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ARE EMPLOYMENT EFFECTS OF MINIMUM WAGE THE SAME ACROSS THE EU? A META-REGRESSION ANALYSIS

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Are Employment Effects of Minimum Wage the Same Across the EU? A Meta-Regression Analysis

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Abstract:
There is still an ongoing debate on employment effects of minimum wage. Not only the magnitude, but also the direction of the effect is a matter of concern. Economic theory on its own cannot unanimously resolve the dispute as it provides concepts within which both negative and positive effects are conceivable. In order to integrate the empirical findings, I deployed a meta-regression analysis (MRA) to systematically review 187 estimates from 18 empirical studies that estimated minimum wage elasticities of employment for countries of the EU. The results show that, overall, there is no practically significant employment effect of minimum wage. Also, no evidence of publication selection bias was found. A more sophisticated, multivariate MRA identified differential effects for specific industries, namely residential home care and retail sector for which the employment effects are significantly negative. The results also indicate that minimum wage negatively affects female employment. Finally, the multiple MRA also investigated whether the employment effects differ across three wider regions of the EU (the West, the South, and the East). The results provide robust evidence of significant differential effects, and show that minimum wage has moderately negative employment effects in the eastern countries of the EU.

JEL: J38, J68
Keywords: Minimum wage, employment effect, meta-regression analysis

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1 Introduction

Many put hopes in minimum wage policy as a redistributive tool that can empower disadvantaged groups in the labour market (Addison & Blackburn, 1999; Freeman, 1996; Stigler, 1946). Others also argue that, besides alleviating poverty, minimum wage stimulates aggregate demand (Herr & Kazandziska, 2011). As the argument goes, low-income households have higher propensity to consume than high-wage earners and thus, transfers from the rich to the poor increases output.

Critics counter that such policies eventually hurts those whom they are meant to help (Brown, Gilroy, & Kohen, 1982). The biggest concerns is that it can lead to general loss of jobs and can make it harder especially for low-skilled workers to find a job. Such predictions are mostly based on a model of a perfectly competitive labour market where workers are paid the value of their marginal product. In such settings, minimum wage policy would indeed need to result either in employment decrease or increased productivity (Stigler, 1946).

On the other hand, in an environment where employers have some monopsony power, an appropriately set minimum wage can in fact increase employment (Maurice, 1974; Stigler, 1946). As Machin and Manning (1994) remarked, empirical literature had for long been concerned only with the size of the negative effects, paying no serious attention to the possibility of the effects being positive. That has changed during the 1990s when new empirical studies (Card & Krueger, 1995b; Machin & Manning, 1994) sparked a debate on whether the employment effects are necessarily negative after all.

However, until these days the discussion is anything but settled (Bazen, 2000; Lemos, 2004; Manning, 2016; Neumark & Wascher, 2007). The endeavour that emerged in the early 2000s, and which Schmitt (2013) calls 'the new minimum-wage research', also did not deliver any clear reconciliation. On one side, there are studies reporting significant negative effects (Abowd, Kramarz, Margolis, & Philippon, 2000; Burkhauser, Couch, & Wittenburg, 2000; Machin, Manning, & Rahman, 2003; Neumark, Schweitzer, & Wascher, 1999; Neumark & Wascher, 2000) and on the other side are those that find no or positive employment effects (Abowd et al., 2000; Card & Krueger, 1994, 1995b; Dickens, Machin, & Manning, 1999; Harasztosi & Lindner, 2017; Machin & Manning, 1994; Stewart, 2002).

A comparison of two particular studies can provide an illustrative example of the inconsistency in findings in this area. Karageorgiou (2004) reports negative impact on youth and positive on teenage employment, while Pereira (2003) finds the exact opposite, i.e. negative effects on teenagers and positive on youth.

Understanding where the differences in empirical results stem from is an essential question if any reconciliation is to be achieved. The origins of the differences can possibly be of three kinds. Firstly, there can be real differences in the employment effects across countries, social groups, industries etc. Secondly, the variance of the results can be purely of a statistical nature (Petticrew & Roberts, 2006).

And thirdly, the differences might arise due to different methodologies, different kind and quality of data, different measures of minimum wage etc. Interestingly enough, Eagly & Carli (1981) showed that reported results can also depend on researches characteristics and their beliefs. It is conceivable that, for example, researchers' beliefs about the impact of minimum wage could possibly proliferate to their results through a mechanism known as self-fulfilling prophecy or researchers' expectations effect, which has been described by psychologists (Rosenthal & Jacobson, 1966; Rosenthal & Rubin, 1978).

