for mw_i that are paid at the bottom of the hourly wage distribution respectively for men or women, in a certain region, for a certain age group and in a certain sector. These lower wage rates represent the minimum standard of pay that is influenced by labor market regulations like collective bargaining or the basic moral threshold according to the German Civil Code.[96] The lower wage thresholds are approximated by the 5th quantile of the observed distribution of hourly wages

[94] The wage equation (5.7) where productivity is identified is estimated in logs. Therefore the variable approximating the lower wage threshold also enters in logs. As explained below, it holds by definition that $mw_i > 0$.

[95] Ideally $e_i^{(w_p)}$ would be added to $\hat{p}_i$. As indicated above, we cannot separate $e_i^{(w_p)}$ from $e_i^{(w_{ld})}$, therefore the composite residual is added.

[96] Article 138 of the German Civil Code states that effort and pay must not be in stark disproportion. According to consistent case-law this is fulfilled, if a wage is below two thirds of collectively bargained wages customary in the sector and region.

in cells defined by gender, region, age group and sector.[97] Since the SOEP does not include enough observations to adequately display the wage distribution for this level of disaggregation, we employ the German Structure of Earnings Survey (GSES, see sub-section 5.4.2 below) for this variable.[98] We use the latest available cross-section for the year 2006 and forward-project the wages with constant growth rates to the year of analysis.

The variation in productivity-minimum wage ratio is thus generated by differences in individual productivity p_i^* as well as the lower wage thresholds mw_i. The distributions of estimated individual productivities, the assigned lower wage thresholds and the log ratio of both variables are documented in Figures 5.1, 5.2, and 5.3 in the Appendix. There is indeed sizeable variation in both components; the productivity-minimum wage ratio is approximately normally distributed.

The matrix $X_i'^{(ue_{dis})}$ includes individual and household characteristics that have an effect on the individual's rationing probability ue_i^* which does not run through individual productivity (as a component of the wage w_i).[99] We include dummies for German nationality, single households, and children younger than three in the household. Those variables might indicate discrimination on the labor market that leads to a higher rationing probability than for the respective reference groups.

The variables denoted by $X_i'^{(ue_{ld})}$ serve as proxies for the demand side of the labor market; again we assume that they neither directly affect the individual's labor supply decision, nor determine the rationing risk through productivity.[100] As the demand for certain skills and professions fluctuates over time, the set of occupation

[97] We utilize the regional differentiation available in the GSES data: north-western states (Schleswig-Holstein, Lower Saxony, Hamburg), western Germany (North Rhine-Westfalia), middle of Germany (Hesse, Rhineland-Palatinate, Saarland), southern states (Baden-Wurttemberg, Bavaria), and eastern Germany (Mecklenburg-Western Pommerania, Brandenburg, Berlin, Saxony-Anhalt, Thuringia, Saxony). The age groups consist of 18-30, 31-50, 51-65 years. Sectors are distinguished at the 2-digit level.

[98] The 5th percentile is a somewhat arbitrary choice; there is a trade-off between approximating the lower wage treshold and being prone to measurement error for the lowest hourly wages.

[99] I.e. $X_i'^{(ue_{dis})}$ is not part of $X_i^{(w)}$; see eq. (5.7) in sub-section 5.3.2. $X_i'^{(ue_{dis})}$ is also not identical with the exclusion restrictions for the selection equation in the specifications with a selection correction.

[100] As with $X_i'^{(ue_{dis})}$ the variables in $X_i'^{(ue_{ld})}$ are also neither contained in $X_i^{(w)}$, nor identical to the exclusion restriction in the selection equation of the two-step specification of the model.

dummies included in $X_i'^{(ue_{ld})}$ captures some of that heterogeneity.[101] Furthermore, a bunch of indicators varying at the regional level cover the economic situation of firms as well as the performance and structure of the local labor market. $X_i'^{(ue_{ld})}$ includes the unemployment rate, the employment rate, the GDP/capita, and the share of part time employment. It depicts demand side shocks as well as cyclical fluctuations. These indicators vary at the level of NUTS 2 regions[102] (so-called 'Raumordnungsregionen') which is an administrative rank just below the federal states.

Assuming η_i to be distributed standard normally we arrive at a probit specification for the rationing probability:

$$\begin{aligned} Pr\left(ue_i = 1\right) &= \Phi\left\{\beta^{(ue_p)}(p_i^* - \ln(mw_i)) + X_i'^{(ue_{dis})}\beta^{(ue_{dis})} + X_i'^{(ue_{ld})}\beta^{(ue_{ld})}\right\} \\ Pr\left(ue_i = 0\right) &= \Phi\left\{-\left(\beta^{(ue_p)}(p_i^* - \ln(mw_i)) + X_i'^{(ue_{dis})}\beta^{(ue_{dis})} + X_i'^{(ue_{ld})}\beta^{(ue_{ld})}\right)\right\} \end{aligned} \tag{5.9}$$

Having described the separate elements of the model, we can now combine the labor supply decision with the rationing probability and write down the labor supply decision with demand side constraints.

5.3.4 Labor supply with rationing

In the first specification we assume that conditional on the observed covariates the choice probability of the labor supply equation and the rationing probability are independent. The probabilities for the different labor market states in the labor supply model with constraints can be written as follows:

$$\begin{aligned} Pr_{i0}^{inact} &= Pr\left(h^a = h^d = 0\right) &&= \frac{exp\{U(y_{i0}, l_{i0}, X_{i0})\}}{\sum_{j=0}^{m} exp\{U(y_{ij}, l_{ij}, X_{ij})\}} \\ Pr_{ik}^{ue} &= Pr\left(h^a = 0, h^d > 0, ue_i = 1\right) &&= \frac{exp\{U(y_{ik}, l_{ik}, X_{ik})\}}{\sum_{j=0}^{m} exp\{U(y_{ij}, l_{ij}, X_{ij})\}}\Phi\left\{.\right\} \\ Pr_{ik}^{emp} &= Pr\left(h^a = h^d > 0, ue_i = 0\right) &&= \frac{exp\{U(y_{ik}, l_{ik}, X_{ik})\}}{\sum_{j=0}^{m} exp\{U(y_{ij}, l_{ij}, X_{ij})\}}\Phi\left\{-(.)\right\} \end{aligned} \tag{5.10}$$

[101] For non-employed persons we insert the occupation that was carried out during the last employment spell. We add a residual category for cases where no occupation is observed; it amounts to less than 2 percent in the sample.

[102] Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS).

The probability of being inactive Pr_{i0}^{inact} is only determined by the utility model for the labor supply decision. Individuals that are located in this category prefer not to work ($h^d = 0$). For these individuals the 'reservation net ressources' exceed the household's utility for each category with positive working hours.[103] The likelihood of involuntary unemployment Pr_{ik}^{ue} results from choosing a category with positive working hours according to the household's utility maximization. This choice probability is multiplied by the risk of being rationed on the labor market $\Phi\{.\}$ from eq. (5.9). For the probability of being employed Pr_{ik}^{emp} the individual again chooses positive working hours as this maximizes the household's utility. This choice probability is multiplied by the probability of being employed $\Phi\{-(.)\}$.[104] The specification corresponds to Bargain et al. (2010) but extends their model by the productivity term in the rationing equation.

The independence assumption means that conditional on the variables in X household utility and the rationing probability are not correlated, i.e. $Cov(\epsilon_{ij}, \eta_i) = 0$. There are no unobservables that have an effect on the labor supply decision and simultaneously on the risk of rationing. In substantive terms this implies that unobserved individual characteristics are not systematically linked to an employee's productivity. Through the wage productivity is related to the household's utility and labor supply, but likewise a crucial explanatory variable in the rationing equation. When wages are exogenous for the labor supply decision and productivity is exogenous for labor market rationing, the wage/productivity equation (5.7), the rationing equation (5.9) and the labor supply equation (5.5) can be estimated separately. Expected values for productivity $\hat{p}_i$ are inserted into the rationing equation and predicted wages $\hat{w}_i$ for non-employed individuals enter into the labor supply decision model. The predicted rationing probability can simply be multiplied with

[103] The group might include people that are *discouraged* to search for a job. Those individuals actually prefer to work, but fail to find a job and therefore might state they do not want to work and do not search (any longer). Then, their labor supply preferences are mis-specified in the estimation, as individuals who actually want to work are rationed and therefore discouraged. This does not apply to the rationing equation, because those individuals do not contribute to identification. But it reduces efficiency because information on some rationed individuals is not exploited.

[104] We mentioned above that we only consider one individual per household. An extended model for couples would have a combined choice set of all hours combinations multiplied by rationing probabilities for both spouses. We leave this extension for future research.

Pr_{ik}^{emp} and Pr_{ik}^{ue} to arrive at the choice probabilities for the labor supply model with constraints.

5.3.5 Joint estimation of the model

Thinking of personal traits like motivation, talent, creativity or ability the independence assumptions from the last sub-section seem overly restrictive. Such unobserved characteristics will influence an individual's productivity and thus be reflected in the wage. Therefore the individual rationing risk should be affected by unobservables through productivity.[105] The labor supply decision is likewise affected. Unobserved differences in productivity translate through the wage into net household income. In addition, these unobservables might be correlated with an individuals preferences for work. In sum, more able and more motivated people should therefore ceteris paribus have a higher labor market participation, earn higher wages and face a lower risk of involuntary unemployment. This means that the error terms of the different equations are correlated. This has to be taken into account; otherwise the model parameters cannot be estimated consistently.

The alternative specification borrowed from Laroque and Salanié (2002) who estimate a somewhat more simple framework[106] reflects these associations. The unobserved component e_i from the wage/productivity equation is incorporated into the labor supply decision and the rationing equation. It enters the utility function through $y_{ij} = R\left[w_i \times (TE - l_{ij}), y_i^{(other)}, X_{ij}^{(LS)}\right]$ from eq. (5.2) as e_i is part of the gross wage. Observed w_i for the employed are used as in eq. (5.10). For non-employed individuals we now not only include the predicted wage based on the observables and parameters from the wage equation $X_i'^{(w_p)}\beta^{(w_p)} + X_i'^{(w_{ld})}\beta^{(w_{ld})}$, but also the unobserved wage component e_i. This can only be done when the wage and labor supply equations are estimated jointly. Since the predicted wages are not estimated in a separate step before the maximization of the utility function,

[105] The unobserved traits could also be correlated with the individual's search intensity and/or effectiveness; through this channel they might also affect the rationing probability. These different channels cannot be identified separately in our framework.

[106] Laroque and Salanié (2002) analyze only the participation decision and do not have a separate rationing decision.

the complex tax and transfer function $R(.)$ becomes part of the likelihood. Net household incomes are endogenously determined within the estimation procedure for non-employed people which complicates the maximization.

In addition to that, Laroque and Salanié (2002) include the error term from the wage equation into the choice probability for labor supply. It is added to the reservation net ressources in the non-employment alternative. Through a parameter ρ the unobserved component from the wage equation is flexibly linked to the labor supply decision. For our model this translates to the inclusion of e_i into the utility function from eq. (5.4)

$$V_{ij} = \alpha_c + \alpha_y y_{ij} + \alpha_l l_{ij} + \alpha_{y^2} y_{ij}^2 + \alpha_{l^2} l_{ij}^2 + \alpha_{yl} l_{ij} y_{ij} + \rho^{(LS)} e_i d_{i0} + \epsilon_{ij} \tag{5.11}$$

The term e_i is interacted with a choice-specific dummy for the non-working alternative leading to the interaction term $e_i d_{ij}$ which is e_i for $j = 0$ and zero otherwise. Besides the translated effect through the income this specification allows for an additional direct effect of the unobservables on the extensive margin of labor supply. The underlying assumption is that unobserved personal traits influence the decision whether to work or not.[107] The choice of a certain number of working hours is only determined through different incomes (including the unobserved e_i) and leisure times.

Finally, the unobserved term influences the risk of rationing through the productivity variable. Now not only expected productivity $\hat{p}_i$ enters the rationing probability as in eq. (5.10), but also its unobserved part e_i. Both components are determined in the wage/productivity equation which is estimated together with the labor supply and the rationing equation; the latter now becomes:

$$ue_i^* = \beta^{(ue_p)} \left[(X_i'^{(w_p)} \beta^{(w_p)} + e_i) - \ln(mw_i) \right] + X_i'^{(ue_{dis})} \beta^{(ue_{dis})} + X_i'^{(ue_{ld})} \beta^{(ue_{ld})} + \eta_i \tag{5.12}$$

Note that we have to assume the unobserved characteristics influencing productivity to be in some way known to employers. Thus they should be reflected in wages

[107] Not including the interaction terms with the other hours categories also avoids the overparameterization of the model. For men a choice-specific part time dummy is already in the model.

and influence the individual's rationing probability. Assuming e_i to be distributed standard normally we can re-write the likelihood contributions for the choice probabilities conditional on the unobserved component:[108]

$$
\begin{aligned}
Pr_{i0}^{inact} &= \int \phi(e) \left[\frac{exp\left\{U\left[R\left(y_{i0}^{other}, X_{i0}^{(LS)}\right), l_{i0}, X_{i0}^{(LS)}, e_i * d_{i0}\right]\right\}}{\sum_{j=0}^{m} exp\left\{U\left[R\left(exp(X_i'^{(w)}\beta^{(w)} + e_i + \sigma_e^2/2) * (TE - l_{ij}), y_{ij}^{other}, X_{ij}^{(LS)}\right), l_{ij}, X_{ij}^{(LS)}, e_i * d_{ij}\right]\right\}} \right] de \\
Pr_{ik}^{ue} &= \int \phi(e) \left[\frac{exp\left\{U\left[R\left(exp(X_i'^{(w)}\beta^{(w)} + e_i + \sigma_e^2/2) * (TE - l_{ik}), y_{ik}^{other}, X_{ik}^{(LS)}\right), l_{ik}, X_{ik}^{(LS)}, e_i * d_{ik}\right]\right\}}{\sum_{j=0}^{m} exp\left\{U\left[R\left(exp(X_i'^{(w)}\beta^{(w)} + e_i + \sigma_e^2/2) * (TE - l_{ij}), y_{ij}^{other}, X_{ij}^{(LS)}\right), l_{ij}, X_{ij}^{(LS)}, e_i * d_{ij}\right]\right\}} \right. \\
&\left. \quad \times \Phi\left\{\beta^{(ue_p)}\left[X_i'^{(w_p)}\beta^{(w_p)} + e_i - \ln(mw_i)\right] + X_i'^{(ue)}\beta^{(ue)}\right\}\right] de \\
Pr_{ik}^{emp} &= \int \phi(e) \left[\frac{exp\left\{U\left[R\left(w_i * (TE - l_{ik}), y_{ik}^{other}, X_{ik}^{(LS)}\right), l_{ik}, X_{ik}^{(LS)}, \hat{e}_i * d_{ik}\right]\right\}}{\sum_{j=0}^{m} exp\left\{U\left[R\left(w_i * (TE - l_{ij}), y_{ij}^{other}, X_{ij}^{(LS)}\right), l_{ij}, X_{ij}^{(LS)}, \hat{e}_i * d_{ij}\right]\right\}} \right. \\
&\quad \times \Phi\left\{-\left(\beta^{(ue_p)}\left[X_i'^{(w_p)}\beta^{(w_p)} + \hat{e}_i - \ln(mw_i)\right] + X_i'^{(ue)}\beta^{(ue)}\right)\right\} \\
&\left. \quad \times \frac{1}{\sigma_e}\phi\left(\frac{\ln w_i - X_i'^{(w)}\beta^{(w)}}{\sigma_e}\right)\right] de
\end{aligned}
\tag{5.13}
$$

For employed people we can compute the residuals $\hat{e}_i$. For the non-employed e_i has to be integrated out of the likelihood. Since this term involves the highly nonlinear function $R(.)$, the integral has no closed-form solution and must be solved numerically. Therefore we have to rely on maximum simulated likelihood to estimate this model. The procedure boils down to repeatedly taking random draws from the standard normal distribution and average the estimation results over this simulated distribution of the error terms of non-employed individuals (Train, 2009). Haan and Uhlendorff (2013) propose a different specification for the unobserved heterogeneity. They assume a discrete distribution of unobserved terms in their labor supply and rationing equation in a two-factor loading model. Their approach requires less restrictive functional form assumptions and includes a more flexible and general variance-covariance matrix.[109]

[108]We simplified the notation for readability and collect the different explanatory variables for the wage $X_i'^{(w)}\beta^{(w)}$ and rationing $X_i'^{(ue)}\beta^{(ue)}$ equation.

[109]This specification is more demanding in our context as we have three related equations. We leave a more general specification for future research.

5.3.6 Likelihood and identification

The sample likelihood for the extended model with labor demand restrictions is given by:

$$L = \prod_{i=1}^{N_1} Pr_{i0}^{inact} \times \prod_{i=N_1+1}^{N_2} \prod_{k=1}^{m} (Pr_{ik}^{ue})^{\delta_{ik}} \times \prod_{i=N_2+1}^{N_3} \prod_{k=1}^{m} (Pr_{ik}^{emp})^{\delta_{ik}} \tag{5.14}$$

The individual choice probabilities are defined in eq. (5.13). The dummy δ_{ik} is equal to one when individual i chooses alternative k and zero otherwise. Three different groups contribute to the likelihood: $i = 1, \ldots, N_1$ individuals who are voluntarily inactive; $i = N_1+1, \ldots, N_2$ individuals who are involuntarily unemployed; and $i = N_2 + 1, \ldots, N_3$ employed individuals.

Some remarks are due on identification. The basic problem in the labor supply model with rationing is to separately identify labor supply decisions and labor demand constraints. Bargain et al. (2010) like Haan and Uhlendorff (2013) argue that demand side rationing is identified from regional labor market conditions which are exogenous to the individual and influence the rationing probability. These factors are asssumed not to have a direct effect on the labor supply.[110] The unemployment rate is the most important indicator. We also use this type of variation here.

Since we also want to make rationing dependent on the individual's productivity, identification is even thornier here because of the direct link of productivity to disposable income in the utility function for labor supply (going through the wage). There are several points to make where the necessary variation comes from. First, we do not identify the mere effect of an individual's productivity, but of productivity in relation to some minimum wage threshold inherent in German labor market institutions. We exploit sectoral minima – where applicable – or use the bottom of the distribution of observed wages in segments of the labor market defined by gender, age, region and sector. Figure 5.2 documents the sizeable variance in this variable as firms are allowed to pay lower wages in certain segments of the labor market than in others. Given individual productivity in the enumerator there is additional variation

[110] A possible channel for that relationship could go through the (potential) wage. If wages were on average lower in regions with a more tense labor market, this could also lead to lower labor supply. Different labor market outlooks might also en- or discourage worker to search for jobs.

in the denominator of this variable. Second, we use the wage (in the tax function) of the labor supply model. Besides individual productivity firm-side variables provide additional variation in labor income. Third, we exploit variation generated by the tax system for labor supply. Given someone's productivity and gross wage, the disposable income varies with the household context (marital status, labor supply of the spouse, children, further income); such differences are not relevant for the firm's labor costs and thus the rationing probability.[111]

Fourth, we use observed covariates as exclusion restrictions in different equations of our model. The identification of individual productivity given the other covariates in the rationing equation hinges on valid exclusion restrictions in the wage/productivity equation that are not part of the rationing model. We use indicators derived from the individual labor market history like the depreciation of human capital (due to previous unemployment spells), tenure, previous incidence of full/part time employment, and qualification variables.[112] As explained the denominator in the productivity/minimum wage threshold variable provides additional variation. Regional labor market indicators were already mentioned as exclusion restrictions for labor demand in the rationing equation. We add a set of occupation dummies to approximate differences in the demand for and mismatch of skills. Occupational choices made earlier in life might influence the rationing probability today without having a direct link to the labor supply decision.