In order to filter out these potential disturbances and to disentangle the real effects of specific factors (e.g. industry or group for which the effects were estimated) from the general employment effect of minimum wage, I analyse the literature using a meta-regression analysis (MRA) (see section 2). This paper analyses studies that focus on minimum wage effects in European Union countries. Special attention is devoted to a question of whether the employment effects differ significantly across EU wider regions, namely the West, the East, and the South. This could be of some practical relevance in a debate about potential introduction of an EU-wide minimum wage.

2 Meta-analysis and Meta-regression analysis (MRA)

Meta-analysis refers to a statistical analysis of a large amount of quantitative results of primary research. It intends to synthetize findings in a literature on a given topic and to shed light on factors that may be responsible for differences between the results of individual studies (Glass, 1976, 1997). Unlike traditional narrative discussions of research, a meta-analysis follows an explicit set of rules that are defined at the outset and that specifies the rules for literature search and selection. It is thus a systematic and consistent approach that helps preserve as much objectivity as possible and reduce researcher's subjective judgement of what studies are relevant or deserve attention (Stanley & Jarrell, 1989).

Meta-regression analysis, then, is a regression analysis which uses the results published in literature as dependent variables and regresses them on various factors that could possibly impact the results reported. As Stanley wrote: 'Meta-regression analysis is a form of meta-analysis especially designed to investigate empirical research in economics' (Stanley, 2001, p. 131).

Petticrew and Roberts (2006) explain the importance of systematic reviews in social sciences. They point out that systematic literature reviews are of value whenever an effect of an intervention is in question and an extensive mass of literature needs to be analysed. Petticrew and Roberts (2006) emphasise that single studies without any consideration of a broader context can be sometimes misleading. Importantly, there are very few studies that have methodology so sound that their results could be easily generalised without any concerns. Thus, a meta-regression analysis gives the results more solid foundations as it builds up on a wide body of literature.

Besides the merits of combining the results into a comprehensive evidence base, meta-analysis has also some drawbacks. The most relevant being that the quality of the meta-analysis results cannot exceed the quality of its inputs (Grant & Booth, 2009).

According to Hafner et al. (2016), another shortcoming of this method is a certain degree of subjectivity which is present in the researchers' selection of studies. This, however, can be addressed through a transparent selection process as already described above. Also for this reason, Stanley, Doucouliagos, Giles, Heckemeyer, and Johnston (2013) issued reporting guidelines for meta-analyses of economic research which aim to standardize the procedure and thus to ensure that the meta-regression analysis is as consistent as possible. This work also follows these guidelines.

MRAs of minimum wage's employment effects

Meta-regression analysis has been used increasingly and extensively in the field of economics in recent years (H. Doucouliagos & Stanley, 2009; Nelson & Kennedy, 2009; Stanley & Doucouliagos, 2012). Below I detail those focusing on the impact of minimum wage.

One of the first influential meta-analysis on this topic was Card and Krueger's (1995a) study that scrutinised 15 US minimum wage studies that deployed time-series for estimating the employment effects. They found publication selection bias that favoured studies which reported statistically significant adverse employment effects. Doucouliagos and Stanley (2009) in their meta-regression analysis of 64 US minimum wage studies corroborated Card and Krueger's (1995a) findings of publication selection bias as they showed that studies reporting negative minimum wage effects were more likely to be publish. Importantly, after correcting for the publication selection bias, they did not find any significant negative employment effects.

Boockmann (2010) found significant cross-country differences when he analysed 55 empirical studies that estimated employment effects of minimum wage in 15 industrial countries. He then undertook an investigation of the heterogeneity in estimated results and tried to see if it could be explained by labour market institutions. He considered, namely, the benefit replacement ratio, employment protection and collective bargaining system. The country-specific effects were found to remain significant even after controlling for the labour market institutions.

Nataraj, Perez-Arce, Kumar, and Srinivasan (2014) used meta-analysis for reviewing research that analysed impact of labour market policies in low-income countries. They utilised 17 studies in their meta-sample and found that minimum wage in these countries led to lower formal employment but at the same time it didn't affect unemployment. They argued that in the low-income countries it was easier to slip into the informal sector. Therefore, they concluded that minimum wage in low-income countries caused the workers to move into the grey economy.

Data from 23 studies published after 2000, of which the majority concerned the USA, were used in the analysis of Belman and Wolfson (2014). The authors report negative employment effects that are statistically significant, though very small and practically insignificant.

De Linde Leonard, Stanley, and Doucouliagos (2014) narrowed their focus only on the UK minimum wage studies. That meant that their meta-sample consisted of 16 studies from which they derived 710 partial correlations and 236 elasticities. They also did not find any practically significant adverse employment effect. They also concluded that a negative employment effect could, however, exist in residential home care industry.