5.4 Institutions, data and descriptive statistics

5.4.1 Institutions and microsimulation model

In order to translate individual gross earnings into disposable incomes at the household level we use the tax-benefit microsimulation model STSM (Steiner et al., 2012). This is a standard approach in the context of discrete choice labor supply models

[111] Like in the unconstrained labor supply model we assume productivity and wages to be constant for different working time categories. Making wages dependent on working hours would complicate identification.

[112] One could argue that some of these factors influence rationing not only through productivity, but to also through different mechanisms, e.g. discriminiation.

(Creedy and Duncan, 2002). The model consists, first, of a representative micro data set (the SOEP, see sub-section 5.4.2) that provides the necessary information on the composition of the households, incomes from various sources (labor, capital, transfers, etc.), working hours, and socio-demographic characteristics. Second, a tax-transfer calculator simulates net household incomes based on gross hourly wages of the employed persons in the household for different working hours categories of those individuals considered here.

The STSM contains the main features of the German tax and transfer system. Gross household income is composed of earnings from dependent employment, income from capital, property rents and other income. Earnings from dependent employment is the most important income component for the great majority of households. Taxable income is calculated by deducting various expenses from gross household income. The income tax is computed by applying the income tax formula to the individual incomes of unmarried spouses; for married spouses, income is taxed jointly based on an income splitting factor of 2. Employees' social security contributions and the income tax are deducted from gross household income and social transfers are added to get net household income. Social transfers include child allowances, child-rearing benefits, educational allowances for students and apprentices, unemployment compensation, the housing allowance, and social assistance. The model accounts for nonlinearities and interactions within the German tax-benefit system, in particular means-tested income-support schemes, exemptions of very low earnings from social security contributions, and the joint income taxation of married couples imposing relatively high marginal tax rates on secondary earners.

The structural parameters of the model are estimated under the existing legislation. As these parameters for the labor supply decision model are not directly interpretable, labor supply elasticities are simulated based on the estimated parameters. First, participation rates and the average hours worked are predicted for the status quo. We then increase the wage of the analyzed individuals by one percent, run the microsimulation model to simulate the resulting adjustment in disposable household income for each hours category and all households. Then the average participation rates and working hours are predicted again and the differences yield participation and hours elasticities.

As outlined above, the rationing probability does not directly depend on the earned wage, but rather on an individual's productivity. Therefore a wage elasticity of the rationing probability cannot be simulated. It is, of course, possible to interpret the marginal effect and elasticity of the productivity variable in the rationing equation. Since it does not have a clear, intuitive interpretation, we simulate reform-induced changes in the rationing risk (see sub-sections 5.6.1 and 5.6.2). A similar procedure is used for the labor supply effects of the policy reforms. We start with our baseline household incomes and labor supply and rationing risk predictions. Then gross wages are adjusted in the labor supply equation and the productivity-labor cost variable in the rationing equation. We then simulate disposable household incomes for all categories under the different minimum wage scenarios and predict the labor supply and rationing risk after the policy reforms.

5.4.2 Data sources

The simulation of wage effects, the microsimulation, and the labor supply estimations are based on data from the German Socio-Economic Panel (SOEP). The SOEP is a representative sample of households living in Germany with detailed information on household incomes, working hours and the household structure (Wagner et al., 2007). We use the wave for the year 2009. Since the STSM is based on retrospective information on income components for the simulation of net household incomes for a given year, wages and incomes computed on basis of the SOEP wave from 2009 refer to 2008. Because our analysis refers to the year 2010, we extrapolate incomes on the basis of realized average growth rates for 2009 and 2010.[113] The tax-benefit system includes all changes in regulations up to the year 2010.

For the regional labor demand variables we resort to data that is collected and

[113]Most interviews in the SOEP refer to the first quarter of the year. We assume that incomes will increase with the annual growth rate in that year. Average annual growth rates are derived from the following indices for the years 2009 and 2010: 1.004, 1.02 for consumer prices; 1.019, 1.007 for wages; 0.99, 1.05 for income from profits (source: national accounts; BMWi (2010); own calculations).

edited jointly by the German Statistical Office with the Federal Institute for Research on Building, Urban Affairs and Spatial Development within the Federal Office for Building and Regional Planning. The dataset "Indicators and Maps on the Spatial Development" ("Indikatoren und Karten zur Raumentwicklung", INKAR, see Helmcke, 2008) allows longitudinal comparisons at different regional levels for Germany. The regional classification conforms to the Nomenclature of territorial units for statistics (NUTS, see European Commission, 2003). The information used here is aggregated at the NUTS 2 level which consists mainly of administrative districts in Germany at which regional policies are planned and implmented. We utilize indicators for employment, unemployment and economic performance. The INKAR and the SOEP data are merged at the regional NUTS 2 level.

The information for the denominator of the variable that relates individual productivity and existing minimum standards for pay comes from the 2006 wave of the German Structure of Earnings Survey (GSES). This is a linked employer-employee data set provided by the German Federal Statistical Office (Hafner, 2006; Statistisches Bundesamt, 2009). The large sample size (about 1 million observations in total) allows to precisely assess the lower quantiles of the wage distribution for sub-groups of employees. The data set contains cardinal information on working hours. The hourly wage measure is more reliable compared to the SOEP, since the information comes directly from the firm and is based on the employment contract. Measurement errors due to incomplete memory of the respondent, discrepancies between reported working hours and wage income are therefore less of a problem (Müller, 2009a).

5.4.3 Sample and descriptive statistics

We analyze the labor supply with rationing separately for men and women. We consider individuals living in single and couple households. Following the chauvinist framework we take the labor supply of the partner in couple households as given.[114] We restrict the sample to people aged 18-65 as we do neither model the educational

[114] An obvious extension of the framework of this paper would be a household labor supply model for couple with both spouses being flexible. This yields a more complicated likelihood as it includes additional wage and rationing equations for the spouse that have to be estimated simultaneously. We leave this extension for future research.

choices nor retiring decisions. Therefore we exclude households where the individual under consideration is retired, disabled, on maternity/paternity leave, or in fulltime education. This results in an estimation sample of 3,858 observations for men and 4,514 observations for women. We estimate the model and run all policy simulations on data referring to the year 2010.

Descriptive statistics are given in Tables 5.12 through 5.19 in the Appendix. Three categories of individuals that contribute to the identification of our model can be distinguished: voluntarily inactive, employed, and involuntarily unemployed people. We therefore present all descriptive statistics for the full sample and separately for each group.

For the *productivity variables* in the *wage equation* some differences between working and non-working individuals can be noticed. Currently employed have on average more years of schooling, more often a higher school certificate or a tertiary education, more working experience and a lower depreciation of human capital (Tables 5.12, 5.16). These discrepancies are more pronounced for rationed individuals whereas voluntarily unemployed are more similar to employed people. There are thus marked differences in observable characteristics that determine an individual's productivity. Although qualitatively similar these discrepancies are more pronounced among women. Regarding the *demand side variables* the dummies for firm size and sector cannot be observed for non-employed individuals; mean values of orthogonalized dummy variables are used in those cases (Tables 5.13, 5.17). The share of German nationals is slightly higher in the working population.

The explanatory variables in the *rationing equation* should be compared first between the working individuals and those who are rationed, since those two groups contribute to the identification of the rationing probability. The assigned lower wage threshold is on average a bit higher for employed in comparison to non-employed people (Tables 5.14, 5.18). It varies between 3.20 € and 16 €/hour for men and 3.20 € and 12.90 €/hour for women. The share of singles is higher whereas that of German nationals is lower among the rationed individuals. There are also substantial differences in the occupational composition of both groups. Finally, the labor demand indicators show that the incidence of unemployment and the economic clout is lower in regions where the rationed individuals live. The characteristics of the voluntarily unemployed people lie in between the employed and rationed individuals, although they more closely resemble the properties of the latter group. These patterns are very similar for men and women.

Table 5.1: Unconditional hours distribution

	Men			**Women**		
		Unconstr.	Constr.		Unconstr.	Constr.
Alternative	Hours	Share	Share	Hours	Share	Share
	Hours	Share	Share	Hours	Share	Share
Inactivity	0.0	0.12	0.07	0.0	0.22	0.17
Small part time	12.5	0.02	0.02	9.0	0.08	0.08
Medium part time				15.0	0.12	0.13
Large part time				26.5	0.20	0.20
Full time	36.5	0.49	0.54	38.5	0.26	0.29
Overtime	46.5	0.37	0.37	44.5	0.12	0.12
Share rationed			0.05			0.05
Observations			3,858			4,514

Notes: Unconstr.=unconstrained model, Constr.=constrained model.
Source: Own calculations based on SOEP, wave 2009.

The descriptive statistics for observed taste shifters in the *labor supply* decision model are not directly interpretable, since the variables are interacted with income and leisure and vary between the different working hours categories (Tables 5.15, 5.19). They are reported for the observed choice category. Table 5.1 presents the observed distribution of working hours for the unconstrained and the constrained labor supply models. Among men we observe 11% of the sample to be voluntarily inactive in the unconstrained case. Only 2% of the sample work in marginal or part time employment whereas nearly 50% of the sample work in the full time category and almost 40% work more than 40 hours. We see that 5% of men in our sample are identified to being rationed on the labor market. Accordingly the share of volunatarily unemployed is reduced by 5 percentage points and the share in the (preferred) full time category increases to 54%.

We specify two additional part time choices for women who are more evenly distributed over the hours categories. The share of inactive people is markedly higher and amounts to 23% in the unconstrained model. Less than 40% work full or over-time. Consequently the importance of part time is much higher for female employees. 5% of women in our sample state to be constrained on the labor market. According to their hours preferences they are either shifted to the medium part time or full time categories. The share of rationed individuals is clearly smaller than aggregate numbers on unemployment for Germany at that time. Except for conceptual differences between registered unemployment and the ILO definition applied here, the discrepancy may also be related to the measurement errors mentioned above. There might be discouraged workers who claim to be voluntarily unemployed. Particularly among women there may also be individuals with high fixed costs of working, e.g. because of little children in the household and high costs of childcare. This dimension is not part of the labor supply model in this paper (Wrohlich, 2011).

5.5 Estimation results

5.5.1 Parameter estimates

We first interpret the parameter estimates and compare them across the different model specifications. With regard to the *wage equation* we see that among the productivity variables age, years of schooling and holding a higher school certificate are significantly related to higher wages (Tables 5.2, 5.3). Conditional on these variables and the other covariates the dummies for vocational or tertiary education are either weakly or not significantly different from zero in the wage equation. The depreciation of human capital due to accumulated spells out of employment has a stronly negative association with the earned wage. Variables measuring the experience on the labor market and the tenure with a firm are also significantly related to the wage. The effects of the productivity variables are of similar magnitude between the models without and with constraints regardless whether common unobserved factors are taken into account or not. The negative effect of human capital depreciation is larger in magnitude in the models with demand side constraints. Except for the age variables these patterns are similar for men and women.

The demand side variables in the wage equation show that there is a wage pre-

Table 5.2: Estimation results: wage equation, men

	Uncon. Model coeff.	[s.e.]	**Con. Model** coeff.	[s.e.]	**Con. Model Het.** coeff.	[s.e.]
Productivity variables						
Age	0.014***	[0.003]	0.007**	[0.003]	0.009***	[0.002]
Years of schooling	0.054***	[0.011]	0.061***	[0.011]	0.060***	[0.011]
Primary/secondary school cert.	-0.001	[0.043]	0.009	[0.042]	0.006	[0.043]
Higher school certificate	0.117**	[0.054]	0.114**	[0.052]	0.110**	[0.053]
Vocational education	-0.079	[0.052]	-0.099*	[0.051]	-0.102*	[0.053]
Tertiary education	0.034	[0.098]	0.006	[0.096]	0.007	[0.100]
Years of experience	-0.021**	[0.010]	-0.013	[0.009]	-0.012	[0.009]
Years of experience^2/100	0.007	[0.021]	-0.002	[0.020]	-0.009	[0.021]
Tenure	0.010***	[0.002]	0.014***	[0.002]	0.017***	[0.002]
Tenure^2/100	-0.009*	[0.005]	-0.018***	[0.005]	-0.022***	[0.005]
Depreciation of human capital	-0.177***	[0.012]	-0.249***	[0.011]	-0.280***	[0.011]
Years full time experience	0.026***	[0.008]	0.025***	[0.008]	0.023***	[0.008]
Years full time experience^2/100	-0.040**	[0.020]	-0.038**	[0.019]	-0.032	[0.020]
Labor demand variables						
German nationality	0.072***	[0.025]	0.078***	[0.025]	0.080***	[0.025]
Civil servant	-0.028***	[0.007]	-0.028***	[0.007]	-0.029***	[0.007]
Firm size: 1-4	-0.186***	[0.025]	-0.173***	[0.025]	-0.173***	[0.025]
Firm size: 5-19	-0.063***	[0.006]	-0.054***	[0.006]	-0.052***	[0.007]
Firm size: 20-199	0.025**	[0.010]	0.019*	[0.010]	0.017	[0.010]
Industry: Engineering, electronics	0.037***	[0.012]	0.031***	[0.012]	0.029**	[0.012]
Industry: Mining and energy	0.091**	[0.037]	0.088**	[0.037]	0.082**	[0.038]
Industry: Chemical, wood, paper	0.023	[0.021]	0.012	[0.021]	0.008	[0.022]
Industry: Clay, stones, construction	0.025	[0.018]	0.039**	[0.018]	0.034*	[0.018]
Industry: Iron, steel, heavy industry	0.021	[0.020]	0.010	[0.020]	0.007	[0.020]
Industry: Clothes	0.095	[0.073]	0.096	[0.074]	0.104	[0.076]
Industry: Wholesale trade	-0.063***	[0.018]	-0.072***	[0.018]	-0.069***	[0.018]
Industry: Train, post, communic.	-0.102***	[0.020]	-0.091***	[0.020]	-0.083***	[0.020]
Industry: Public services	-0.011	[0.011]	-0.009	[0.012]	-0.008	[0.012]
Industry: Private services	0.076***	[0.018]	0.080***	[0.018]	0.079***	[0.018]
Industry: Others	-0.028	[0.021]	-0.020	[0.021]	-0.014	[0.021]
Schleswig-Holstein and Hamburg	0.124***	[0.040]	0.135***	[0.040]	0.139***	[0.040]
Lower Saxony and Bremen	0.109***	[0.035]	0.103***	[0.035]	0.110***	[0.035]
North Rhine-Westphalia	0.120***	[0.033]	0.121***	[0.032]	0.122***	[0.033]
Hesse	0.155***	[0.036]	0.152***	[0.036]	0.155***	[0.037]
Rhineland-Palatinate and Saarland	0.154***	[0.038]	0.136***	[0.038]	0.147***	[0.038]
Baden-Württemberg	0.180***	[0.034]	0.173***	[0.034]	0.179***	[0.034]
Bavaria	0.137***	[0.033]	0.128***	[0.033]	0.133***	[0.033]
Mecklenburg-Western Pomerania	-0.065	[0.046]	-0.043	[0.047]	-0.037	[0.047]
Brandenburg	-0.043	[0.041]	-0.056	[0.041]	-0.046	[0.041]
Saxony-Anhalt	-0.108***	[0.040]	-0.117***	[0.041]	-0.118***	[0.041]
Thuringia	-0.166***	[0.040]	-0.181***	[0.040]	-0.172***	[0.041]
Saxony	-0.149***	[0.036]	-0.153***	[0.036]	-0.145***	[0.036]
Mills ratio	-0.081	[0.060]	0.061	[0.053]		
Constant	0.311***	[0.004]	1.505***	[0.110]	1.445***	[0.114]
Observations	3,443		3,858		3,858	
Log-likelihood	-860		-4,763		-4,718	

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

mium for German employees. Male civil servants earn on average less, female civil servants significantly more than all other employees. People working in small firms have lower hourly wages compared to those in larger firms. There are also differences in pay between sectors, e.g. wages in (automotive) engineering, mining and energy or private services are significantly higher for men, than in wholesale trade or in transport or communication services; agriculture and forestry form the baseline category. Sectoral differences are less pronounced for women. Female employees in public servives earn significantly higher wages compared to other sectors. Moreover, there is a substantial difference in average wages between West and East German federal states.

Table 5.3: Estimation results: wage equation, women

	Uncon. Model		**Con. Model**		**Con. Model Het.**	
	coeff.	[s.e.]	coeff.	[s.e.]	coeff.	[s.e.]
Productivity variables						
Age	-0.002	[0.002]	0.003*	[0.001]	-0.004***	[0.001]
Years of schooling	0.069***	[0.011]	0.065***	[0.011]	0.076***	[0.011]
Primary/secondary school cert.	0.034	[0.041]	-0.003	[0.034]	0.022	[0.036]
Higher school certificate	0.117**	[0.053]	0.074	[0.048]	0.114**	[0.050]
Vocational education	-0.062	[0.053]	-0.080**	[0.049]	-0.064	[0.051]
Tertiary education	0.017	[0.100]	-0.030	[0.095]	-0.025	[0.099]
Years of experience	-0.001	[0.005]	-0.018***	[0.004]	0.002	[0.004]
Years of experience^2/100	-0.006	[0.010]	0.008	[0.009]	-0.021***	[0.008]
Tenure	0.022***	[0.002]	0.050***	[0.002]	0.047***	[0.002]
Tenure^2/100	-0.034***	[0.006]	-0.094***	[0.006]	-0.087***	[0.006]
Depreciation of human capital	-0.033***	[0.008]	-0.129***	[0.006]	-0.143***	[0.007]
Years full time experience	0.019***	[0.003]	0.023***	[0.003]	0.016***	[0.003]
Years full time experience^2/100	-0.031***	[0.009]	-0.041***	[0.008]	-0.026***	[0.008]
Labor demand variables						
German nationality	0.110***	[0.028]	0.098***	[0.025]	0.111***	[0.026]
Civil servant	0.025***	[0.008]	0.032***	[0.009]	0.028***	[0.008]
Firm size: 1-4	-0.211***	[0.018]	-0.154***	[0.019]	-0.138***	[0.018]
Firm size: 5-19	-0.035***	[0.006]	-0.026***	[0.007]	-0.026***	[0.006]
Firm size: 20-199	0.071***	[0.012]	0.051***	[0.013]	0.050***	[0.012]
Industry: Engineering, electronics	0.018	[0.022]	0.008	[0.024]	0.003	[0.023]
Industry: Mining and energy	0.145*	[0.080]	0.134	[0.086]	0.133	[0.083]
Industry: Chemical, wood, paper	-0.021	[0.031]	-0.030	[0.034]	-0.035	[0.032]
Industry: Clay, stones, construction	0.027	[0.046]	0.040	[0.049]	0.038	[0.047]
Industry: Iron, steel, heavy industry	0.081*	[0.047]	0.066	[0.051]	0.062	[0.049]
Industry: Clothes	-0.099	[0.080]	-0.044	[0.086]	-0.030	[0.082]
Industry: Wholesale trade	-0.101***	[0.014]	-0.090***	[0.016]	-0.089***	[0.015]
Industry: Train, post, communic.	-0.017	[0.034]	-0.033	[0.037]	-0.034	[0.036]
Industry: Public services	0.046***	[0.007]	0.038***	[0.008]	0.039***	[0.007]
Industry: Private services	0.007	[0.016]	0.020	[0.017]	0.016	[0.016]
Industry: Others	-0.085***	[0.022]	-0.067***	[0.024]	-0.053**	[0.022]
Schleswig-Holstein and Hamburg	0.136***	[0.042]	0.134***	[0.041]	0.160***	[0.041]
Lower Saxony and Bremen	0.095***	[0.036]	0.083**	[0.035]	0.105***	[0.035]
North Rhine-Westphalia	0.137***	[0.033]	0.118***	[0.032]	0.128***	[0.032]
Hesse	0.151***	[0.037]	0.126***	[0.036]	0.139***	[0.036]
Rhineland-Palatinate and Saarland	0.095**	[0.038]	0.093**	[0.037]	0.124***	[0.037]
Baden-Württemberg	0.177***	[0.035]	0.144***	[0.034]	0.161***	[0.034]
Bavaria	0.137***	[0.034]	0.111***	[0.033]	0.141***	[0.033]
Mecklenburg-Western Pomerania	-0.041	[0.048]	-0.071	[0.046]	-0.082*	[0.046]
Brandenburg	-0.008	[0.042]	-0.023	[0.040]	-0.052	[0.040]
Saxony-Anhalt	-0.064	[0.042]	-0.083**	[0.041]	-0.106***	[0.041]
Thuringia	-0.105**	[0.042]	-0.110***	[0.041]	-0.129***	[0.041]
Saxony	-0.090**	[0.037]	-0.113***	[0.036]	-0.125***	[0.036]
Mills ratio	0.027	[0.037]	-0.159***	[0.025]		
Constant	1.297***	[0.116]	1.303***	[0.109]	1.202***	[0.113]
Observations	3,533		4,514		4,514	
Log-likelihood	-1,264		-8,553		-8,666	

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

In the *rationing equation* we see that the variable relating an individual's productivity to institutional wage constrains at the lower end of the distribution is strongly and significantly related to the risk of rationing (Tables 5.4, 5.5). A higher productivity reduces the rationing probability, whereas the effect of institutional constraints at the lower end of the wage distribution goes in the opposite direction. For men the magnitude of the coefficient is higher in the constrained models and particularly large for the model with unobserved heterogeneity. Since the estimates for the observed determinants of productivity are (except from human capital depreciation) rather similar between the specifications, unobserved differences seem to play a larger role her. For women the are no large differences between the specifications for this variable.