Hafner et al. (2016) followed up and further extended the study of de Linde Leonard, Stanley, and Doucouliagos (2014). They systematically reviewed studies that estimated the impact of the UK minimum wage on employment, hours worked and employment retention probabilities. They concluded that there was no true negative effect of minimum wage on none of these three indicators.

Contrary to an earlier study of Doucouliagos and Stanley (2009) that analysed US minimum wage literature, both de Linde Leonard, Stanley, and Doucouliagos (2014) and Hafner et al. (2016) did not find publication selection bias.

Giotis and Chletsos (2015) investigated the presence of publication bias in the minimum wage literature published during the period from 2010 to 2014, i.e. the period following the publication of Doucouliagos and Stanley (2009) that found the presence of publication selection bias in the US minimum wage literature. They analysed a sample of 45 empirical studies. The results showed that publication selection bias was still found among minimum wage elasticities but not among minimum wage coefficients. Nevertheless, once corrected for the bias, only a small negative effect was found.

3 MRA of minimum wage's employment effect in the EU

The main goal of this work is to estimate the true employment effect of minimum wage in European Union countries and to investigate if the effects vary across three wider regions of the EU - the West, the East and the South.

The South includes 4 countries of Southern Europe, namely Greece, Italy, Spain and Portugal. The East consist of post-communist countries and the West then includes all the other countries of western, central and northern Europe that do not fall in any of the previous regions. The table below summarizes this classification.

Table 1: Countries classification into wider regions

Region	Countries
The West	Austria, Belgium, Denmark*, Finland*, France, Germany, Ireland, Luxembourg*, Malta*, Netherlands, Sweden, United Kingdom
The East	Bulgaria*, Croatia*, Czech Republic, Estonia*, Hungary*, Latvia*, Lithuania*, Poland, Romania*, Slovakia, Slovenia
The South	Cyprus*, Greece, Italy, Spain, Portugal

Note: '*' marks countries for which no minimum wage study that would meet selection criteria defined below was found. Therefore, their classification does not impact the results.

The Research Data

During the collection of the literature, I used the UCL library's search engine Explore that covers a wide range of databases.[1] In order to double-check that relevant literature appeared in the initial search, I also searched ECONLIT and RePEc databases separately and found that all results from these databases indeed appear already in the initial search.

In the Table 1 below I detail the key words used in the search. The same combinations were used for searching each database. The search was completed on 24th of August 2018.

Table 2: Keywords used in the literature search

Keywords combination	Text field specified
'minimum wage'	All
'minimum wage' AND 'employment'	TI + TI, AB + AB
'minimum wage' AND 'increase'	TI + TI
'minimum wage' AND 'consequences'	TI + TI
'minimum wage' AND 'impact'	TI + TI, AB + AB

Note: TI = Title, AB = Abstract. 'AND' is an option in the search engine that returns only results where both keywords are present. The right column describes in which text field were the respective keywords searched.

In order to be included in the meta-sample, a study had to meet the following criteria that were define before the search began:

- A study that estimated employment effects of minimum wage in any of the European Union member states,
- Published in peer-reviewed journals after 1995,
- Published in English,
- Minimum wage elasticity of employment and its standard error had to be reported, or the sufficient information which allowed conversion of the estimated coefficients in to elasticities had to be provided,
- Employment effects were estimated econometrically by an estimator more sophisticated than simply a bivariate correlation,

[1] The complete list of databases covered by UCL Explore can be found at http://www.ucl.ac.uk/library/electronic-resources/databases.

- Studies that estimated employment effects for several countries (e.g., in a pooled cross-section time-series study for a panel of countries) are excluded, unless they report country-specific estimates,[2]
- Studies using unemployment rate as dependent variable were excluded.[3]

There are two reasons for selecting elasticities of employment with respect to minimum wage as the common metric for the analysis. Firstly, empirical effects of minimum wage are most frequently reported in the form of minimum wage elasticities. And secondly, elasticities are deemed to be relatively stable (Giotis & Chletsos, 2015).

When collecting the data, I first revised the data sets used by de Linde Leonard et al. (2014) and Giotis & Chletsos (2015) and draw the eligible data from them. Then I carried out the search as described above. The complete meta-sample counted 18 eligible studies from which 187 estimates were derived.