Table 5.4: Estimation results: rationing equation, men

	Uncon. Model		**Con. Model**		**Con. Model Het.**	
	coeff.	[s.e.]	coeff.	[s.e.]	coeff.	[s.e.]
Productivity–minimum wage	-1.251***	[0.121]	-1.405***	[0.107]	-2.062***	[0.171]
Discrimination variables						
Dummy single	0.401***	[0.090]	0.389***	[0.094]	0.408***	[0.110]
Dummy German nationality	-0.267*	[0.138]	-0.217	[0.144]	-0.250	[0.172]
Dummy children < 3 years	0.156	[0.136]	0.192	[0.140]	0.261	[0.160]
Labor demand variables						
Occ.: Armed forces	-0.534	[0.520]	-0.401	[0.541]	-0.207	[0.645]
Occ.: Managers	-1.584***	[0.350]	-1.481***	[0.360]	-1.010**	[0.424]
Occ.: Professionals	-1.125***	[0.175]	-1.031***	[0.181]	-0.690***	[0.222]
Occ.: Technicians	-1.103***	[0.158]	-1.013***	[0.163]	-0.749***	[0.194]
Occ.: Clerical support workers	-0.789***	[0.178]	-0.713***	[0.184]	-0.621***	[0.216]
Occ.: Service & sales workers	-0.828***	[0.210]	-0.766***	[0.219]	-0.768***	[0.258]
Occ.: Agricultural, forestry	-0.100	[0.320]	-0.111	[0.336]	0.101	[0.396]
Occ.: Craft & related trades	-0.543***	[0.114]	-0.500***	[0.118]	-0.360***	[0.136]
Occ.: Plant & machine operators	-0.888***	[0.146]	-0.852***	[0.153]	-1.012***	[0.183]
Regional unemployment rate	0.101***	[0.021]	0.102***	[0.021]	0.126***	[0.026]
Regional employment rate	0.040**	[0.020]	0.047**	[0.021]	0.064**	[0.026]
Regional part time share	0.049	[0.030]	0.051	[0.031]	0.046	[0.037]
Regional BIP	0.006	[0.008]	0.006	[0.008]	0.011	[0.010]
Constant	-4.443**	[1.744]	-7.139***	[1.856]	-9.445***	[2.272]
Observations	3,625		3,858			
Log-likelihood	-628		-4,739			

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error, Occ.=occupation.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

All covariates indicating possible individual constraints or discrimination on the labor market are highly significant for women: Germans face a lower rationing risk compared to foreigners; singles as well as women with small children have a higher probability of being constrained. For men only the effect for singles is statistically significant.

The demand side variables in the rationing equation show that the rationing risk varies significantly among different occupations: for male employees managers, professionals, and technicians have the lowest rationing risks (elementary occupations serve as the baseline category). The same holds for female technicians. Managers and professionals are part of the baseline catgeory here because there are very few cases. The regional unemployment rate as an indicator for the tightness of the local labor market is strongly and positively related to the risk of being involuntarily unemployed (somewhat lesser for women than for men). This holds – although to a much lesser degree – for the employment rate as a further indicator characterizing the local labor market. Conditional on the other covariates neither the regional BIP per capita, nor the share of part time employment is significantly related to the rationing risk. The coefficients of the demand side variables are similar between the different specifications of the model.

Table 5.5: Estimation results: rationing equation, women

	Uncon. Model		**Con. Model**		**Con. Model Het.**	
	coeff.	[s.e.]	coeff.	[s.e.]	coeff.	[s.e.]
Productivity–minimum wage	-1.554***	[0.135]	-1.810***	[0.120]	-1.554***	[0.098]
Discrimination variables						
Dummy single	0.363***	[0.079]	0.349***	[0.087]	0.356***	[0.089]
Dummy German nationality	-0.454***	[0.135]	-0.484***	[0.146]	-0.480***	[0.154]
Dummy children < 3 years	0.456***	[0.151]	0.440***	[0.161]	0.487***	[0.164]
Labor demand variables						
Occ.: Technicians	-0.704***	[0.118]	-0.808***	[0.131]	-0.763***	[0.136]
Occ.: Clerical support workers	-0.316***	[0.121]	-0.416***	[0.133]	-0.461***	[0.137]
Occ.: Service & sales workers	-0.537***	[0.123]	-0.715***	[0.135]	-0.768***	[0.137]
Occ.: Agricultural, forestry	0.066	[0.333]	-0.197	[0.364]	-0.117	[0.349]
Occ.: Craft & related trades	0.164	[0.163]	-0.051	[0.181]	-0.076	[0.181]
Occ.: Plant & machine operators	-0.046	[0.207]	-0.200	[0.227]	-0.441*	[0.238]
Occ.: Elementary	-0.387***	[0.144]	-0.569***	[0.157]	-0.627***	[0.157]
Regional unemployment rate	0.072***	[0.013]	0.076***	[0.014]	0.082***	[0.015]
Regional employment rate	0.017*	[0.010]	0.022**	[0.011]	0.023**	[0.011]
Regional part time share	-0.047*	[0.026]	-0.048*	[0.029]	-0.048	[0.030]
Regional BIP	-0.008	[0.007]	-0.008	[0.008]	-0.005	[0.008]
Constant	-0.965	[0.835]	-3.533***	[0.961]	-3.374***	[0.975]
Observations	3,738		4,514		4,514	
Log-likelihood	-649		-8,553		-8,666	

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error, Occ.=occupation.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

The estimates of the *labor supply* models are presented in Tables 5.6 and 5.7. In the unconstrained as well as the constrained models the great majority of households fulfills monotonicity and concavity of the utility function with respect to the choice variables. Utility increases with the disposable household income for virtually all households (see the bottom part of Tables 5.6 and 5.7) which is the minimum requirement for the consistency of the policy simulations below. According to the derivatives with respect to leisure, for a limited proportion of the population positive monotonicity in leisure is not respected. Euwals and van Soest (1999) show that it is not necessary to restrict preferences relative to the taste for leisure.

Table 5.6: Estimation results: labor supply model, men

	Uncon. Model		**Con. Model**		**Con. Model Het.**	
	coeff.	[s.e.]	coeff.	[s.e.]	coeff.	[s.e.]
Consumption						
Linear term	-0.300	[2.938]	-27.186***	[4.082]	5.456	[3.968]
Quadratic term	0.289***	[0.072]	1.568***	[0.158]	0.618***	[0.113]
x Age	0.120	[0.110]	0.176	[0.151]	-0.250	[0.159]
x Age squared	-0.138	[0.119]	-0.186	[0.164]	0.302*	[0.175]
x Single	0.294	[0.400]	0.864	[0.546]	0.793	[0.593]
x Leisure	-1.122***	[0.225]	0.338***	[0.037]	-1.501***	[0.273]
Leisure						
Linear term	49.388***	[4.213]	51.678***	[3.001]	90.089***	[5.217]
Quadratic term	-4.641***	[0.291]	-5.868***	[0.305]	-9.112***	[0.434]
x Age	-0.210**	[0.101]	-0.421***	[0.080]	-0.399***	[0.101]
x Age squared	0.301***	[0.111]	0.547***	[0.088]	0.546***	[0.111]
x East	0.111	[0.153]	0.163	[0.187]	-0.788***	[0.221]
x German	-1.004***	[0.235]	-1.475***	[0.306]	-0.523	[0.337]
x Handicapped	1.450***	[0.374]	1.584***	[0.457]	1.897***	[0.538]
x Child <= 3 years	0.185	[0.268]	1.201***	[0.351]	0.050	[0.363]
x Child 3-6 years	0.512**	[0.237]	0.579**	[0.295]	0.716**	[0.325]
x Single	0.664	[0.429]	1.812***	[0.290]	0.589	[0.462]
x Single x child < 3 years	0.567	[0.845]	-0.938	[1.205]	-0.151	[1.226]
Costs part time work	2.576***	[0.131]	2.514***	[0.145]	1.729***	[0.152]
Rho (unobs. het. x inact.)					-0.470	[0.406]
Observations	3,877		3,858		3,858	
Wald chi2	2.26		3.65		5.70	
Log-likelihood	-3,847		-4,763		-4,718	
Positive 1st Derivates (in %)						
U_c (consumption)	100.0		97.8		100.0	
U_l (leisure)	87.0		92.2		92.1	

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

The marginal utility of income and leisure varies with individual- and household-specific variables. Except for the age variables taste-shifters for the consumption of household income do not exhibit significant observable heterogeneity in preferences among men. There are more significant differences for women, particularly in the unconstrained model. The preference for leisure among men is higher for singles, households with children and people with a handicap. The effects of children are even more pronounced for women which calls to mind that time spent in childcare (as in other household activities) is captured as a preference for leisure in our model. The age variables display a significant nonlinear pattern with respect to the preferences for leisure for men and women. The choice-specific dummy variable which – specified as costs of childcare – has the expected positive sign and is statistically significant throughout all specifications. Given the other covariates men indeed seem to dislike working reduced hours. For men the relationship between the unobserved productivity component and inactivity is negative, but not statistically different from zero. For women the sign is reversed and highly significant.

Table 5.7: Estimation results: labor supply model, women

	Uncon. Model		**Con. Model**		**Con. Model Het.**	
	coeff.	[s.e.]	coeff.	[s.e.]	coeff.	[s.e.]
Consumption						
Linear term	-18.092***	[2.978]	4.999	[4.016]	6.466**	[3.075]
Quadratic term	0.398***	[0.054]	0.318*	[0.167]	0.215*	[0.125]
x Age	0.715***	[0.118]	-0.072	[0.133]	-0.151	[0.108]
x Age squared	-0.828***	[0.130]	0.058	[0.149]	0.177	[0.120]
x Single	0.881**	[0.378]	-1.017**	[0.424]	-0.758**	[0.337]
x Leisure	0.035	[0.163]	-0.186	[0.217]	-0.224	[0.187]
Leisure						
Linear term	3.088	[3.261]	56.743***	[3.731]	57.387***	[3.494]
Quadratic term	-1.497***	[0.259]	-6.804***	[0.314]	-6.923***	[0.316]
x Age	0.439***	[0.094]	-0.046	[0.091]	-0.062	[0.080]
x Age squared	-0.410***	[0.105]	0.172*	[0.102]	0.200**	[0.090]
x East	-1.419***	[0.142]	-2.490***	[0.174]	-2.400***	[0.170]
x German	-0.923***	[0.261]	0.312	[0.301]	0.244	[0.293]
x Handicapped	0.288	[0.277]	0.362	[0.338]	0.365	[0.330]
x Child <= 3 years	4.533***	[0.355]	4.039***	[0.395]	4.382***	[0.372]
x Child 3-6 years	2.155***	[0.228]	2.344***	[0.265]	2.127***	[0.252]
x Single	0.382	[0.345]	-0.331	[0.326]	-0.432	[0.286]
x Single x child < 3 years	0.534	[0.774]	-0.170	[0.770]	0.485	[0.762]
Rho (unobs. het. x inact.)					2.392***	[0.174]
Observations	4,514		4,514		4,514	
Wald chi2	47.11		6.93		8.32	
Log-likelihood	7,552		-8,553		-8,666	
Positive 1st Derivates (in %)						
U_c (consumption)	99.4		100.0		100.0	
U_l (leisure)	91.4		74.3		74.3	

Notes: Uncon. Model=unconstrained model, Con. Model=constrained model, Con. Model Het.=constrained model with unobserved heterogeneity (joint estimation), coeff.=regression coefficient, s.e.=standard error.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

The model fit is adequate and comparable to previous estimations with similar data. In most model specifications, particularly for women, the category of non-working individuals is a bit underpredicted. As mentioned above for women we include a category-specific dummy for the part time choice. Without this dummy, this category would be underpredicted. There is a trade-off between fitting the data and over-parameterizing the model, i.e. specifying more choice-specific dummies.

5.5.2 Elasticities

Wage elasticities cannot be derived directly from the parameter estimates of the discrete choice model. We numerically simulate the labor supply elasticities on the basis of the structural parameters. The probabilities for the different choice categories are first simulated for the status quo wages and disposable incomes. Then wages are increased by one percent for each employee (including the shadow wages for currently non-employed individuals). The disposable incomes are then re-simulated and the choice probabilities are predicted with these counterfactual incomes. Then we calculate the difference between both scenarios for the expected participation rate in percentage points and for the difference in expected working hours in percent. We report the results separately for workers in West and East Germany.

As we are interested in the labor supply elasticities, i.e. the behavioral response of a worker to an (exogenous) wage increase, we look at changes in desired and not realized hours. This means that we only consider labor supply reactions irrespective of rationing probabilities. We use the whole continuum of potential workers including voluntarily inactive, involuntarily unemployed and employed people. This distinction does not apply to the unconstrained model as observed are assumed to coincide with desired working hours.

For the unconstrained model participation elasticities[115] of East and West German *men* are about 0.15 which means that raising gross wages by 1% will increase the participation rate by about 0.15 percentage points (Table 5.8). The hours elasticity for West German men is 0.22 and 0.26 for men in East Germany. These values are in the ballpark of the empirical literature (Blundell and Macurdy, 1999) and confirm previous findings with a similar model and the same data set for previous years (Haan and Steiner, 2005a; Steiner and Wrohlich, 2005; Bargain et al., 2010).

As discussed at the outset the omission of demand side constraints in labor supply estimation will bias elasticities for several reasons. Participation bias results from falsely depicting rationed individuals as voluntarily inactive. Preference bias follows from overstating the value of leisure in the unconstrained model by characterizing

[115]In technical terms this is not an elasticity, but the participtation change in percentage points.

Table 5.8: Labor supply elasticities

	Men			
	East		West	
Percentage point change participation rate				
Unconstrained model	0.16	[0.13,0.19]	0.14	[0.12,0.16]
Constrained model	0.08	[0.06,0.10]	0.08	[0.07,0.09]
Constrained model with heterogeneity	0.05	[0.03,0.07]	0.05	[0.03,0.07]
Percent change hours				
Unconstrained model	0.26	[0.20,0.31]	0.22	[0.19,0.26]
Constrained model	0.16	[0.13,0.19]	0.17	[0.14,0.19]
Constrained model with heterogeneity	0.13	[0.09,0.16]	0.14	[0.11,0.17]
	Women			
	East		**West**	
Percentage point change participation rate				
Unconstrained model	0.06	[0.04,0.07]	0.06	[0.04,0.08]
Constrained model	0.03	[0.02,0.04]	0.06	[0.04,0.07]
Constrained model with heterogeneity	0.02	[0.01,0.03]	0.04	[0.02,0.06]
Percent change hours				
Unconstrained model	0.30	[0.23,0.36]	0.33	[0.23,0.44]
Constrained model	0.31	[0.24,0.37]	0.47	[0.27,0.68]
Constrained model with heterogeneity	0.30	[0.19,0.40]	0.38	[0.10,0.59]

Notes: PP change part. rate=change of participation rate in percentage points, Pct. change hours=change in working hours in percent, Unconstrained=unconstrained model, Constrained=constrained model, Constrained with heterogeneity=constrained model with unobserved heterogeneity (joint estimation), Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

involuntarily unemployed as inactive. There might also be specification bias in the unconstrained model. The first two biases go into opposite directions and the third one is a priori indeterminate. The simulated participation elasticities show that an upward participation bias indeed exists. The participation elasticities for the model with demand side constraints are reduced by half to 0.08 for West and East German men compared to the unconstrained model. They are further diminished to 0.05 when unobserved heterogeneity is taken into account (Table 5.8). The differences in the hours elasticities are smaller; the model with rationing yields elasticities of 0.17 (0.16) without and 0.14 (0.13) with unobserved heterogeneity for West (East) German men. The participation bias dominates dominates overall, since the hours elasticities (incorporating the extensive and intensive margin) are smaller in the constrained models. Yet, the participation bias also seems to play a role because the differences between the unconstrained and constrained models are smaller than for the participation elasticities.

There are several differences in the elasticities for *women*. First, their magnitude is smaller for participation (0.06 in the unconstrained model) and larger for total hours worked (about 0.3) in all model specifications compared to men (Table 5.8). The magnitude of the elasticities is slightly larger in West compared to East Germany. The discrepancies between men and women are known from previous research. Regarding the differences across the model specifications, we again find the participation bias to be relevant. The participation elasticities for women go down in the models with labor demand constraints. On the other hand hours elasticities for East German women remain largely unchanged and become even larger for West German women in the constrained estimations. The upward-going preference bias seems to have a larger relative weight than for men and offsets the participation bias (leaving aside potential specification bias).

5.6 Policy simulations

Based on the parameters of our structural model we are able to carry out several ex ante simulations for different policy measures. Section 5.6.1 considers the implementation of a federal minimum wage of 7.50 € in Germany. We will compare the predictions of the unconstrained and the constrained model concerning the consequences for employment. Section 5.6.2 compares the consequences of employee- and employer-oriented wage subsidies for employment when a federal minimum wage is already in place. We also discuss the differences between the outcomes of the unconstrained and the constrained model.

5.6.1 Employment effects of a federal minimum wage

In this sub-section we simulate the employment effects a federal minimum wage of 7.50 € would have induced when it had been introduced in 2010. We compare this counterfactual scenario with the observed situation in 2010 without a federal, but several sectoral minima. We follow Müller and Steiner (2010) and simulate a counterfactual wage distribution under a federal minimum wage by setting all hourly wages below the minimum to 7.50 €. This means that all employees that previously earned sub-minimum wages are assumed to be paid exactly the minimum wage. Moreover, spillover effects are ruled out meaning that the wage distribution above the minimum wage would by assumption not be affected.[116]

How is the introduction of a federal minimum wage reflected in the different specifications of the structural labor supply model? In both versions of the model hourly wages become $w_i^{MW} = max(w_i, 7.50)$; this holds for observed wages of employed people and also for the predicted wage rates $\hat{w}_i^{MW}$ of non-working individuals. Through the tax and transfer function $R(.)$ the disposable household income y_{ij}^{MW} will also be adjusted with marginal tax rates on the additional labor income depending on the individual's working hours and the household context. The amount of additional household income determines the labor supply incentives of this reform for a specific individual. The increase in net household income is markedly smaller than the nominal changes in gross labor earnings as marginal tax rates can be very high when, e.g., welfare transfers are substituted (Müller and Steiner, 2009).