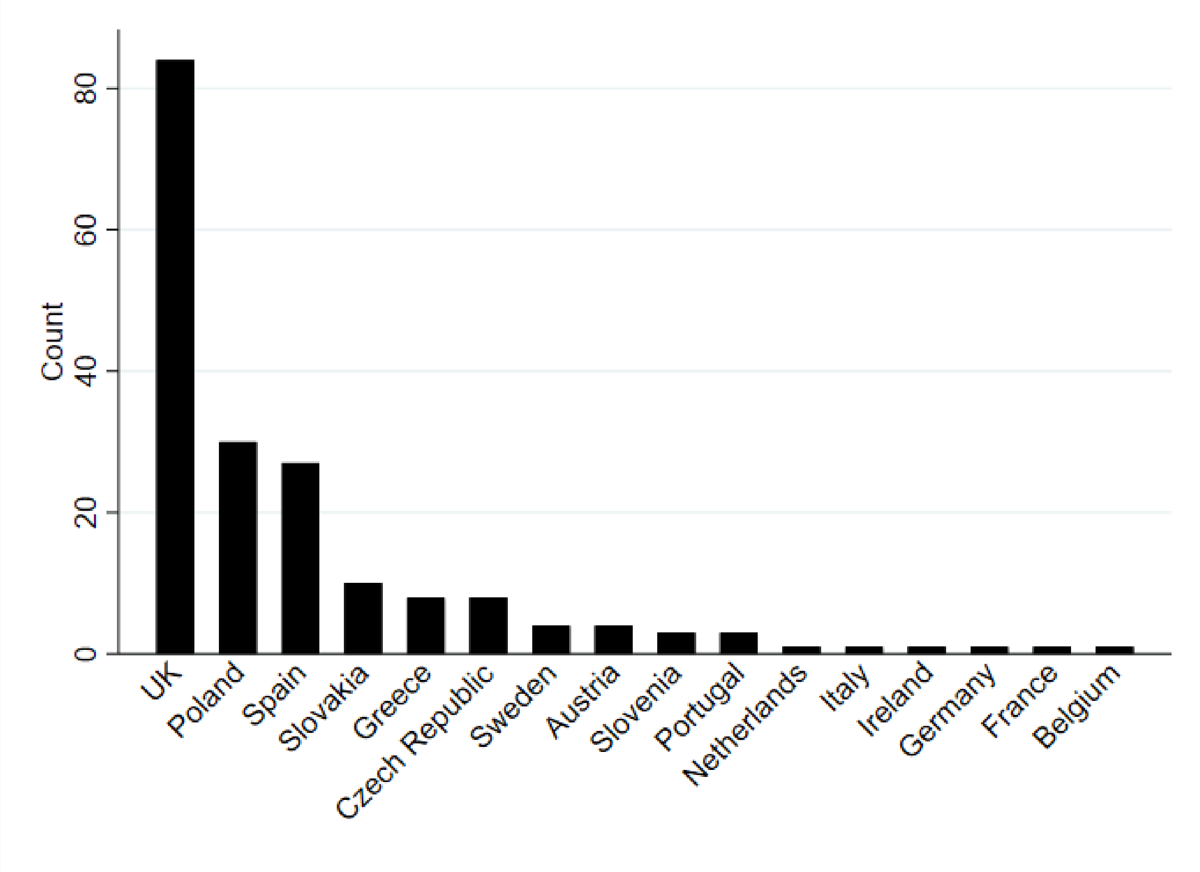
Figure 1 shows the number of estimates broken down by countries. It shows that by far the biggest share, almost 45% of all estimates, concern the impact of minimum wage in the UK. The breakdown of the number of estimates by the regions would then show that 51 observations (27%) concern the East, 39 (21%) concern the South, and the remaining 97 (52%) are then the estimates for the West.

Basic meta-analysis

The distribution and descriptive statistics of the sample of estimates of minimum wage elasticity are depicted in Figure 1. Notice that the mean elasticity is -0.038. That means that the minimum wage would have to be raised by approx. 26% to result in 1% decrease in employment. Such a small magnitude of the effect can bring its practical insignificant into question. Coincidentally, the median of -0.030 is exactly the same as found by de Linde Leonard et al. (2014) in the meta-analysis of the UK minimum wage research.

[2] This and the previous point follow the selection criteria in Boockmann (2010).
[3] This point is adopted from Giotis and Chletsos (2015).