On the other hand, the institutionally fixed lower bound for wages puts a strain on companies' wage costs. Firms may not be willing to employ a person whose productivity does not match the wage costs. When an individual is bound by the wage threshold, his rationing risk is also affected. This side of the labor market is not reflected in the unconstrained labor supply model where it is assumed that the additional labor supply induced by the minimum wage policy equals the rise in realized employment. In the extended model with demand side rationing such wage rigidities are captured in the equation for the latent risk of involuntary unemployment. An individual's productivity p_i^* is related to lower wage thresholds mw_i determined by, e.g., collective bargaining agreements or sectoral minima, that apply to the respective person. In the scenario with a federal minimum this variable becomes $mw_i^{MW} = 7.5$ $\forall\ mw_i < 7.5$. For all individuals with thresholds below the statutory minimum wage, mw_i^{MW} is set to this level. According to the estimates (Tables 5.4 and 5.5 above) this will increase the rationing probability. The total employment effect will thus depend on the increase in labor supply incentives and the adjustment of labor demand estimated in the rationing equation.

[116] The gross hourly wage is calculated by dividing reported earnings in the month before the interview by the number of hours worked in that month; paid overtime hours are included in this measure. See Müller and Steiner (2010) for a detailed discussion.

Our model does not feature equilibrium wage effects. When supply and demand shift after a legal minimum wage is introduced and the equilibrium wage distribution adjusts, these 'second round' wage changes are not captured in our policy simulation. We rely on the nominal changes in wages and labor costs. Based on these assumptions we calculate the expected change in labor supply – as well as adjusted rationing probabilities in the constrained model – under the observed and the counterfactual distributions in wages and wage constraints. The resulting differences in employment and rationing are reported in Table 5.9.

The results from the unconstrained model show that a federal minimum wage of 7.50 € would increase labor supply. As shown elsewhere (Müller and Steiner, 2010), the magnitude is limited due to high marginal tax rates of minimum wage earners. For men the participation rate would increase by 0.2 (0.8) percentage points in West (East) Germany which amounts to about 23,000 (22,000) additional male employees represented by our sample (Table 5.9). Working hours would on average increase by about 0.4% for men in the West and 1.6% in the East corresponding to about 23,000 and 22,000 full time equivalents in total. For women in West (East) Germany the participation would rise by 1.1 (0.5) percentage points amounting to 140,000 (13,000) additional employees. Working hours would increase by 3.6% (165,000 full time equivalents) for women in West and by 0.4% (29,000 full time equivalents) in East Germany. For the interpretation of these effects one has to keep in mind that they are conditional on the fixed labor supply of the spouse. This is particularly relevant for women and explains the differences to previous findings which were a bit smaller for women (Müller and Steiner, 2010).

The unconstrained model disregards the increase in labor costs induced by a federal minimum wage. The model with demand side rationing entails this margin in the calculation of the expected employment change due to a statutory minimum wage. In addition to the labor supply incentives, the individual rationing risk is also affected. As shown in Table 5.9 the rationing probability for men increases by 0.6 percentage points in West Germany and by 2.5-2.8 percentage points in the East. Since nominal wage increases because of the minimum are markedly higher, firms in

Table 5.9: Employment effects: MW=7.50 €

	Men											
	East						West					
	Unconstrained		Constrained		Constr. Het.		Unconstrained		Constrained		Constr. Het.	
Employment												
Participation												
Pp. change participation rate	0.8	[0.5,1.1]	-2.0	[-2.7,-1.2]	-2.4	[-3.3,-1.6]	0.2	[0.1,0.3]	-0.4	[-0.6,-0.2]	-0.5	[-0.8,-0.3]
Change employment in 1000	22	[15,28]	-53	[-75,-33]	-63	[-91,-41]	23	[14,33]	-51	[-78,-25]	-58	[-94,-31]
Working hours												
Change hours	0.4	[0.2,0.5]	-0.4	[-0.7,-0.1]	-0.5	[-0.9,-0.1]	0.1	[0.0,0.1]	-0.1	[-0.2,0.0]	-0.1	[-0.2,0.0]
Pct. change hours	1.6	[1.0,2.3]	-1.2	[-2.5,0.1]	-1.7	[-3.2,-0.2]	0.4	[0.2,0.5]	0.0	[-0.4,0.4]	0.0	[-0.4,0.6]
Change hours 1000 fte.	22	[15,29]	-23	[-40,-5]	-29	[-56,-5]	23	[14,33]	-19	[-41,4]	-18	[-46,10]
Rationing												
Whole population												
Rationing probability SQ			12.5	[9.7,15.3]	11.1	[8.5,13.9]			7.3	[6.0,8.6]	7.3	[6.2,8.5]
Rationing probability MW			15.0	[11.8,18.1]	13.8	[10.7,17.3]			7.9	[6.5,9.2]	7.9	[6.5,9.1]
Pp. change rationing probability			2.5	[2.1,2.9]	2.8	[2.1,3.4]			0.6	[0.5,0.6]	0.6	[0.3,0.6]
Active on labor market												
Rationing probability SQ			9.8	[7.7,11.9]	8.1	[6.1,10.3]			5.5	[4.6,6.5]	5.1	[4.2,6.0]
Rationing probability MW			11.9	[9.3,14.5]	10.3	[8.1,13.4]			6.0	[5.0,7.1]	5.6	[4.7,6.6]
Pp. change rationing probability			2.1	[1.6,2.6]	2.3	[1.9,3.1]			0.5	[0.4,0.5]	0.5	[0.5,0.6]

	Women											
	East						West					
	Unconstrained		Constrained		Constr. Het.		Unconstrained		Constrained		Constr. Het.	
Employment												
Participation												
Pp. change participation rate	0.5	[0.3,0.7]	-6.5	[-8.0,-5.1]	-7.8	[-9.6,-6.3]	1.1	[0.8,1.3]	-1.1	[-1.3,-0.8]	-1.1	[-1.4,-0.8]
Change employment in 1000	13	[9,17]	-178	[-225,-135]	-207	[-265,-161]	138	[111,164]	-133	[-172,-95]	-132	[-177,-97]
Working hours												
Change hours	0.4	[0.3,0.5]	-0.8	[-1.2,-0.4]	-0.8	[-1.2,-0.4]	0.5	[0.4,0.6]	0.0	[-0.1,0.1]	0.3	[-1.0,1.6]
Pct. change hours	2.0	[1.3,2.7]	-3.1	[-5.0,-1.1]	-3.3	[-5.2,-1.7]	3.6	[2.8,4.4]	0.3	[-0.1,0.7]	1.5	[0.7,2.5]
Change hours 1000 fte.	29	[20,38]	-61	[-91,-32]	-55	[-87,-27]	165	[135,195]	6	[-19,31]	85	[56,107]
Rationing												
Whole population												
Rationing probability SQ			13.6	[10.7,16.5]	12.3	[9.6,15.3]			8.3	[6.9,9.6]	8.1	[6.9,9.4]
Rationing probability MW			20.7	[16.7,24.6]	20.5	[16.2,25.1]			9.7	[8.1,11.2]	9.6	[8.0,10.9]
Pp. change rationing probability			7.0	[6.0,8.1]	8.2	[6.5,9.9]			1.4	[1.2,1.6]	1.4	[0.8,1.5]
Active on labor market												
Rationing probability SQ			10.4	[7.9,12.9]	8.1	[5.9,10.6]			4.7	[3.9,5.6]	3.3	[2.7,3.9]
Rationing probability MW			15.4	[12.0,18.8]	13.4	[10.4,17.3]			5.8	[4.8,6.7]	4.2	[3.5,4.8]
Pp. change rationing probability			5.0	[4.1,5.9]	5.2	[4.6,6.7]			1.0	[0.9,1.2]	0.8	[0.8,1.0]

Notes: Unconstr.=unconstrained model, Constr.=constrained model, Constr. Het.=constrained model with unobserved heterogeneity (joint estimation), SQ=status quo, MW=minimum wage, pp.=percentage points, pct.=percent, Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

East Germany are hit harder by this reform and would decrease their labor demand more strongly. For the same reason the magnitude of the effects is substantially larger for women. The rationing probability would rise by about 1.4 percentage points in West and 7-8 percentage points (depending on the specification) in East Germany. Note that all those changes refer to the rationing probability of the whole sample. The effects are smaller for people that are active on the labor market, i.e. employees and individuals looking for work. Currently inactive persons face on average a higher risk of not finding job, as their productivity is estimated to be lower compared to people attached to the labor market (Table 5.9).

Taking the change in rationing probabilities into account, the net effect on participation becomes negative for men and women. Depending on the specification male participation rates would decrease by about 0.4-0.5 (2.0-2.4) percentage points which in total equals about 51-58,000 (53-63,000) employees for West (East) Germany represented in our estimation sample. The effects are larger for women where participation would be reduced by 1.0% (6.5-7.8%) in the West (East) equaling an employment loss of 133,000 (178,000-207,000) employees. Interestingly, the change in the volume of employment is significantly smaller. Measured in full time equivalents male employment would be reduced by about 20,000 (23-29,000) in West (East) Germany. For women the effects vary with the specifications; in West Germany total employment would be zero or even positive (85,000 full time equivalents) and in East Germany the loss is estimated at 55-61,000 full time equivalents. Getting at the total employment effects could not be done in previous papers as they either focused on supply or demand. Jobs that would be lost following the introduction of a minimum wage do often not involve full time contracts. On the other hand people are to some degree incentivized by the minimum wage to extend their working hours. For women in West Germany this increase in working hours compensates the losses in jobs. Again, it has to be kept in mind that the effects for individuals living in couple households are estimated conditional on the employment of their spouse.

In order to compare the results to previous simulations, several factors have to be considered. First, this model combines supply and demand effects whereas most simulation studies are confined to labor demand adjustments (Müller and Steiner, 2008b; Müller, 2009b). Müller and Steiner (2010) consider supply and demand effects, but do not link them in a systematic way. Our approach facilitates a joint analysis of supply and demand adjustments yielding net employment effects. Second, we lose observations that do not provide sufficient information to put them into the different labor market states of the extended model.[117] We report the findings for the estimation sample (see sub-section 5.4.3). Given these qualifications the findings are within the range of previous simulations (Müller and Steiner, 2008b; Müller, 2009b; Müller and Steiner, 2010) and predict relatively moderate employment reductions following a federal minimum wage.

The comparison of the different model specifications shows that a labor supply model with demand side constraints is suited for policy simulations in cases where not only labor supply incentives are affected, but labor costs are directly influenced. Under these circumstances a pure labor supply model will not provide policy relevant results as estimated labor supply adjustments are not informative about employment changes. The extended model is also able to shed light on different margins of employment. According to the estimates, the total number of employed would be reduced, but this loss would be partially compensated by increased working hours of people remaining employed. While people with low individual productivity are in danger of losing their job, other, more productive persons who earned low hourly wages without the minimum will benefit from such a reform. Such substitution mechanisms have been found to be relevant (Ahn et al., 2011).

5.6.2 Minimum wage and wage subsidies

In the second policy simulation we analyze different wage subsidies in the presence of a federal minimum wage. In a partial model of the labor market with fully flexible wages the incidence of wage subsidies does not depend on whether they are paid to employers or employees, but rather on the labor demand and supply elasticities. If a subsidy is paid to employees, more people will be prepared to work for lower nominal

[117] This concerns especially information on desired working hours among involuntarily unemployed workers.

wages because these are topped up by the subsidy resulting in higher effective wages. Likewise already employed people might extend their working hours for given nominal wages. The expansion of labor supply leads to lower equilibrium wages and more employment. If the subsidy is directed to employers, they will agree to employ also less productive workers at given nominal wages as they are compensated for the difference in wage costs and productivity. They would agree to higher wages for already employed people when the state covered the increase in wage costs. This would also result in higher employment levels.

This reasoning does not hold anymore in a scenario where the wage adjustment mechanism is limited by a minimum wage. When a binding lower wage threshold is put in place, employee-oriented wage subsidies are no longer effective at the bottom of the distribution. While employees would accept lower nominal gross wages, these must not be paid because of the minimum wage regulation. Therefore an equilibrium with lower wages and higher employment levels cannot be reached. Since a minimum wage only impedes downward wage adjustments below the threshold, the opposite mechanism still works. An employer-oriented wage subsidy reduces wage costs. Subsidized firms are therefore prepared to employ people at higher nominal wages as they are compensated by the subsidy. The higher wage in turn incentivizes people to supply more labor boosting employment.

In this sub-section we simulate *wage subsidies with a statutory minimum wage* in place. We compare a situation where a federal minimum wage of 7.50 €/hour exists without subsidies with the same minimum wage scenario including employee- or employer-oriented wage subsidies. The subsidies are targeted at low *hourly* gross wages, between the minimum wage threshold of 7.50 € and 10.00 €/hour. They benefit low productive employees, not low labor earnings per se. We calibrate the subsidy in a way that its total volume does not exceed 100 million €/month which is about half of the amount Müller and Steiner (2011) calculated to be available for re-distribution from a minimum of 7.50 € after labor demand adjustments. The lowest wages, i.e. those at the nominal minimum, receive the largest subsidy which – according to our calibration – amounts to 0.18 € per 1 € earned. After that the subsidy is linearily phased out up to a wage of 10.00 €/hour. We assume the economic and the de jure incidence to coincide. Employees and employers benefit fully from their respective subsidy without any adjustments of gross wages.[118] Given this incidence we analyze labor supply, demand and employment effects.

How are the wage subsidies implemented in our framework? With the unconstrained model we are only able to analyze employee-oriented wage subsidies. In this framework the subsidy induces a proportional rise in the hourly wage w_i^{MW} of individuals benefitting from the subsidy. The (potential) increase in household income that is simulated for this scenario incentivizes individuals to supply additional labor. In this model this additional supply equals realized employment. We calculate the change in expected participation and working hours in comparison to the situation with a federal minimum wage but no subsidies. Given our assumptions on the incidence, wage subsidies targeted at employers will not lead to any changes in the (potential) wages of employees. That the subsidy diminishes the cost of labor for jobs paying the minimum wage and that demand for those jobs will increase is not captured by this model.

In the model with demand side constraints wage subsidies for employees and employers can be investigated. Subsidies for employees increase the (potential) wage for covered individuals and – through the change in disposable incomes – labor supply incentives. Labor costs for firms are not affected, though. Wages below the minimum wage threshold must not be paid. Therefore the rationing probability for people receiving the subsidy does not change. Whether the estimated employment effects are smaller or larger compared to the unconstrained model depends on the relative importance of the participation, preference and specification biases. An employer-oriented subsidy, however, is directly targeted at the wage costs for low wage earners. In the constrained model this is reflected in a proportional reduction of the institutionally fixed wage costs mw_i for low wage earners (up to 10 €/hour with a declining rate) which in turn increases the labor demand and reduces the rationing

[118] This obviously is a simplifying assumption. The literature has provided mixed results on the incidence of labor taxes. Recent evidence shows that nominal and economic incidence might be closer than previously thought (Neumann, 2013).

risk for given productivities. Although the (potential) wages w_i^{MW} of employees do not change in this scenario, the labor supply incentives induced by the minimum wage may be realized as the related increase in wage costs is compensated by the subsidy and labor demand rises.

Looking first at the results for the *employee-oriented subsidy*, the unconstrained model predicts a moderate increase of labor supply. The participation rate of men rises by 0.2 in West and 0.9 percentage points in East Germany which amounts to 24,000 and 23,000 employees in total (Table 5.10). The change of total hours in full time equivalents roughly equals the extensive margin. Among women participation would rise by about 0.2 percentage points in West (East) Germany equaling 22,000 (5,000) employees. Changes in working hours are higher among women and amount to 39,000 full time equivalents in the West and 15,000 full time eqiuvalents in the East.

In the extended model with rationing[119] the changes in participation lead to smaller effects. The participation rates for West (East) German men would increase by merely 0.1 (0.3) percentage points which equals 13,000 (6,000) employees in total. The same holds for the participation among women. The unconstrained model thus overestimates the consequences of employee-oriented subsidies on the extensive margin reflecting the participation bias in the elasticities (Table 5.8). It also ignores that those people who decide to start working because of the subsidy could be rationed.

The model with demand side rationing estimates larger hours gains for women and men in West Germany, only East German men react less to the subsidiy in comparison to the unconstrained model. Already employed individuals would thus extend their working hours.[120] For those female employees and men in West Germany who earn low wages and are covered by the subsidy, the preference bias seems to dominate the participation bias.

The situation is different for an *employer-oriented wage subsidy*. Such a policy

[119] We will refer to the constrained model with unobserved heterogeneity as this is the preferred specification.

[120] As discussed above our model does not include hours constraints. When individuals find a job, i.e. are not constrained by labor demand, we assume that they can freely choose their number of hours worked.

Table 5.10: Employment effects: MW=7.50 €, employee-oriented wage subsidies, men, women

	East						West					
	Unconstrained		Constrained		Constr. Het.		Unconstrained		Constrained		Constr. Het.	
Men												
Employment												
Participation												
Pp. change participation rate	0.9	[0.6,1.1]	0.4	[0.3,0.6]	0.2	[0.1,0.4]	0.2	[0.1,0.3]	0.2	[0.1,0.2]	0.1	[0.1,0.2]
Change employment in 1000	23	[17,29]	12	[8,15]	6	[3,10]	24	[16,32]	19	[13,25]	13	[6,21]
Working hours												
Change hours	0.4	[0.3,0.5]	0.3	[0.2,0.4]	0.3	[0.1,0.4]	0.1	[0.1,0.1]	0.1	[0.1,0.1]	0.1	[0.1,0.2]
Pct. change hours	1.6	[1.0,2.1]	1.3	[0.9,1.7]	1.1	[0.6,1.5]	0.3	[0.2,0.5]	0.5	[0.3,0.7]	0.5	[0.2,0.7]
Change hours 1000 fte.	24	[17,32]	19	[12,26]	16	[8,24]	25	[16,33]	31	[21,41]	30	[18,45]
Rationing												
Whole population												
Rationing prob. MW			15.0	[11.8,18.1]	13.8	[10.7,17.3]			7.9	[6.5,9.2]	7.9	[6.5,9.1]
Rationing prob. MW & subsidy			15.0	[11.8,18.1]	13.8	[10.7,17.3]			7.9	[6.5,9.2]	7.9	[6.5,9.1]
Pp. change rationing probability			0.0	[0.0,0.0]	0.0	[0.0,0.0]			0.0	[0.0,0.0]	0.0	[0.0,0.0]
Women												
Employment												
Participation												
Pp. change participation rate	0.2	[0.2,0.2]	0.1	[0.1,0.1]	0.1	[0.0,0.1]	0.2	[0.1,0.2]	0.1	[0.1,0.2]	0.1	[0.1,0.1]
Change employment in 1000	5	[4,6]	3	[2,3]	2	[1,2]	22	[19,26]	18	[15,20]	14	[11,18]
Working hours												
Change hours	0.2	[0.2,0.3]	0.3	[0.2,0.4]	0.3	[0.2,0.4]	0.1	[0.1,0.1]	0.2	[0.1,0.2]	0.2	[0.1,0.3]
Pct. change hours	0.9	[0.7,1.1]	1.4	[1.1,1.6]	1.3	[1.0,1.6]	0.6	[0.5,0.8]	0.9	[0.7,1.1]	1.0	[0.7,1.3]
Change hours 1000 fte.	15	[11,19]	22	[17,26]	21	[15,28]	39	[31,47]	64	[50,77]	67	[48,89]
Rationing												
Whole population												
Rationing prob. MW			20.7	[16.7,24.6]	20.5	[16.2,25.1]			9.7	[8.1,11.2]	9.6	[8.0,10.9]
Rationing prob. MW & subsidy			20.7	[16.7,24.6]	20.5	[16.2,25.1]			9.7	[8.1,11.2]	9.6	[8.0,10.9]
Pp. change rationing probability			0.0	[0.0,0.0]	0.0	[0.0,0.0]			0.0	[0.0,0.0]	0.0	[0.0,0.0]

Notes: Unconstr.=unconstrained model, Constr.=constrained model, Constr. Het.=constrained model with unobserved heterogeneity (joint estimation), SQ=status quo, MW=minimum wage, pp.=percentage points, pct.=percent, Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

is beyond the scope of the unconstrained labor supply model when it only affects the labor costs, but not the (potential) wages of employees. Yet, in the model with demand side restrictions an employer-oriented subsidy changes the labor supply predictions in a scenario with a statutory minimum wage. The subsidy reduces the labor costs of low-productive workers who earn low wages. This significantly reduces the predicted rationing probability for those individuals. The rationing risk would decrease by 1.1 (2.8) percentage points for men in West (East) Germany (Table 5.11). For West German women it would be reduced by 1.8, for female employees in East Germany by 2.9 percentage points.[121] The share of low wage earners is larger in East than in West Germany and also higher for women compared to men.

This substantial reduction of the rationing risk leads to a considerable surge in employment at the extensive and intensive margin. With an employer-oriented subsidy the participation rate for men would rise by 0.9 (2.6) percentage points in West (East) Germany which amounts to 115,000 (68,000) employees. For women participation would increase by 1.7 and 2.8 percentage points in West and East Germany equaling an employment gain of 206,000 and 74,000 people respectively. The employment losses induced by the minimum wage (Tables 5.9 above) would be virtually compensated. The effect on total working hours is also substantial. For men it would amount to 60,000 (42,000) full time equalivalents in West (East) Germany and 53,000 (43,000) full time equivalents among women. Most of the jobs created by an employer-oriented wage subsidy would thus be some form of part time arrangement.

Several conclusions can be drawn from these findings. First, the model with demand side constraints improves the applicability of labor supply models for the evaluation of wage subsidies under a federal minimum wage. An unconstrained model provides very limited evidence at best; interpreting its labor supply predictions as employment effects can lead to misleading policy conclusions. Second, it shows that the type of wage subsidy makes a fundamental difference when a statutory minimum wage is in place. It confirms that employer-oriented subsidies are more effective in

[121] These numbers are predictions over the whole sample; the magnitude is lower for people active on the labor market.

Table 5.11: Employment effects: MW=7.50 €, employer-oriented wage subsidies, men, women

	East						West					
	Unconstrained		Constrained		Constr. Het.		Unconstrained		Constrained		Constr. Het.	
Men												
Employment												
Participation												
Pp. change participation rate	0.0	[0.0,0.0]	2.3	[1.7,2.8]	2.6	[1.7,3.7]	0.0	[0.0,0.0]	0.7	[0.5,0.9]	0.9	[0.6,1.3]
Change employment in 1000	0	[0,0]	61	[49,72]	68	[46,93]	0	[0,0]	87	[68,105]	115	[80,158]
Working hours												
Change hours	0.0	[0.0,0.0]	0.8	[0.6,0.9]	0.7	[0.4,1.0]	0.0	[0.0,0.0]	0.2	[0.2,0.3]	0.2	[0.1,0.3]
Pct. change hours	0.0	[0.0,0.0]	4.0	[2.6,5.5]	5.0	[2.5,9.1]	0.0	[0.0,0.0]	1.3	[0.8,1.8]	2.1	[1.0,3.4]
Change hours 1000 fte.	0	[0,0]	46	[36,57]	42	[26,60]	0	[0,0]	62	[48,77]	60	[40,80]
Rationing												
Whole population												
Rationing prob. MW			15.0	[11.8,18.1]	13.8	[10.7,17.3]			7.9	[6.5,9.2]	7.9	[6.5,9.1]
Rationing prob. MW & subsidy			13.0	[10.1,15.8]	11.1	[7.5,14.7]			7.2	[6.0,8.5]	6.8	[5.5,8.0]
Pp. change rationing probability			-2.0	[-1.6,-2.3]	-2.8	[-3.2,-2.6]			-0.6	[-0.6,-0.7]	-1.1	[-1.0,-1.1]
Women												
Employment												
Participation												
Pp. change participation rate	0.0	[0.0,0.0]	1.8	[1.5,2.1]	2.8	[2.0,3.7]	0.0	[0.0,0.0]	1.0	[0.8,1.2]	1.7	[1.3,2.2]
Change employment in 1000	0	[0,0]	49	[41,56]	74	[56,94]	0	[0,0]	124	[103,144]	206	[158,265]
Working hours												
Change hours	0.0	[0.0,0.0]	0.6	[0.5,0.7]	0.6	[0.4,0.8]	0.0	[0.0,0.0]	0.3	[0.2,0.3]	0.2	[0.1,0.2]
Pct. change hours	0.0	[0.0,0.0]	3.4	[2.6,4.3]	4.7	[3.1,7.3]	0.0	[0.0,0.0]	1.4	[1.2,1.7]	1.3	[1.0,1.7]
Change hours 1000 fte.	0	[0,0]	46	[37,55]	43	[28,60]	0	[0,0]	89	[73,105]	53	[40,67]
Rationing												
Whole population												
Rationing prob. MW			20.7	[16.7,24.6]	20.5	[16.2,25.1]			9.7	[8.1,11.2]	9.6	[8.0,10.9]
Rationing prob. MW & subsidy			18.9	[15.2,22.6]	17.6	[12.5,22.8]			8.7	[7.3,10.2]	7.8	[6.4,9.0]
Pp. change rationing probability			-1.8	[-1.5,-2.0]	-2.9	[-3.2,-2.7]			-0.9	[-0.8,-1.1]	-1.8	[-1.6,-1.9]

Notes: Unconstr.=unconstrained model, Constr.=constrained model, Constr. Het.=constrained model with unobserved heterogeneity (joint estimation), SQ=status quo, MW=minimum wage, pp.=percentage points, pct.=percent, Bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

increasing employment under those circumstances. Third, in economic policy terms the findings show the potential of wage subsidies for employers that are related to low hourly wages, i.e. predominantly low-productivity jobs, when they flank a federal minimum wage. They could serve as a complentary policy tool during the implementation of a general minimum wage to protect low-productive employees from adverse consequences. However, this is a stylized simulation in order to illustrate the outcomes of different subsidies in various model specifications. Further questions, e.g. alternative assumptions on the incidence of subsidies, equilibrium effects on wages, or deadweight effects, go beyond the scope of this paper.

5.7 Conclusion

We developed a discrete choice labor supply model with labor demand constraints. The implications of the tax and transfer system are modeled with a microsimulation model to calculate disposable household incomes determining labor supply together with preferences for work. The framework extends previous approaches as it identifies the rationing risk not only from exogenous labor demand shocks, but also from individual productivity. A structural wage/productivity equation is part of the model. Institutional variation in minimum wage thresholds is used for identification in the rationing equation. We also include unobserved individual effects that – through productivity – influence household income and labor supply as well as the rationing probability. The likelihood function is maximized with simulation techniques.

The extensions of the model have been shown to matter as they lead to significantly different results. We demonstrated the elasticities of the unconstrained labor supply model to be biased. Inhowfar this affects the model predictions depends on the relative importance of different biases. For men and women in East and West Germany participation elasticities are upward biased in the unconstrained model which therefore overestimates labor supply reactions at the extensive margin. Among men the hours elasticities (including the extensive and intensive margin) are also upward biased in the unconstrained model. Yet, for women the hours elasticties in East Germany are identical for different model specifications. In the West hours elasticities are even higher in the model with constraints. Leaving aside potential specification bias, the participation bias in the unconstrained model apparently dominates for men. For women the prefernce bias which goes in the opposite direction offsets or even outweighs the participation bias.

The discrepancies in elasticies are revealed in the policy simulations. Predictions from the unconstrained labor supply model are particularly misleading for policy applications where interventions simultaneously affect labor supply incentives and labor costs. Demand side adjustments are by definition not covered by the pure labor supply model. An example is the introduction of a federal minimum wage. Contrary to the unconstrained estimation, the labor supply model with demand side constraints predicts universally negative participation effects which are particularly large for women and in East Germany. The reduction in total working hours is estimated to be considerably smaller. The decline in the volume of employment as a result of a federal minimum could therefore be relatively moderate. On the other hand, this masks that employees, especially those with low productivities, run the risk of losing their jobs which might be substituted by more productive labor. This sheds light on the dynamics a minimum wage might induce on the labor market, even if the employment level is not or only moderately reduced.

Finally, we demonstrate that various types of wages subsidies yield different effects in a scenario with a statutory minimum wage. According to our simulations, employee-oriented subsidies would be largely ineffective in expanding employment. On the other hand, subsidies paid to employers and targeted at low-productive workers could on aggregate virtually offset the negative effects of a federal minimum wage on participation. Although they cannot not be perfectly targeted at the most disadvantaged individuals and fully reverse the detrimental effects of a minimum wage, employer-oriented subsidies could nevertheless be an effective tool to absorb the shock on labor costs induced by the minimum for employees with low productivities.

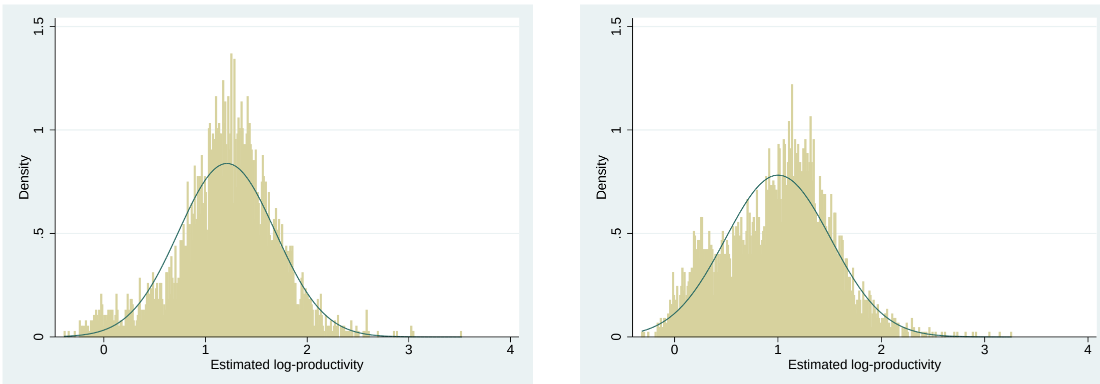
The model of this paper suffers from several shortcomings. The assumptions related to the identification of the model have already been discussed above. The crucial problem is to identify an individual's productivity as a function of observed and unobserved characteristics and separate it from other determinants of the market wage. Ultimately, this boils down to distinguishing between labor supply and demand. Ideally one would would have information about firms to get variation that is exogenous to the individual and household. For the SOEP data used here the next step could be to exploit the longitudinal dimension. One could, e.g., try to identify a time-invariant individual component of productivity. Similarly the denominator in the productivity/minimum wage threshold-ratio can be questioned. Using lower quantiles of the wage distribution for different labor market segments where no sectoral minimum wage is in place, might not be an optimal solution because the observed market wages are a function of supply, demand and institutional constraints. Again, having firm information would also provide better instruments for lower wage constraints on the labor demand side.

Another limitation of the framework is that it lacks an equilibrium wage adjustment (à la Haan and Steiner, 2005b or Peichl and Siegloch, 2012). Although labor supply and demand changes are analyzed in a common model, there is no feedback mechanism of either supply or demand to the wage equation. Therefore we can only consider the nominal wage changes of a minimum wage or wage subsidies in the policy analysis and leave out equilibrium wage adjustments after supply and demand have adapted. An obvious extension would be to include the unemployment rate in the wage equation. This would in principle make the simulation of wage adjustments possible as a reaction to demand and supply shifts. At the same time some of the assumptions would have to be modified. The regional unemployment rate is assumed to be exogenous for the rationing risk in the current specification. Some of the identification issues would thus be aggrevated. The fact that this equilibrium mechanism is not modeled, should be taken into account for the interpretation of the results.

Labor supply is estimated conditional on the spouse's decision in couple households. The obvious extension would be to specify a household labor supply model for both spouses. This complicates the likelihood considerably, though, as additional rationing and wage/productivity equations have to be included for the spouse. We currently use a static model. Since labor supply decisions and the probability of being rationed depend on the individual's labor market history, specifying a dynamic model like Haan and Uhlendorff (2013) would be a reasonable extension. Lastly, one could think about the treatment of unobserved hetreogeneity. Exploiting the longitudinal dimension of the data set will help identification when individuals switch between labor market states. Less restrictive assumptions on the functional form of the unobserved components (see Haan and Uhlendorff, 2013) will probably lead to more complicated specifications. It would still be worthwhile to test the robustness of the results in this regard. In spite of these issues the labor supply model with demand side constraints has proven to be a promising route for the integration of the labor demand side into microeconometric labor supply models.

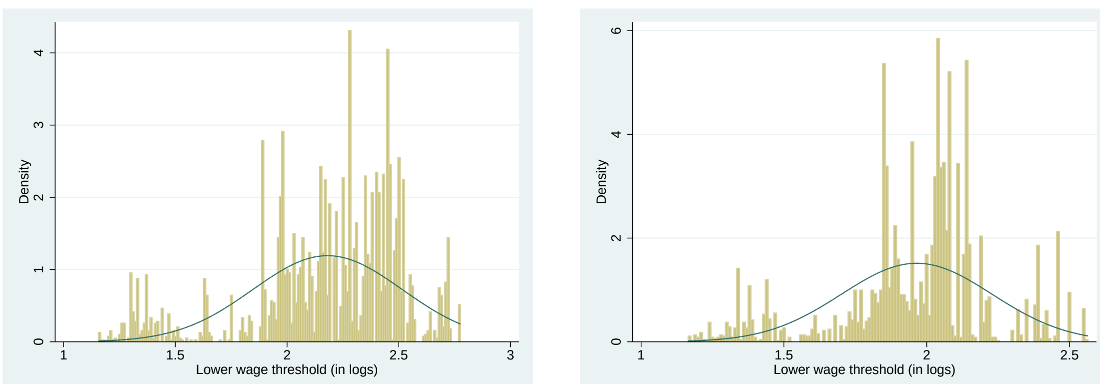
Appendix

Figure 5.1: Estimated log productivity, men & women



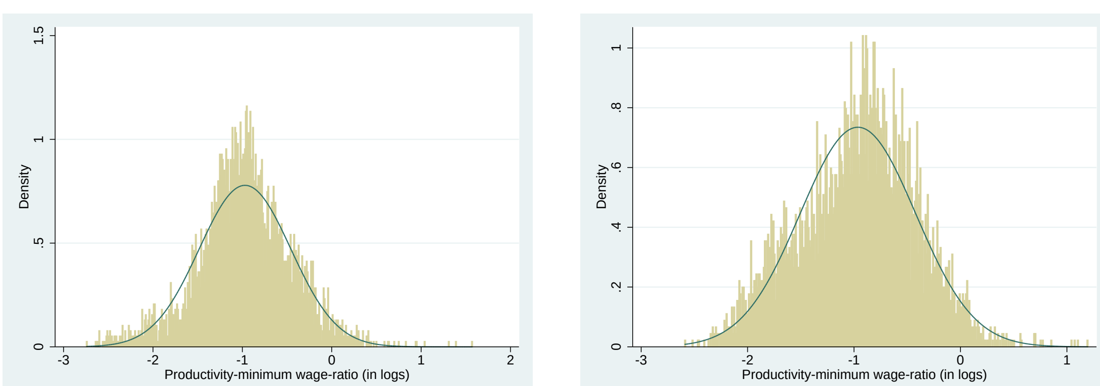
Notes: Estimated prouctivities from constrained model with constraints, joint estimation.
Source: Own calculations based on SOEP, wave 2009.

Figure 5.2: Minimum wage thresholds (in logs), men & women



Notes: Sectoral minimum wages, if applicable, observed lower wage thresholds otherwise.
Source: Own calculations based on GSES, wave 2006, WSI minimum wage data base.

Figure 5.3: Productivity-minimum wage-ratio (in logs), men & women



Source: Own calculations based on SOEP, wave 2009, GSES, wave 2006, WSI minimum wage data base.

Table 5.12: Descriptive statistics: wage equation – productivity variables, men

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Log hourly wage	2.89	[0.45]	2.89	[0.45]						
Age	45.78	[9.88]	45.45	[9.58]	48.36	[11.67]	45.05	[10.99]	51.24	[11.51]
Years of schooling	13.79	[2.41]	13.90	[2.40]	12.90	[2.31]	12.67	[2.23]	13.09	[2.37]
Primary/secondary school certificate	0.03		0.03		0.04		0.05		0.04	
Higher school certificate	0.10		0.10		0.07		0.05		0.09	
Vocational education	0.58		0.57		0.61		0.63		0.60	
Tertiary education	0.24		0.25		0.14		0.11		0.16	
Years of experience	21.83	[10.42]	21.91	[10.19]	21.15	[12.05]	18.25	[10.60]	23.67	[12.67]
Years of experience^2/100	5.85	[4.64]	5.84	[4.57]	5.92	[5.21]	4.45	[4.00]	7.20	[5.78]
Tenure	12.25	[11.00]	13.68	[10.86]	1.00	[1.24]	2.15	[0.91]	0.00	[0.00]
Tenure^2/100	2.73	[3.88]	3.05	[4.00]	0.22	[0.28]	0.48	[0.20]	0.00	[0.00]
Depreciation of human capital	0.45	[0.93]	0.23	[0.53]	2.18	[1.43]	2.08	[1.35]	2.26	[1.49]
Years of full time experience	21.27	[10.64]	21.39	[10.42]	20.38	[12.21]	17.45	[10.75]	22.93	[12.83]
Years of full time experience^2/100	5.66	[4.63]	5.66	[4.56]	5.64	[5.15]	4.19	[3.96]	6.90	[5.72]
Observations	3,858		3,424		434		202		232	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals
Source: Own calculations based on SOEP, wave 2009.