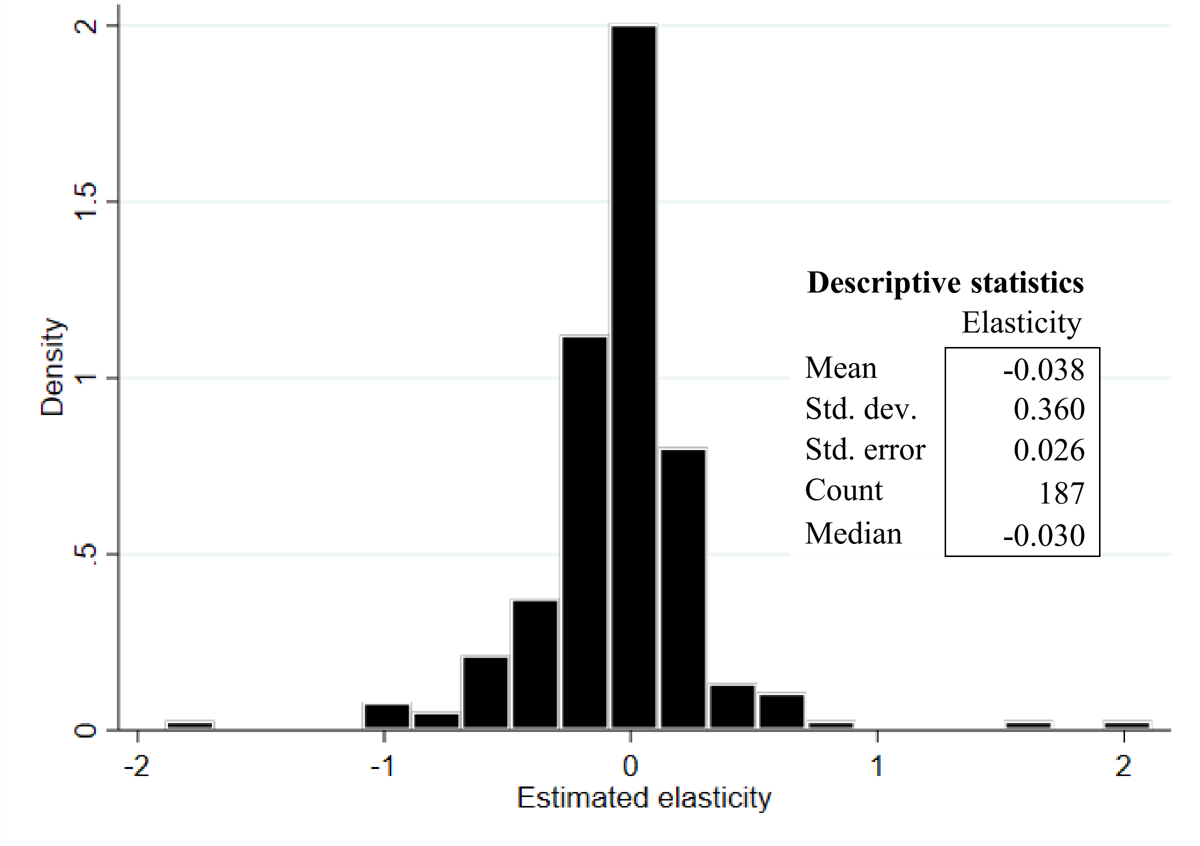
Figure 1: Number of observations for each country



The sample contained one significant outlier which deviated from the mean by a margin greater than 10 standard deviations. Thus, this observation was excluded from the sample. It was an estimate from a study by Balcombe and Prakash (2000) that estimated the effect of minimum wage indirectly, through modelling supply and demand of a labour market. This study, unlike all of the others, provided only one estimate of the minimum wage elasticity, so it meant that an entire study was excluded.

Nevertheless, there is still non-negligible variance of the estimates that needs to be explained. In the following parts, a multiple MRA is deployed to investigate whether the variance is a mere noise caused by differences in methodology and the type of data used, or whether there are factors that truly cause the magnitude of minimum wage's employment effects to vary.

Figure 2: Distribution of estimates of minimum wage elasticity of employment



But since other meta-analysis (H. Doucouliagos & Stanley, 2009) revealed that publication selection bias can be present in the minimum wage research, I start with a test for its detection.

Publication selection bias

The existence of publication bias is a well-recognized problem in social sciences, economics and medical research (Begg & Berlin, 1988; Card & Krueger, 1995a; De Long & Lang, 1992; Glass, McGaw, & Lee, 1982; Rosenthal, 1979; Wasserman, Hedges, & Olkin, 1988). The problem is, as Rosenthal (1979) puts it, that while studies that report statistically significant results fill the journals, the others, which in the extreme case would consist 95% of the all the studies, only fill the file drawers. Such a selection can then lead to exaggerated size of the effects of an empirical phenomena at hand (C. Doucouliagos, Stanley, & Giles, 2012; Havránek, 2010; Stanley & Doucouliagos, 2012).

It was showed by Doucouliagos and Stanley (2009) that the US minimum wage research was also contaminated by this selective reporting. They found a profound publication bias and showed that it was the publication bias which was responsible for the significantly negative employment effect found in the meta-analysis of 64 US minimum wage studies. After they controlled for the publication bias, no significant adverse employment effect remained.

Although de Linde Leonard et al. (2014) have not found any trace of publication bias in the UK minimum wage literature, Giotis & Chletsos (2015) found small though statistically significant publication selection bias in their sample of elasticities. As the meta-sample used for this study partly overlaps with the meta-samples of these two studies, I also carry out the test to detect the potential bias.

It has been shown that a simple model is effective in identifying publication bias (C. Doucouliagos et al., 2012; Egger, Smith, Schneider, & Minder, 1997; Stanley, 2008). Namely, it is the so called Funnel Asymmetry Test (FAT) and takes the following form:

$$effect_i = \beta_0 + \beta_1 SE_i + \varepsilon_i \qquad (1)$$

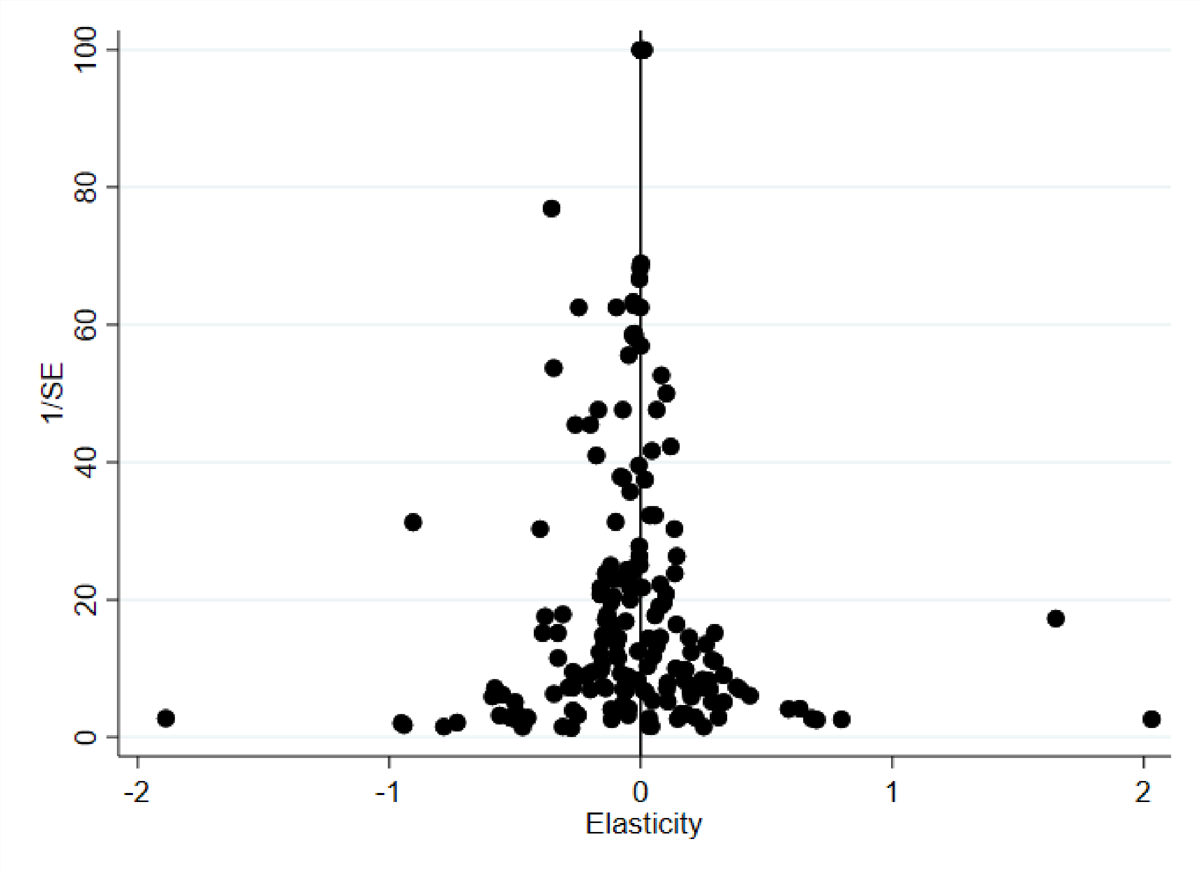
where $effect_i$ is an i^{th} estimate of interest (minimum wage elasticity in our case) and SE_i is a standard error of the corresponding estimate. The matter of interest in model (1) is the term $\beta_1 SE_i$ through which the publication selection bias is captured. As de Linde Leonard et al. (2014), the idea behind FAT is that the larger standard error of the estimate, the more remodelling, resampling and further estimation is needed for such an estimate to gain statistical significance.