Table 5.13: Descriptive statistics: wage equation – labor demand variables, men

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
German nationality	0.94		0.94		0.88		0.88		0.89	
Civil servant	0.27		0.30		0.00		0.00		0.00	
Firm size: 1-4	-0.02		-0.02		0.00		0.00		0.00	
Firm size: 5-19	-0.02		-0.02		0.00		0.00		0.00	
Firm size: 20-199	0.00		0.00		0.00		0.00		0.00	
Industry: Engineering, electronics	-0.04		-0.05		0.00		0.00		0.00	
Industry: Mining and energy	0.00		0.00		0.00		0.00		0.00	
Industry: Chemical industry, wood, paper	-0.02		-0.02		0.00		0.00		0.00	
Industry: Clay, stones, earthes, construction	-0.02		-0.02		0.00		0.00		0.00	
Industry: Iron, steel, heavy industry	-0.01		-0.01		0.00		0.00		0.00	
Industry: Clothes	0.00		0.00		0.00		0.00		0.00	
Industry: Wholesale trade	-0.02		-0.03		0.00		0.00		0.00	
Industry: Train, post, communication	-0.01		-0.01		0.00		0.00		0.00	
Industry: Public services	-0.02		-0.02		0.00		0.00		0.00	
Industry: Private services	-0.01		-0.02		0.00		0.00		0.00	
Other industries	-0.02		-0.03		0.00		0.00		0.00	
Schleswig-Holstein and Hamburg	0.04		0.04		0.04		0.03		0.04	
Lower Saxony and Bremen	0.10		0.10		0.09		0.11		0.07	
North Rhine-Westphalia	0.20		0.21		0.17		0.15		0.19	
Hesse	0.07		0.07		0.05		0.04		0.06	
Rhineland-Palatinate and Saarland	0.06		0.06		0.06		0.07		0.06	
Baden-Wurttemberg	0.12		0.13		0.07		0.07		0.07	
Bavaria	0.15		0.15		0.13		0.08		0.16	
Mecklenburg-Western Pomerania	0.02		0.02		0.03		0.03		0.02	
Brandenburg	0.04		0.04		0.08		0.09		0.07	
Saxony-Anhalt	0.04		0.04		0.07		0.08		0.06	
Thuringia	0.04		0.04		0.06		0.06		0.06	
Saxony	0.08		0.07		0.10		0.11		0.09	
Observations	3,858		3,424		434		202		232	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals
Source: Own calculations based on SOEP, wave 2009.

Table 5.14: Descriptive statistics: rationing equation, men

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Rationing dummy	0.05		0.00		0.47		1.00		0.00	
Lower wage threshold	9.32	[2.73]	9.41	[2.73]	8.66	[2.62]	8.25	[2.73]	9.02	[2.47]
Dummy single	0.21		0.20		0.31		0.34		0.28	
Dummy German nationality	0.94		0.94		0.88		0.88		0.89	
Dummy children < 3 years	0.08		0.08		0.09		0.09		0.09	
Occ.: Armed forces	0.01		0.01		0.00		0.00		0.00	
Occ.: Managers	0.07		0.08		0.01		0.00		0.01	
Occ.: Professionals	0.19		0.21		0.05		0.04		0.06	
Occ.: Technicians	0.17		0.19		0.07		0.06		0.09	
Occ.: Clerical support workers	0.07		0.07		0.05		0.05		0.04	
Occ.: Service & sales workers	0.05		0.05		0.03		0.03		0.03	
Occ.: Agricultural, forestry	0.01		0.01		0.03		0.02		0.03	
Occ.: Craft & related trades	0.23		0.21		0.39		0.40		0.38	
Occ.: Plant & machine operators	0.11		0.12		0.09		0.10		0.07	
Regional unemployment rate	8.62	[3.80]	8.48	[3.75]	9.71	[4.00]	10.15	[4.00]	9.31	[3.97]
Regional employment rate	55.46	[3.55]	55.53	[3.57]	54.97	[3.30]	54.77	[3.28]	55.15	[3.30]
Regional part time share	18.14	[1.67]	18.14	[1.68]	18.12	[1.53]	18.29	[1.57]	17.98	[1.49]
Regional BIP	29.01	[7.32]	29.17	[7.31]	27.69	[7.30]	27.01	[7.01]	28.28	[7.50]
Observations	3,858		3,424		434		202		232	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals, Occ.=occupation.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

Table 5.15: Descriptive statistics: labor supply equation, men

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Consumption										
Age	368.99	[86.48]	371.00	[85.39]	353.13	[93.26]	334.26	[84.63]	369.57	[97.40]
Age squared	176.93	[73.51]	176.49	[72.78]	180.39	[79.08]	159.41	[70.28]	198.66	[81.87]
Leisure	29.88	[2.21]	29.87	[1.89]	29.98	[3.94]	28.08	[2.07]	31.63	[4.41]
Constant	8.06	[0.56]	8.14	[0.50]	7.46	[0.66]	7.66	[0.47]	7.28	[0.75]
Consumption squared	65.10	[9.25]	66.49	[8.18]	54.15	[9.93]	55.36	[8.17]	53.10	[11.15]
Leisure										
Age	170.61	[39.81]	166.96	[36.09]	199.39	[53.73]	170.49	[41.58]	224.54	[50.42]
Age squared	81.88	[34.70]	79.27	[31.98]	102.46	[46.49]	81.36	[35.68]	120.84	[47.07]
East	0.91	[1.61]	0.84	[1.55]	1.45	[1.96]	1.52	[1.86]	1.40	[2.05]
German	3.48	[0.93]	3.46	[0.86]	3.62	[1.35]	3.32	[1.25]	3.89	[1.39]
Handicapped	0.08	[0.56]	0.07	[0.49]	0.22	[0.95]	0.11	[0.64]	0.32	[1.14]
Child <= 3 years	0.31	[1.04]	0.31	[1.01]	0.39	[1.21]	0.36	[1.11]	0.42	[1.29]
Child 3-6 years	0.37	[1.11]	0.37	[1.11]	0.32	[1.09]	0.37	[1.13]	0.26	[1.05]
Single	0.78	[1.53]	0.72	[1.46]	1.25	[1.89]	1.27	[1.79]	1.23	[1.97]
Single x child < 3 years	0.02	[0.26]	0.01	[0.23]	0.05	[0.43]	0.06	[0.46]	0.04	[0.41]
Constant	3.72	[0.22]	3.67	[0.15]	4.10	[0.30]	3.78	[0.00]	4.38	[0.00]
Leisure squared	13.90	[1.73]	13.51	[1.14]	16.93	[2.44]	14.32	[0.00]	19.20	[0.00]
Observations	3,877		3,443		434		202		232	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

Table 5.16: Descriptive statistics: wage equation – productivity variables, women

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Log hourly wage	2.59	[1.15]	2.59	[0.47]						
Age	44.36	[9.86]	44.30	[9.49]	44.59	[11.10]	42.25	[10.09]	45.20	[11.28]
Years of schooling	13.39	[2.36]	13.59	[2.32]	12.65	[2.34]	12.34	[2.07]	12.74	[2.40]
Primary/secondary school certificate	0.05		0.04		0.09		0.06		0.10	
Higher school certificate	0.12		0.13		0.10		0.11		0.10	
Vocational education	0.56		0.57		0.54		0.58		0.53	
Tertiary education	0.19		0.21		0.12		0.07		0.13	
Years of experience	16.35	[9.98]	17.71	[9.69]	11.47	[9.48]	11.70	[9.41]	11.41	[9.51]
Years of experience^2/100	3.67	[3.80]	4.07	[3.82]	2.21	[3.35]	2.25	[3.15]	2.20	[3.40]
Tenure	8.57	[9.66]	10.89	[9.72]	0.24	[0.52]	1.15	[0.50]	0.00	[0.00]
Tenure^2/100	1.68	[3.00]	2.13	[3.25]	0.05	[0.10]	0.23	[0.10]	0.00	[0.00]
Depreciation of human capital	1.31	[1.47]	0.79	[1.01]	3.15	[1.37]	2.74	[1.39]	3.26	[1.35]
Years of full time experience	11.51	[9.52]	12.33	[9.66]	8.54	[8.36]	8.66	[8.49]	8.51	[8.33]
Years of full time experience^2/100	2.23	[3.18]	2.45	[3.30]	1.43	[2.57]	1.47	[2.44]	1.42	[2.61]
Observations	4,514		3,533		981		205		776	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals
Source: Own calculations based on SOEP, wave 2009.

Table 5.17: Descriptive statistics: wage equation – labor demand variables, women

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
German nationality	0.94		0.95		0.90		0.88		0.90	
Civil servant	0.18		0.23		0.00		0.00		0.00	
Firm size: 1-4	-0.01		-0.01		0.00		0.00		0.00	
Firm size: 5-19	-0.02		-0.02		0.00		0.00		0.00	
Firm size: 20-199	0.00		-0.01		0.00		0.00		0.00	
Industry: Engineering, electronics	-0.01		-0.01		0.00		0.00		0.00	
Industry: Mining and energy	0.00		0.00		0.00		0.00		0.00	
Industry: Chemical industry, wood, paper	-0.01		-0.01		0.00		0.00		0.00	
Industry: Clay, stones, earthes, construction	0.00		0.00		0.00		0.00		0.00	
Industry: Iron, steel, heavy industry	-0.01		-0.01		0.00		0.00		0.00	
Industry: Clothes	0.00		0.00		0.00		0.00		0.00	
Industry: Wholesale trade	-0.04		-0.05		0.00		0.00		0.00	
Industry: Train, post, communication	0.00		-0.01		0.00		0.00		0.00	
Industry: Public services	-0.04		-0.05		0.00		0.00		0.00	
Industry: Private services	-0.02		-0.03		0.00		0.00		0.00	
Other industries	0.00		0.00		0.00		0.00		0.00	
Schleswig-Holstein and Hamburg	0.04		0.04		0.03		0.05		0.03	
Lower Saxony and Bremen	0.10		0.10		0.09		0.07		0.09	
North Rhine-Westphalia	0.20		0.19		0.24		0.21		0.25	
Hesse	0.08		0.08		0.07		0.06		0.08	
Rhineland-Palatinate and Saarland	0.06		0.06		0.07		0.05		0.07	
Baden-Wurttemberg	0.11		0.11		0.12		0.05		0.13	
Bavaria	0.15		0.16		0.13		0.08		0.15	
Mecklenburg-Western Pomerania	0.03		0.03		0.03		0.05		0.02	
Brandenburg	0.04		0.04		0.04		0.08		0.04	
Saxony-Anhalt	0.04		0.04		0.04		0.08		0.03	
Thuringia	0.04		0.04		0.04		0.07		0.03	
Saxony	0.07		0.08		0.06		0.10		0.04	
Observations	4,514		3,533		981		205		776	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals
Source: Own calculations based on SOEP, wave 2009.

Table 5.18: Descriptive statistics: rationing equation, women

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Rationing dummy	0.05		0.00		0.21		1.00		0.00	
Lower wage threshold	7.37	[1.83]	7.43	[1.86]	7.16	[1.70]	6.70	[1.71]	7.28	[1.68]
Dummy single	0.28		0.28		0.27		0.42		0.22	
Dummy German nationality	0.94		0.95		0.90		0.88		0.90	
Dummy children < 3 years	0.08		0.05		0.21		0.08		0.25	
Occ.: Technicians	0.29		0.33		0.17		0.14		0.18	
Occ.: Clerical support workers	0.16		0.16		0.14		0.16		0.14	
Occ.: Service & sales workers	0.18		0.18		0.18		0.15		0.19	
Occ.: Agricultural, forestry	0.01		0.01		0.02		0.02		0.02	
Occ.: Craft & related trades	0.04		0.03		0.09		0.10		0.08	
Occ.: Plant & machine operators	0.02		0.02		0.03		0.05		0.03	
Occ.: Elementary	0.08		0.08		0.07		0.11		0.06	
Regional unemployment rate	9.10	[3.74]	9.06	[3.72]	9.27	[3.78]	10.68	[3.95]	8.89	[3.64]
Regional employment rate	46.89	[4.07]	47.02	[3.99]	46.43	[4.31]	47.53	[4.69]	46.14	[4.16]
Regional part time share	18.18	[1.67]	18.21	[1.70]	18.05	[1.59]	18.08	[1.43]	18.05	[1.62]
Regional BIP	28.98	[7.28]	29.04	[7.32]	28.75	[7.14]	26.74	[7.31]	29.29	[7.00]
Observations	4,514		3,533		981		205		776	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work. vol. unemployed=voluntarily unemployed individuals, Occ.=occupation.
Source: Own calculations based on SOEP, wave 2009; INKAR, wave 2010.

Table 5.19: Descriptive statistics: labor supply equation, women

	All		Working		Non-working		Non-working, rationed		Non-work., vol. uenem.	
	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]	mean	[s.d.]
Consumption										
Age	351.45	[82.02]	354.20	[80.29]	341.57	[87.30]	322.66	[79.50]	346.57	[88.63]
Age squared	163.50	[68.25]	164.15	[66.49]	161.16	[74.25]	143.97	[63.81]	165.70	[76.17]
Leisure	31.52	[3.04]	31.14	[2.78]	32.89	[3.52]	29.83	[2.71]	33.70	[3.25]
Constant	7.98	[0.61]	8.04	[0.58]	7.75	[0.66]	7.66	[0.51]	7.78	[0.70]
Consumption squared	63.07	[9.15]	64.08	[8.55]	59.46	[10.27]	58.53	[7.61]	59.70	[10.86]
Leisure										
Age	176.89	[42.20]	172.91	[38.96]	191.22	[49.65]	165.26	[41.24]	198.08	[49.44]
Age squared	82.44	[35.42]	80.16	[32.58]	90.67	[43.21]	73.84	[33.37]	95.11	[44.42]
East	0.94	[1.67]	0.93	[1.64]	0.95	[1.76]	1.55	[1.89]	0.79	[1.69]
German	3.73	[1.00]	3.70	[0.88]	3.84	[1.33]	3.46	[1.28]	3.94	[1.33]
Handicapped	0.19	[0.85]	0.18	[0.82]	0.22	[0.96]	0.13	[0.71]	0.25	[1.01]
Child <= 3 years	0.35	[1.16]	0.19	[0.85]	0.93	[1.78]	0.33	[1.10]	1.08	[1.89]
Child 3-6 years	0.43	[1.26]	0.36	[1.14]	0.68	[1.58]	0.43	[1.24]	0.75	[1.65]
Single	1.08	[1.75]	1.07	[1.72]	1.12	[1.86]	1.62	[1.92]	0.98	[1.83]
Single x child < 3 years	0.07	[0.54]	0.03	[0.35]	0.21	[0.93]	0.08	[0.55]	0.24	[1.00]
Constant	3.98	[0.28]	3.90	[0.24]	4.28	[0.22]	3.91	[0.23]	4.38	[0.00]
Leisure squared	15.94	[2.24]	15.26	[1.85]	18.39	[1.78]	15.32	[1.80]	19.20	[0.00]
Observations	4,514		3,533		981		205		776	

Notes: All=whole estimation sample, Working=all employed individuals, Non-working=all non-working individuals, Non-working, rationed=involuntarily unemployed individuals, Non-work., vol. unemployed=voluntarily unemployed individuals.

Source: Own calculations based on SOEP, wave 2009, INKAR, wave 2010.

Conclusions

This dissertation investigated the consequences of a statutory minimum wage. The research was motivated by the long-lasting discussion about the introduction of a federal minimum wage in Germany. In the beginning fears of negative consequences for collective bargaining and employment were such that the labor unions, employer organizations and most political parties strictly opposed it. The perception of the minimum wage and the tone of this debate have changed tremendously within the context of solid economic growth, declining unemployment rates and an increasing income and wealth gap. At present the minimum wage sometimes seems to serve as a panacea for problems of inequality and (in-work) poverty in Germany. Potential employment losses are viewed less critically in the light of inconclusive results from several official evaluation studies on sectoral minimum wages. The thesis thus addresses the two most important sets of questions related to the minimum wage – its potential consequences for employment and its re-distributive impact on labor earnings and disposable income.

The empirical literature has confirmed that a binding minimum wage affects the distribution of *gross labor earnings*. The magnitude of this impact depends on its nominal level in relation to the wage distribution. There is less consensus, whether the minimum wage influences parts of the distribution that are not nominally bound it. Such spillovers would reduce the re-distributive effects and increase the change in the total wage sum as well as the burden on the firms' wage costs. Except for chapter 4 we conduct ex ante evaluations of the federal minimum wage. We therefore rely on assumptions about coverage, compliance and (no) spillovers and simulate the effect on labor earnings in chapters 1, 2, 3 and 5.

Previous research regarding the impact of the minimum on *disposable household incomes* has found that the minimum wage hardly influences the distribution of net incomes. Most of these studies have relied on stylized model calculations and are not based on actual micro data. Two chapters are dedicated to the distributional implications of the minimum wage. In chapter 1 we simulate the consequences for the distribution of disposable net incomes. We contribute to the literature by modeling the minimum wage effects at the household level tax and by taking interactions with the tax-benefit system into account. In chapter 2 we also incorporate different behavioral adjustments into these distributional analyses considering labor supply and demand as well as changes in consumer prices and the adaption of consumption behavior.

Empirical studies on *employment* make the bulk of the economic minimum wage research. Most of those studies are reduced-form ex post evaluations. The current state of findings is rather mixed: some studies find negative effects, others get insignificant or even positive results. Leaving identification issues aside, theoretical and structural empirical models are able to explain the heterogeneous effects which can depend on the market structure or frictions in the labor market. A minimum wage can have ambiguous effects, if market wages are inferior to marginal productivity and the employment level is below the market equilibrium, at least in certain segments of the labor market. The employment effects might thus vary across countries, different labor markets and with the level of the minimum wage.

Since a federal minimum wage does not exist in Germany, we have relied mostly on structural models and ex ante simulations. Chapter 2 calculates the labor demand reactions on the basis of estimated own-wage and cross-wage elasticities and average wage changes induced by a minimum wage in different segments of the labor market. These adjustments are incorporated into a microsimulation model: the probability of becoming unemployed due to the minimum wage is taken into account for the simulation of disposable net incomes. Chapter 3 looks deeper into existing simulation studies that calculate the employment effects. In particular, we investigate the measurement of hourly wages in the low wage sector for different data sources and discuss the estimation of labor demand elasticities on which the simulations are based. Chapter 4 looks at a sectoral minimum wage that was implemented several years ago. This is an ex post analysis based on a structural labor demand model. The employment effects in the main construction sector are estimated with a cross-sectional data set. The approach complements the other reduced-form evaluations. Chapter 5 analyzes the interaction of labor supply and labor demand effects in a structural labor supply model that jointly determines individual productivity, market wages and the probability of being involuntarily unemployed. Extending previous models it provides a structural interpretation of the link between an individual's productivity, the labor supply decision and the probability of becoming unemployed. This model can be applied to policy reforms that simultaneously affect labor supply and wage costs, i.e. labor demand. We investigate the introduction of a minimum wage and compare different types of wage subsidies when a minimum wage is in place.

Overview of the findings

The simulations of chapters 1 through 3 show that a federal minimum wage would have sizeable effects on the lower part of the *gross wage distribution*. The share of people affected and the magnitude of the average and total wage increase depends on the level at which the minimum wage is fixed. For the year 2012, e.g., a minimum of 5.00 €/hour would affect only about 1% of employes; this share increases to more than 11% and almost 19% for minimum wage levels of 8.50 or 10.00 €/hour, respectively. In absolute terms a minimum wage of 8.50 €/hour would increase the wage bill by about 650 million €/month, or 7.8 billion €/year, which is about 0.9% of the total wage bill in 2012. This increase is substantially lower for a moderate minimum of 5.00 €/hour. An increase in the minimum wage level to 10.00 €/hour, on the other hand, more than doubles the increase in the total wage bill to 1.5 billion €/month or almost 2%.

Ruling out spillover effects the wage increases are by definition concentrated at the bottom of the distribution. A relatively moderate minimum wage of 7.50 €/hour would have increased the wage incomes by about 50% in the first five percentiles of the wage distribution in the year 2008 (see chapter 1), whereas higher parts of the wage distribution would not be affected at all. The impact on the wage distribution can also be summarized by composite inequality indices. While a low minimum wage of 5.00 €/hour could not significantly reduce inequality when measured by the Gini coefficient or the bottom-sensitive Atkinson inequality indicator, minimum wages set at a medium level or above would achieve this goal. Fixed at 8.50 €/hour the minimum wage would reduce overall gross wage inequality by 6% and – according to the Atkinson index – by 17% in the lower tail of the distribution. These reductions reach 14% and 29% for a minimum wage of 10.00 €/hour.