In other words, standard errors get larger as the analysed sample gets smaller. And with smaller samples, more extreme results are more likely to be found. Then, if one extreme is more likely to be published, the mean of estimates and thus the overall picture of the real effects would be biased. And FAT accommodates exactly for this effect.

It has become conventional to identify publication selection bias through the FAT. Practically, the FAT requires testing H_0: $\beta_1 = 0$. (Egger et al., 1997; Stanley, 2008). In order to see whether there is any genuine empirical effect left after the publication bias has been taken care of, the focus shifts to β_0. By testing H_0: $\beta_0 = 0$ we verify whether any genuine effect remains (Stanley, 2008). This is called Precision-effect Test (PET).

The simplest way to spot a publication bias is by visually analysing a funnel graph which is a plot of elasticities and the inverse of their standard errors (Giotis & Chletsos, 2015). A clear asymmetry would suggest the presence of publication bias. Such a funnel graph is provided below (see figure 3).

Figure 3: Funnel graph of minimum wage elasticities



This funnel graph does not reveal any obvious publication bias as the points seem to be quite symmetrically distributed. However, it is meant only as a basic and approximate test and thus the presence of publication cannot be ruled out yet. To investigate its presence in a more sophisticated manner, the FAT-PET test is employed and reported below.

Table 3 provides the estimation results for the model (1). As meta-regressions commonly suffer from heteroscedasticity (de Linde Leonard et al., 2014), I first carried out White and Breusch-Pagan test. The results of both tests, White (F(2, 184)=804.69; p-value << 0.01) and Breusch-Pagan (F(16, 170)=2.47; p-value=0.002), indicate the presence of heteroscedasticity in the meta-sample. Therefore, throughout all the estimations I employ weighted least squares (WLS).

Moreover, having derived 187 estimates from 18 studies means that each study provides several estimates. The estimates coming from a single study cannot be assumed independent. Therefore, in order to take this peculiarity into account, cluster-robust standard errors are used throughout the study.

Table 3: Weighted least square of Meta-regression Model (1)

	(1)
Dependent variable	elasticity
SE: β_1 {**FAT**}	-0.955
	(1.474)
Constant: β_0 {**PET**}	0.544
	(0.507)
Observations	187
R-squared	0.015

Notes: Cells report coefficients for equation (1). Cluster-robust standard errors are provided in parentheses. As coefficient β_1 is not significantly different from zero, the FAT did not find publication bias. β_0 is also not significantly different from zero which suggests that no genuine empirical effect is found.
*** p<0.01, ** p<0.05, * p<0.1

The results in Table 3 show that there is no statistical evidence for publication bias in the analysed meta-sample as $\hat{\beta}_1$ is not significantly different from zero (t-test, p = 0.526) – see FAT in Table 3. Nor is there a statistical evidence for a genuine empirical effect of minimum wage since $\hat{\beta}_0$ is also not significantly different from zero (t-test, p = 0.299) – see PET in Table 3.

Both of these findings are consistent with those reported by de Linde Leonard et al. (2014) and Hafner et al. (2016). The slight deviation occurs in the study of Giotis and Chletsos (2015). In this paper, although they also did not find any significant employment effect of minimum wage, they did find publication selection bias in their meta-sample of employment elasticities. However, their sample contained only studies published during the years 2010-2014 and did not restrict their sample geographically. In this study, the sample was restricted on studies estimating the employment effects for the EU countries only and the publication time span ranged from 1996 to 2018.

In order to check for robustness of the findings, outliers defined by the cluster-robust FAT-PET-MRA model (1) were excluded. Similarly as in de Linde Leonard et al. (2014), for an observation to be considered an outlier, the absolute value of its residual from the model (1) estimation had to exceed the multiple of 2.5 of the residuals' standard deviation. Through this process, 5 observations were identified as outliers.

Table 4: Robustness check for Meta-regression Model (1)

	(1)
Dependent variable	elasticity
SE: β_1 {**FAT**}	-0.708
	(0.803)
Constant: β_0 {**PET**}	0.134
	(0.194)
Observations	182
R-squared	0.057

Notes: Cells report coefficients for equation (1) after outliers are removed. Cluster-robust standard errors are provided in parentheses. As coefficient $\hat{\beta}_1$ is not significantly different from zero, the FAT did not find publication bias. $\hat{\beta}_0$ is also not significantly different from zero which suggests that no genuine empirical effect is found.
*** p<0.01, ** p<0.05, * p<0.1

The estimation results of the Model (1) after removing outliers are reported in Table 4. As before, WLS with cluster-robust standard errors were used. Although the estimates changed slightly, both $\hat{\beta}_0$ (t-test, p = 0.513) and $\hat{\beta}_1$ (t-test, p = 0.284) remain statistically insignificant. Thus even after removing outliers, no evidence of publication selection bias and genuine nonzero employment effect is found. In other words, the MRA suggest that, overall, minimum wage does not affect employment.