These average and total changes cover considerable heterogeneity of the wage effects along different characteristics. East Germany is more affected than West Germany and the impact is stronger for women compared to men. This holds for the minimum wage incidence and the magnitude of the wage increases among affected employees. Abstracting from behavioral effects women, e.g., would receive about 70% of the total gain in gross wages generated by a minimum wage. Other groups that are particularly affected by wage increases include young employees, low-qualified persons, part-time and in particular marginally employed, as well as individuals working in small firms. A minimum wage would first and foremost cover specific groups of the population and would – if it is set at a sufficiently high level – significantly reduce earnings inequality among employees.

Chapters 1 and 2 utilize a tax-benefit microsimulation model to translate the simulated changes in gross wages into adjustments of *disposable net incomes* at the household level. The distributional effects of the minimum wage are assessed on equivalent incomes. While chapter 1 is focused on the bottom of the income distribution and on poverty, chapter 2 looks at the whole income distibution and also estimates how workers, employers and firms would adapt to a federal minimum wage. Both chapters confirm that average gains in net incomes are substantially smaller compared to the increase in gross earnings. Marginal tax rates on the additional labor income are in most cases very high because, e.g., welfare transfers are substituted.

For a low minimum wage level of 5.00 €/hour the total increase in net incomes is virtually zero. The rise in disposable incomes following a minimum wage of 8.50 €/hour amounts to about 270 million €/month without behavioral adjustments which equals 40% of the effect on gross wages. For a high level of 10.00 €/hour the total gain is about 650 million €/month which is approximately 45% of the total amount in gross earnings.

Various behavioral adjustments after a minimum wage is introduced will also influence the net income gains. When employment effects are simulated on the basis of estimated labor demand elasticities, the increase in incomes is reduced by roughly 50%. Unless the minimum wage is not set very high, the pure labor supply effects are moderate because of the relatively small increase in net incomes. When the probability of becoming unemployed rises under a federal minimum wage, this is reflected in lower average income gains. A surge in labor costs will eventually also show up in consumption prices. We calculate those price adjustments and simulate their effect on the consumption expenditures. If households would not adapt their behavior the average effect on household incomes would be even slightly negative when increased consumption prices are also incorporated. This changes when consumption adjustments are allowed. Then the average income change would again be positive, although only about one fourth of the original gain remains with the households.

The impact on disposable incomes is heterogenous with respect to observed covariates. East German households receive approximately the same total gain as households in the West, although only about one fith of the population lives there. Households with children are disproportionately affected by the minimum wage; their average increase in net incomes is only about 60% of the average gain. Couple households, especially those with both spouses working, would benefit more from the minimum wage than single earner families.

The most important result of chapters 1 and 2 is that a federal minimum wage would have virtually no consequences for the distribution of disposable incomes. This finding holds irrespective of the level of the minimum wage. Neither the incidence nor the depth of poverty would be reduced significantly. The distribution of incomes within the poor population also does not change. The decomposition of poverty measures by various groups has shown that these results are not driven by compositional effects. The same finding holds for various measures of overall income inequality. Neither the Gini coefficient, which is sensitive to income changes in the middle of the distribution, nor the bottom-sensitive mean logarithmic deviation or the Atkinson poverty measure with high inequality aversion record any significant change. The distributional impact is further weakened when behavioral effects are taken into account. These very small reductions are comparable between West and East Germany. The minimum wage is thus ineffective in improving the economic situation of households under the current welfare system.

The *employment effects* of the minimum wage are in various forms subject of chapters 2 through 5. In chapters 2 and 3 we simulate labor demand changes on the basis of compensated own- and cross-wage elasticities. The effect depends on the assumed price elasticity of the demand for goods which varies from perfectly inelastic (0), to elastic (-1) and highly elastic (-2) in separate simulations. If the demand for goods was perfectly inelastic, overall labor demand would decrease by about 6,000 persons for a minimum wage of 5.00 €/hour, by 70,000 individuals for a level of 8.50 €/hour, and by 135,000 persons for a level of 10.00 €/hour. If the demand for goods was highly elastic with respect to price changes, the overall decrease in demand for labor would amount to about 30,000, 600,000, and 1.35 million persons, respectively. We regard the scenario with an assumed price elasticity of demand for goods of -1 as the most plausible one for the German economy. The resulting decrease in labor demand for a minimum wage of 5.00 €/hour amounts to about 18,000 persons, for a minimum wage level of 8.50 €/hour to about 340,000 individuals, and for a level of 10.00 €/hour to 740,000 persons. The lion's share of employment losses would be borne by marginally employed. Women working part-time in East Germany would also disproportionately affected.

In chapter 3 we analyze the underlying determinants of this simulation approach in greater detail and evaluate existing simulation studies. We find that the simulated labor demand effects are particularly sensitive to measurement errors in hourly wages. Those are driven by unreliable information on labor earnings and on working time. The quality of this information varies considerably between different data sets; in administrative data from the federal employment agency it is missing altogether. The representativeness with respect to different forms of employment is also not given for all data sets. Apart from these issues, the simulations stand or fall with the estimated and assumed labor demand and output price elasticities. There is a trade-off between the level of disaggregation in the elasticities and the consistency of estimation. The interdependencies of the various factors can lead to substantial differences in simulation outcomes.

Contrary to the aforementioned simulations, chapter 5 provides an extended structural model that allows to jointly simulate individual labor supply and demand adjustments in a coherent framework. In terms of participation effects this model estimates that a minimum wage of 7.50 €/hour in the year 2010 would have led to a loss of more than 400,000 employees. This is in the ballpark of the labor demand simulations of chapter 2. Effects are larger in the East and for women. With the extended model we are also able to analyze different margins of employment. For total working hours the picture is quite different. For men the estimated loss amounts to about 40,000 full time equivalents, for women the effect is even positive overall. This demonstrates that jobs losses due to a minimum wage do often not involve full time contracts. At the same time more productive employees that keep their jobs are incentivized by the minimum wage to extend their working hours. Because of this substitution the reduction in the volume of employment is relatively moderate.

The model of chapter 5 also allows a comparison between employee- and employer-oriented wages subsidies when a statutory minimum wage is already in place. We could show that under these circumstances the type of wage subsidy makes a fundamental difference. While subsidies paid to employees are largely ineffective in increasing employment, employer-oriented subsidies would lead to a substantial rise in participation. We simulate an increase of more than 200,000 employees among men and 280,000 employees among women which would on aggregate compensate the negative impact of the minimum wage.

Chapter 4 looks into the employment effects of the sectoral minimum wage in the German main construction sector. This is the lone ex post analyis of the thesis. It does not employ a standard reduced-form evaluation approach, but is based on a structural labor demand model. According to our results employment levels would have been 4-5% higher without the minimum wage in East Germany where the minimum bit hard. The effects for West Germany are markedly smaller as the minimum was hardly binding. Employment would have been 1-2% higher without the minimum wage. The employment effects are also decomposed according to individual and firm characteristics. Employment losses are borne by young construction workers, employees not covered by a collective bargaining agreement and individuals working in small establishments.

Policy implications

Which conclusions can be drawn from these findings for the economic policy discussion about a federal minimum wage in Germany? As indicated at the outset, the shift of emphasis in this debate and the re-positioning of important political actors point strongly to the expansion of minimum wage regulations in Germany. Our empirical results help to gauge the different arguments used and to determine what can realistically be expected from a minimum wage. Moreover, we point to implications and problems that are neglected in the discussion.

A federal minimum wage will have a sizeable effect on *labor earnings*. Setting it at a low level of, e.g., 5.00 €/hour could prevent wage dumping at the bottom of the distribution. According to various data sets, there are jobs with hourly wages below this threshold in the lowest percentiles of the distribution. In order to significantly reduce earnings inequality, it would have to be fixed at a higher level. A minimum wage between between 7.00 and 8.00 €/hour would achieve this goal. These nominal effects hinge on several assumptions, though.

The reduction of relative wage inequality could be smaller when wages in other parts of the distribution that are not bound by the minimum wage also rise. Although the literature is mixed in general, there is some evidence for Germany confirming such spillover effects (Rattenhuber, 2011). The labor demand model of chapter 4 also provides some evidence. Second, the redistributive effects for labor earnings are conditional on employment to remain constant. Findings from several chapters cast doubt on this assumption. Even if employment levels are reduced only moderately, low-productive jobs will be substituted by more productive labor. A minimum wage might help thus help to avoid ruinous wage competition and also reduce earnings inequality to some degree. Its redistributive efficiency with respect to gross earnings might be lower than expected at first sight.

The minimum wage is no instrument for *income redistribution*. This is an unequivocal and very robust finding that does not depend on the level of the minimum or its effects on employment. The average gain in disposable incomes is only a fraction of the increase in gross labor earnings. Although higher minimum wage levels increase the income gain, they do not lead to more redistribution. Low-wage workers are spread over the whole income distribution and the additional labor income is often subject to high marginal tax rates. Behavioral changes of firms or consumers further diminish the re-distributive power of the minimum wage. These facts are hardly acknowledged in public debates about the potential benefits of the minimum wage where the assertion that it improves the economic situation of households is still taken for granted.

A counterargument often made is that it does matter, whether people earn higher labor incomes and do not have to rely on tansfers. For a sizeable proportion of this group, top-up benefits result from low working hours (Luchtmeier and Ziemendorff, 2007; Brenke, 2012). Although individuals would have an incentive to work longer hours, the results from chapter 5 have shown that it is questionable, whether these type of jobs would still be available under a minimum wage. Only about 20% of workers receiving top-up benefits have a fulltime job. Their hourly wages are mostly not in the bottom percentiles of the distribution. These individuals receive transfers because they are mostly single earners in large households (Brenke and Ziemendorff, 2008). Minimum wages of 8.00 or even 10.00 €/hour would hardly change that.

As shown in chapter 1, poverty concerns first and foremost people and households that are detached from the labor market. A federal minimum wage would be rather counterproductive for their employability.

Another argument for the substitution of transfer by labor incomes through a minimum wage is that the increased contributions to the pension scheme help to avoid old-age poverty. This goes beyond the static models of this dissertation. A crucial condition for the assertion is, however, that a minimum does not lead to higher unemployment.

The biggest concern about minimum wages are the potential negative *employment effects*. The results from the labor demand simulations in chapters 2 and 3 suggest that a negative impact on employment would be noticeable when the minimum wage is not set at a very low level. The results for varying levels of the minimum wage make clear that the consequences for employment of a high minimum wage in the range of 10.00 €/hour would be very undesireable. These findings are confirmed by the labor supply model with rationing from chapter 5 which also predicts significantly negative consequences at the extensive margin. The results can be qualified in two respects. First, the overall effect on the level of employment may be more moderate. Low productive jobs could be substituted by extended working hours of more productive employees. Second, and related to that, the decline in employment affects particularly those employees that are targeted by the minimum wage.

The results from chapter 4 for the main construction sector in East Germany underline the skepticism. When a minimum wage is set too high, it will reduce employment. These findings put the inconclusive results of the official evaluation studies a bit into perspective. Moreover, the (re-)distributional dimension of the employment effects is also neglected in the discussion. The findings from Chapter 4 (similar to results from chapters 2 and 5) indicate that certain groups would be very strongly affected. This is at odds with the redistributive motive for a minimum wage.

Given that the debate in Germany has seemingly shifted to a widely shared perception that a minimum wage would not be harmful to employment, the findings of this thesis advise some caution. It is true that our structural approaches rest on various assumptionss. On the other hand, the internal validity of the reduced-form evaluation studies can also be questioned (e.g. lack of hours information, inadequate control groups). The level of a number of sectoral minima is also below those proposed for a general minimum wage. The variety of different simulations in this thesis – regarding model assumptions and specifications, minimum wage levels, assumed (price) elasticities, effect heterogeneity – gives a good indication of the potential consequences.

A further adjustment mechanism for firms is to shift wage cost increases to product prices. We showed in chapter 2 that higher consumption prices diminish potential gains in disposable incomes, even if households adjust their consumption behavior. Households with lower incomes are disproportionately affected. This point is also often overlooked when it is argued that a minimum wage would not reduce employment. The higher costs have to be borne somewhere.

As indicated above the public opinion is very much in favor of a minimum wage. Depending on the composition of the next government coalition, a federal minimum wage could soon become reality in Germany. Which recommendations can be derived from our findings? First, public expectations towards a minimum wage should be lowered, particularly with respect to its redistributive impact. Second, introducing a minimum wage with a starting level of 8.50 €/hour is not advisable. The implied immediate shock on wage costs would risk employment losses. The very moderate effects for this scenario suggest a starting level around 5.00 €/hour. Then, the level could be increased incrementally and a close monitoring of the effects on wages and employment could be conducted following the implementation strategy of the British Low Pay Comission (Metcalf, 1999, 2008). Third, in the light of the heterogeneous effects of the minimum wage one should keep an eye on disadvantaged groups. The results from chapter 5 have indicated that employer-oriented wage subsidies could be an effective policy instrument to mitigate adverse effects. Fourth, the introduction of a federal or further sectoral minimum wages should be closely monitored. The data basis for the evaluation of minimum wage policies has to be improved, particularly with respect to working time information in the administrative data. Chapter 3 has shown how important a reliable measure of hourly wages is.

Contributions to the literature and future research

The dissertation makes two principal contributions to the literature. First, the economic consequences of the minimum wage are estimated at the micro level. This allows conducting a detailed distributional analysis that takes behavioral adjustments into account. Second, we apply structural models to the empirical analysis of minimum wages. The structural approach allows an ex ante-analysis of a federal minimum wage and can help to evaluate already existing minimum wages when adequate data or control groups are missing. We also extend available labor supply models with rationing.

In Chapters 1 and 2 a *distributional perspective* on the economic consequences of minimum wages is adopted. Existing approaches are extended as the relationship between the effects on the distribution of gross labor earnings and disposable net incomes is investigated at the micro level. Previous studies often relied on stylized model calculations and did not simulate the complex interactions of the minimum wage with the system of taxes and transfers. Chapter 2 extends this analysis by considering behavioral changes. Microsimulation is combined with labor supply, labor demand and Engle curve estimations for the consumption descisions of households. The labor supply and the consumption models are estimated at the household level, whereas labor demand elasticities are available for different segments of the labor market. In chapter 5 we identify the probability to be constrained by labor demand restrictions even at the individual level. Moreover, we translate the increase in wage costs into price changes of consumption goods at the 2-digit level of industry classifications. The distributional analysis incoporates these different margins of behavioral adjustments.

Another important distributional aspect concerns the employment effects of the minimum wage. The models used for the identification of the employment effects allow to decompose the average employment effects of the minimum wage. There is substantial heterogeneity with respect to observed variables. Chapter 4 shows that certain groups of workers bear most of the employment losses whereas others do not suffer at all. Chapter 5 demonstrates that low-productive jobs might be substituted by more productive labor. The findings on heterogeneous effects deepen the knowledge of the economic consequences of minimum wages. The distributional dimension can often not be analyzed in quasi-experimental studies that are focused on specific treatment groups. We argue that the (re-)distributive effects of the minimum wage should receive greater attention in future research.

The empirical analyses of this dissertation are based on *structural models*. The approach for the labor supply estimates in chapters 2 and 5 consists of a structural decision model which is combined with microsimulation. Various behavioral adjustments to the minimum wage can be incorporated within a coherent modeling framework. To our knowledge such a framework has so far not been applied to the analysis of minimum wages. The connection of labor demand and supply estimates in combination with a microsimulation model is an innovation as previous studies relied on stylized calculations for a few model households. The approach enables the ex ante analysis of different minimum wage scenarios when a federal minimum wage is not yet in place.

The integration of labor supply and demand estimation is refined in Chapter 5. It contains a discrete choice labor supply model that also takes demand side constraints into account. It extends previous approaches by identifying the rationing risk not only from exogenous labor demand shocks, but also from individual productivity. We also consider unobserved individual effects that – through productivity – influence household income and labor supply as well as the rationing probability. The extended model has be shown to matter for labor supply elasticities. In particular, participation effects are smaller than in the unconstrained model. Relating the rationing risk to individual productivity and to institutional constraints on the wage setting allows applying the model to the analysis of minimum wages. This could neither be done with pure labor supply models nor with constrained models where rationing is identified by exogenous labor demand factors. In addition, we also consider the effectiveness of different types of wages subsidies. This has so far not been done in a scenario with a federal minimum wage.

The model is based on relative restrictive assumptions for identification. The crucial problem is to separately identify factors that influence labor supply and demand. Having firm information would provide additional variation that is exogenous to the individual. A practical next step is to exploit the longitudinal dimension of the SOEP data to improve the identification of the individuals' productivity. Similarly, a better instrument for the institutional constraints a firm faces for the wage setting would be useful. Another limitation of the framework is that it does not have a built-in equilibrium wage adjustment mechanism. There is no feedback link of supply and demand adjustments to the wage equation. A possible extension would be to put an unemployment indicator into the wage equation. Yet, this would also aggravate the identification problems. The current version of the model estimates supply and demand conditional on the spouse's decision in couple households. The obvious extension would be to specify a fully flexible household labor supply model which becomes more complex as additional rationing and wage equations have to included. One could also think of specifying a dynamic model. Both, labor supply and the rationing probability depend on the individual's labor market history. The refined labor supply model with rationing has plenty potential for future improvement. A better integration of labor demand into microeconometric labor supply models is a promising route to built more realistic models for policy analysis.

Ex ante simulations are subject to methodological critique. For the simulation of wage effects, e.g., simplifying assumptions have to be made: All individuals are covered by and all firms comply to the mimimum wage regulations. People earning below the threshold will earn exactly the minimum wage. Wages above the threshold are not affected at all. That no spillover effects occur might be unlikely given existing wage scales and wage premia for more productive employees. Without changes in employment we thus underestimate the average wage (and income) gains. The distributional effects on wages and incomes could be under- or over-estimated in the simulation studies of this thesis, depending on whether we focus on the bottom, or look at the whole distribution. An extension would be to simulate different scenarios where the whole wage distribution changes on the basis of previous estimates on minimum wage effects on the whole distribution. This is left for future research.

The evaluation of the employment effects in the German construction sector in chapter 4 is also based on a structural model of the labor market. The main adavantage of our structural approach is that it allows to identify the effect from a single cross-section of data. Therefore we could exploit the GSES. This is the only data set for Germany which is sufficiently large for a sector-specific analysis and contains reliable information on gross earnings and working time to calculate hourly wages. Reduced-form evaluations either need panel data, or at least repeated cross-sections. For Germany there is no longitudinal data set with precise information on working hours and sufficient observations for the construction sector. In addition, no control group is needed in the structural model. Finding adequate control groups has proven very problematic in the official evaluation studies. The structural approach is a viable alternative when the necessary institutional variation or data base is either not available, or the model assumptions are problematic. On the other hand this approach, particularly its functional form assumptions, have been criticized. A contribution of this chapter is to address these concerns and relax the assumptions by adopting semi-parametric estimation techniques.

A number of empirical questions have not been analyzed explicitly. First, we have not looked explicitly into the issue, to what degree a federal minimum wage would reduce the number of people topping up their wage income with welfare benefits. We covered this question in the policy implications above. Second, we have not calculated the fiscal effects of our different minimum wage scenarios without and with behavioral adjustments. Third, our policy simulations are always focused on a general minimum wage. One could also simulate scenarios with, e.g. regionally, flexible minimum wages and compare them to a federal minimum wage. All of these questions can be easily addressed with the existing approaches developed in this thesis.

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Summary

The dissertation fits into this empirical literature on the economic effects of a federal minimum wage in Germany. The research questions are related to the arguments and issues that have been brought forward in the policy debate and that have been addressed in the economic literature on minimum wages: How would a federal minimum wage affect the distribution of gross wages? Which individuals would be particularly affected by its introduction? Does a general minimum wage induce a significant change in the distribution of disposable household incomes when the economic agents do not adjust their behavior? Will it reduce poverty and/or overall income inequality? How would a minimum wage affect the behavior of economic agents? Do labor supply and demand adapt after the introduction of a minimum wage? What will be the likely effects on total employment? Where does the large variation in the results of published simulation studies on the employment effects of a minimum wage come from? Has the introduction of the sectoral minimum wage in the main construction trade in 1997 had an impact on employment? Which consequences has the minimum for prices of consumption goods? How will households react, do they adapt their consumption behavior? Do behavioral changes at different margins modify the distributional effects of the minimum wage on disposable incomes? Is the minimum wage an effective instrument for income redistribution? How effective would different types of wage subsidies be when a statutory minimum is in place?

We tackle these questions empirically using various micro-datasets based on survey and administrative information. The disseration employs microsimulation and micro-econometric techniques that are grounded in structural models of the labor

market. The dissertation aims to close some of the gaps in the empirical literature for Germany. The first focal point (chapters 1 and 2) is a comprehensive distributional analysis of the effects a federal minimum will have for labor earnings and disposable household incomes. The distributional analysis of net income, the interaction of the minimum wage with the tax and benefit system and the integration of behavioral adjustments at different margins has been largely neglected in the debate. The findings put a number of arguments for the minimum wage into perspective. The depth of the empirical analysis at the micro level and some methodological extensions contribute to the distributional minimum wage literature in general.

The second emphasis of the thesis (chapters 3 through 5) is to complement the existing evaluation literature on the employment effects of minimum wages with structural approaches. These are particularly helpful when information on already implemented sectoral minimum wages is limited (data restrictions, lack of control groups) and the assumptions of the reduced-form evaluation methods are challenged (chapter 4). Moreover, structural models enable ex ante evaluations of the federal minimum wage in combination with other policies (chapter 5).

Chapter 1 analyzes the distributional consequences of the introduction of a nationwide legal minimum wage of 7.50 €/hour on disposable household incomes in Germany. We are especially interested in its effect on the incidence and depth of poverty. Assuming that there are no behavioral adjustments, i.e. no disemployment effects and spill-overs in parts of the wage distribution above the nominal minimum, we simulate the counterfactual wage distribution resulting from a statutory minimum wage and compare it with the observed distribution. We then use a static microsimulation model that translates various components of individual gross incomes into disposable income after taxes and transfers at the household level. A distributional minimum wage analysis of net incomes at the household level is a novelty in the minimum wage literature. We exploit individual and household data from the German Socioeconomic Panel (SOEP). Simulation results show that the minimum wage would be ineffective in reducing poverty, although it leads to a substantial increase in hourly wages at the bottom of the wage distribution. This is an upper bound effect, since potential negative employment effects are ruled out by assumption. The ineffectiveness of the minimum wage in preventing poverty is mainly explained by the existing system of income support – the labor income often substitutes means-tested transfers. Second, people earning low hourly wages do predominantly not live in poor households.

Chapter 2 builds on these first round effects of a statutory minimum wage on net household incomes that are simulated on the basis of a tax-and-transfer microsimulation model. The distributional analysis of chapter one is extended and generalized in various respects. First, we look at the effect of different minimum wage levels on the stated goal to reduce the degree and depth of income inequality among the working population. We systematically compare different scenarios starting from a low level of 5.00 €/hour, to 8.50 €/hour, to a high minimum of 10.00 €/hour that represent the different strands of the political debate sketched above. Second, whereas chapter 1 rules out behavioral adjustments due to the minimum wage, we estimate how individuals, households and firms adapt their behavior. Labor supply, labor demand and consumption effects are considered. These adjustments are directly incorporated into the microsimulation of disposable incomes at the household level. Third, the whole income distribution and overall inequality is analyzed. The microsimulation analysis is based on SOEP data. In addition, we exploit the IAB employment sub-sample for the labor demand estimations and the Continuous Household Budget Survey for Germany for the estimation of the consumption behavior.

A statutory minimum wage would have only a very moderate impact on the distribution of net household incomes and hardly reduces overall inequality. This holds regardless of the minimum wage level. The average gains in net incomes are reduced by half when the effects on labor demand are taken into account. When increases in product prices and the adaption of consumption are also included, these gains are further diminished. As shown in the previous chapter low wage earners are not concentrated at the bottom of the income distribution. Additional labor earnings are often subject to high marginal tax rates because as they substitute transfer incomes or the splitting advantage is lost. In addition, the disemployment effects and price increases in consumption goods disproportionately affect low income households.

Chapter 3 considers various published empirical minimum wage studies that simulate employment effects of a federal minimum wage in Germany. We disentangle several factors that explain the variation of these simulation results. Based on data from the SOEP and the German Structure of Earnings Survey (GSES) we conduct robustness analyses that systematically test the range in the outcomes of different labor demand simulations. We find that labor demand effects are sensitive to measurement errors in wages, the representativeness of the sample with respect to several types of labor inputs as well as estimated and assumed labor demand and output price elasticities. Interdependencies of those determinants may lead to substantial differences in simulation outcomes.

Chapter 4 analyzes the sectoral minimum wage in the main construction sector. This study contributes to the evaluation literature for sectoral minimum wages in Germany. Instead of using the common difference-in-difference framework, the employment effects are estimated on the basis of a structural labor demand model. The structural and functional form assumptions allow to identify the effect from a single cross-sectional wage distribution of the GSES data. This data set contains reliable information on working hours and thus a precise measure of hourly wages. The administrative panel data that are used in all other evaluation studies lack this hours information which generates several problems. The methodological contribution of the chapter is to relax functional form assumptions of earlier papers by adopting semi-parametric censored quantile regressions to this framework. According to our results, employment levels would be 4-5% higher without the minimum wage in the East where the minimum bit quite hard. The effect for West Germany is markedly smaller as the minimum was hardly binding. These significantly negative effects are larger than in other evaluation studies. The semi-parametrically estimated structural approach proves to be a useful complement to established panel data or difference-in-difference models when the necessary institutional variation or data base is either not available, or the necessary assumptions are problematic.

Chapter 5 extends a static labor supply model by taking labor demand constraints into account. Contrary to previous studies we identify rationing not only from exogenous labor demand shocks, but also link the constraints to individual productivity. The framework consists of a discrete choice labor supply model. Microsimulation is used to calculate net household incomes. A structural wage/productivity equation provides predicted market wages for the non-employed and also allows identifying individual productivity. The rationing risk depends on individual productivity relative to some institutionally given minimum standard of pay (e.g. a sectoral minimum wage) and exogenous demand side variables (e.g. the regional unemployment rate). Estimating the equations jointly allows us to also model unobserved individual characteristics that influence labor supply and rationing at the same time. We use data from the SOEP, the dataset “Indicators and Maps on the Spatial Development” for the regional labor demand variables, and the GSES data to approximate minimum standards for pay.

We show that the elasticities are biased in the unconstrained model. Therefore the labor supply adjustments estimated by a pure labor supply model will not be informative for a rationed labor market. Participation elasticities are uniformly upward biased whereas for hours elasticities the bias for men is positive and for women in West Germany negative. The extended labor supply model is suited to analyze labor supply and demand reactions to the introduction of a federal minimum wage in a coherent framework. We predict significant negative participation effects which are larger in East than in West Germany and also more negative for women compared to men. The loss in total working hours would be smaller, as people remaining employed expand their working hours. Reductions in the volume of employment might thus be relatively moderate. Nevertheless we showed that jobs from low-productive people might be substituted by more productive labor. The constrained model also made a comparison of different wage subsidies under a statutory minimum possible. While employee-oriented subsidies would be largely ineffective, subsidies paid to employers and targeted at low-productive workers could nearly offset the negative effects of a federal minimum wage on participation.

German Summary

Die Dissertation reiht sich in die empirische Literatur zu den ökonomischen Effekten des Mindestlohnes in Deutschland ein. Die Forschungsfragen nehmen Argumente und Probleme der politischen Debatte auf. Sie sind ebenfalls ein zentraler Gegenstand der wissenschaftlichen Literatur zu Mindestlöhnen: Inwiefern würde ein Mindestlohn die Verteilung der Lohneinkommen beeinflussen? Welche Personen wären besonders von seiner Einführung betroffen? Würde ein allgemeiner Mindestlohn eine signifikante Veränderung in der Verteilung der verfügbaren Haushaltseinkommen verursachen, selbst wenn die ökonomischen Akteure ihr Verhalten nicht anpassen würden? Würde er die Armut bzw. die Einkommensverteilung insgesamt beeinflussen? Inwiefern würde der Mindestlohn das Verhalten der ökonomischen Akteure beeinflussen? Passen sich Arbeitsangebot und -nachfrage nach seiner Einführung an? Was sind die Folgen für die Beschäftigung? Woher kommt die große Variation in den Ergebnissen der veröffentlichen Simulationsstudien zu den Beschäftigungseffekten des Mindestlohnes? Hat die Einführung des sektoralen Mindestlohnes im Bauhauptgewerbe 1997 einen Einfluss auf die Beschäftigung gehabt? Welche Folgen hat die Einführung eines allgemeinen Mindestlohnes für die Güterpreise? Passen die Haushalte ihr Konsumverhalten an? Ändert die Verhaltensanpassung die Verteilungswirkungen des Mindestlohnes? Wie effektiv sind verschiedene Arten von Lohnsubventionen, wenn ein allgemeiner Mindestlohn in Kraft ist?

Diese Fragen werden empirisch auf Basis verschiedener Mikrodatensätze analysiert, die auf Umfragen oder administrativen Daten beruhen. In der Dissertation werden Mikrosimulationsmethoden und mikroökonometrische Ansätze verwendet, die in strukturellen Modellen des Arbeitsmarktes verankert sind. Die Dissertation beabsichtigt, verschiedene Lücken der empirischen Literatur für Deutschland zu schließen. Der erste Hauptfokus (Kapitel 1 und 2) ist auf eine umfassende Verteilungsanalyse der Effekte des Mindestlohnes gerichtet. Dabei werden Arbeitseinkommen und verfügbare Haushaltseinkommen betrachtet. Die Verteilungsanalyse der Nettoeinkommen, die Interaktion des Mindestlohnes mit dem Steuer- und Transfersystem und die Integration verschiedener Verhaltensanpassungen wurden bislang in der Debatte vernachlässigt. Die Ergebnisse relativieren einige der oft verwendeten Argumente der Mindestlohndikussion. Die detaillierte Analyse auf der Mikroebene und verschiedene methodische Erweiterungen tragen zur allgmeinen empirischen Forschungsliteratur zu Mindestlöhnen bei.

Der zweite Schwerpunkt (Kapitel 3 bis 5) besteht darin, zur empirischen Literatur zu den Beschäftigungseffekten des Mindestlohnes mit strukturellen Ansätzen beizutragen. Diese sind speziell dann hilfreich, wenn die Datenlage zu bestehenden Mindestlöhnen unzureichend ist oder keine Kontrollgruppen verfügbar sind. In diesen Fällen sind die Voraussetzungen für klassische Evaluationsansätze nicht günstig (Kapitel 4). Strukturelle Modelle können darüber hinaus zu Ex ante-Evaluationen genutzt werden.

Kapitel 1 analysiert die Verteilungswirkungen der Einführung eines allgemeinen Mindestlohnes von 7.50 €/h auf die verfügbaren Haushaltseinkommen in Deutschland. Dabei sind die Effekte auf die Inzidenz und den Grad der Armut von besonderem Interesse. Unter der Annahme, dass keine Verhaltensanpassungen erfolgen (keine Beschäftigungsverluste und keine Spillover-Effekte in höhere Bereiche der Lohnverteilung), werden kontrafaktische Lohnverteilungen simuliert, die aus der Einführung eines Mindestlohnes resultieren. Diese werden mit der beobachteten Verteilung verglichen. Anschließend werden die Änderungen der Bruttoeinkommen mit einem Mikrosimulationsmodell in verfügbare Haushaltseinkommen übersetzt. Eine Verteilungsanalyse des Mindestlohnes auf Haushaltsebene ist bislang noch nicht durchgeführt worden. Wir nutzen Daten des Sozio-Oekonomischen Panels (SOEP). Die Simulationsergebnisse zeigen, dass der Mindestlohn die Armut nicht reduzieren würde, obwohl die Stundenlöhne am unteren Ende der Verteilung erheblich ansteigen würden. Dabei handelt es sich eher um die Obergrenze der Wirkungen, da potenziell negative Beschäftigungseffekte ausgeschlossen werden. Die Hauptursachen für dieses Ergebnis sind Wechselwirkungen mit dem bestehenden sozialen Sicherungssystem: die höheren Arbeitseinkommen substituieren oft bestehende Transfers. Zudem leben Niedriglohnbezieher nicht unbedingt in armen Haushalten.

Kapitel 2 baut auf diesen Erstrundeneffekten auf. Die Verteilungsanalyse des ersten Kapitels wird um einige Aspekte bereichert. Erstens werden verschiedene Mindestlohnniveaus verglichen: ein niedriges Level von 5.00 €/h, über 8.50 €/h, bis hin zu einem hohen Niveau von 10.00 €/h. Diese repräsentieren die verschiedenen Stränge der eingangs angeführten Debatte. Zweitens, während Kapitel 1 Verhaltensanpassungen ausgeschlossen hat, wird hier geschätzt, wie Individuen, Haushalte und Firmen ihr Verhalten nach der Mindestlohneinführung ändern würden. Arbeitsangebot und -nachfrage sowie das Konsumverhalten werden betrachtet. Die Anpassungen werden direkt in das Mikrosimulationsmodell integriert. Drittens wird die gesamte Einkommensverteilung und die Ungleichheit analysiert. Die Mikrosimulation und die Arbeitsangebotsschätzungen basieren auf Daten des SOEP. Die Arbeitsnachfrageeffekte werden auf Basis der IAB-Beschäftigungsstichprobe geschätzt und die Laufenden Wirtschaftsrechnungen werden für die Schätzung der Konsumeffekte verwendet.

Ein allgemeiner Mindestlohn hätte nur geringe Auswirkungen auf die Verteilung der Netthaushaltseinkommen und würde die Ungleichheit nicht reduzieren. Dies gilt unabhängig vom Niveau des Mindestlohnes. Die durchschnittlichen Einkommensgewinne werden halbiert, wenn Arbeitsnachfrageeffekte berücksichtigt werden. Wenn der Anstieg der Güterpreise und die Anpassung des Konsumverhaltens einbezogen werden, reduzieren sich diese Gewinne weiter. Wie im ersten Kapitel gezeigt, sind Niedriglohnbezieher nicht am unteren Ende der Einkommensverteilung konzentriert. Arbeitseinkünfte unterliegen häufig hohen marginalen Steuersätzen. Zudem betreffen Beschäftigungsverluste und Anstiege der Konsumgüterpreise Haushalte mit niedrigen Einkommen überdurchschnittlich.

Kapitel 3 betrachtet verschiedene veröffentlichte Simulationsstudien zu den Beschäftigungseffekten eines allgemeinen Mindestlohnes in Deutschland. Wir untersuchen verschiedene Faktoren, die die Variation in diesen Ergebnissen erklären. Auf Basis von Daten des SOEP und der Verdienststrukturerhebung (VSE) führen wir verschiedene Robustheitsanalysen durch, die systematisch die Bandbreite der Ergebnisse von Arbeitsnachfragesimulationen ausloten. Wir finden, dass die Ergebnisse sensitiv auf Messfehler bei Stundenlöhnen, die Repräsentativität des jeweiligen Datensatzes im Hinblick auf verschiedene Formen von Beschäftigung wie auch die verwendeten Arbeitsnachfrageelastizitäten reagieren. Interdependenzen zwischen diesen Faktoren können erhebliche Abweichungen hervorrufen.

Kapitel 4 analysiert den sektoralen Mindestlohn im Bauhauptgewerbe. Die Studie trägt zur Evaluationsliteratur der sektoralen Mindeslöhne in Deutschland bei. Anstelle des gängigen Differenz-in-Differenzen-Ansatzes werden die Beschäftigungseffekte auf Basis eines strukturellen Arbeitsnachfragemodells geschätzt. Annahmen zur funktionalen Form erlauben die Identifikation des Effektes auf Basis einer Querschnittslohnverteilung der VSE-Daten. Der Datensatz enthält zuverlässige Informationen zu den Arbeitsstunden und daher präzise gemessene Stundenlöhne. Die administrativen Daten, auf denen die offiziellen Evaluationsstudien beruhen, verfügen nicht über diese Informationen. Der methodische Beitrag besteht in der teilweisen Lockerung der Annahmen zur funktionalen Form auf Basis semiparametrischer zensierter Quantilsregressionen. Laut den Ergebnissen wäre das Beschäftigungsniveau im ostdeutschen Bauhauptgewerbe, wo der Mindestlohn besonders hoch angesetzt war, um 4-5% höher gewesen, wenn der Mindestlohn nicht eingeführt worden wäre. Die Effekte sind deutlich geringer im Westen, wo der Mindestlohn erheblich niederiger lag. Die signifikant negativen Effekte sind größer als in bisherigen Schätzungen. Der strukturelle Ansatz kann herkömmliche Evaluationsmethoden ergänzen, wenn die notwendige institutionelle Variation nicht vorhanden, die Datenbasis ungenügend ist oder die identifizierenden Annahmen für die konkrete Anwendung problematisch sind.

Kapitel 5 erweitert bisherige Arbeitsangebotsmodelle mit Restriktionen der Arbeitsnachfrage. Im Gegensatz zu bisherigen Modellen wird die Rationierung nicht ausschließlich auf Basis exogener Arbeitsnachfragevariablen identifiziert, sondern auch mit der individuellen Produktivität erklärt. Der Ansatz basiert auf einem diskreten Entscheidungsmodell zum Arbeitsangebot. Haushaltnettoeinkommen werden mit einem Mikrosimulationsmodell berechnet. Eine strukturelle Lohn- und Produktivitätsgleichung liefert potenzielle Löhne für Nichtbeschäftigte und erlaubt auch, die individuelle Produktivität zu schätzen. Das Rationierungsrisiko hängt von der individuellen Produktivität in Relation zu institutionell gegebenen Lohnuntergrenzen für Firmen ab. Exogene Nachfrageindikatoren tragen zur Identifikation bei. Die einzelnen Gleichungen werden simultan geschätzt und unbeobachtete Heterogenität, die simultan das Arbeitsangebot und die -nachfrage beeinflusst, wird modelliert. Neben dem SOEP werden Indikatoren zur Raumentwicklung und Daten aus der VSE verwendet.

Wir zeigen, dass die Arbeitsangebotselastiziäten des Modells ohne Rationierung verzerrt sind. Daher sind die Arbeitsangebotsänderungen, die ein reines Angebotsmodell prognostiziert, für Arbeitsmärkte mit Rationierung nicht informativ. Das erweiterte Modell kann zur Analyse von Arbeitsangebots- und Arbeitsnachfragereaktionen auf die Einführung eines allgemeinen Mindestlohnes genutzt werden. Das Modell sagt signifikant negative Beschäftigungswirkungen für diesen Fall voraus, wobei die Effekte für Frauen und Ostdeutschland jeweils größer ausfielen. Der Rückgang des Beschäftigungsvolumens wäre deutlich geringer, da die Beschäftigten gleichzeitig ihre Stunden ausdehnen würden. Damit können vom Mindestlohn hervorgerufene Substitutionseffekte transparent gemacht werden. Das erweiterte Modell wird auch zu einem Vergleich arbeitnehmer- und arbeitgeberseitiger Lohnsubventionen unter einem allgemeinen Mindestlohn herangezogen. Während Subventionen für Arbeitnehmer weitgehend wirkungslos blieben, könnten arbeitgeberseitige Zuschüsse die negativen Partizipationseffekte des Mindestlohnes weitgehend kompensieren.