A list of several possible explanations why minimum wage can have no significant negative employment effects is presented by Metcalf (2008). Although the list was tailored specifically for the UK, several of the explanations are generally applicable. Among the explanations which Metcalf (2008) labels as probable, he suggests that instead of reducing employment, minimum wage might rather increase output prices and/or decrease profits. This explanation can be corroborated by the findings of Harasztosi & Lindner (2017) who showed that a considerably large increase in Hungarian minimum wage in 2001 had practically neglectable impact on employment, while it indeed increased prices and slightly compressed profits.

Another possible way in which businesses may cope with minimum wage while not reducing employment is by increasing productivity and their employee's effort (Metcalf, 2008). Productivity might be increased for example be boosting capital investments. Such investment might be both extensive and intensive, meaning that either the capital stock is expanded or the quality of the existing stock is improved. This can be, again, supported by the findings of Harasztosi & Lindner (2017) who found that firms most exposed to the minimum wage hike increased their capital investment considerably. Minimum wage hike can also prompt companies to invest more into training that augments human capital and to organise work more effectively (Metcalf, 2008).

The existence of monopsony in the labour market, as already discussed in the introduction, is also a likely explanation. Although one would not expect to find a monopsony in the traditional form in contemporary low-wage segments of the labour market, some form of monopsonistic competition can be realistically assumed (Metcalf, 2008). The evidence of monopsonistic wage determination is provided by several studies (Lam, Ormerod, Ritchie, & Vaze, 2006; Manning, 2003; Ram & Edwards, 2004).

The last explanation that Metcalf (2008) also highlighted as probable (rather than just possible) is that minimum wage would reduce hours worked rather than the number of employees as lay-offs may be costly due to redundancy payments, unfair dismissal claims, etc. This, however, is not unambiguously supported by the empirical literature. Although some studies indeed showed that minimum wage led to reduction in hours worked (Stewart & Swaffield, 2002, 2008), others (Connolly & Gregory, 2002) showed that it does not always have to be the case. As it is the purpose of meta-regression analysis to integrate findings of empirical literature, the effect on hours worked rather than on employment is also controlled for in the multiple MRA which is reported in the following section.

Lastly, it can be suggested that endogeneity of minimum wage could be also an issue. If minimum wage was increased as a response to increasing employment (i.e. if minimum wage was endogenous) and studies failed to control for this endogeneity, it would bias the results and could potentially explain the absence of adverse employment effect. However, Dickens et al. (1999) tried to control for the potential endogeneity but did not find any evidence that it would matter. Nevertheless, the multiple MRA reported below takes into account the potential uncontrolled endogeneity. It does so by controlling for the use of difference-in-differences approach as it can be argued that difference-in-differences setting eliminates the potential impact of endogeneity (Stewart & Swaffield, 2008).

Multiple MRA

Model (1) can be further extended in order to account for potential heterogeneity and complexity of employment effects, potential misspecification biases and researchers' characteristics and differential inclination to report certain results. The expanded model in general form then reads as follows:

$$effect_i = \beta_0 + \sum_k \beta_k Z_{ki} + \beta_1 SE_i + \sum_j \delta_j SE_i K_{ji} + \varepsilon_i \quad (2)$$

Compared to MRA model (1), this multiple MRA model (2) only breaks down the two terms from the first model into smaller pieces. To illustrate it, notice that β_0 is now broken down into $\beta_0 + \sum_k \beta_k Z_{ki}$ and the second term of the model (1) is now replaced by $\beta_1 SE_i + \sum_j \delta_j SE_i K_{ji}$.

Using $\beta_0 + \sum_k \beta_k Z_{ki}$ allows to control for heterogeneity by including Z-variables that may control for e.g. a specific group, industry or country for which the effect was estimated. The Z-variables also include the factors that may help control for misspecifications, such as the methodology used or the kind of data analysed.

The term $SE_i K_{ji}$ is meant to help identify factors that might explain propensities to selective reporting. However, similarly as de Linde Leonard et al. (2014), I do not include K-variables since there was no publication selection bias detected in the meta-sample. Moreover, inclusion of K-variables could lead to very large collinearity (Stanley & Doucouliagos, 2012).

The list of moderator variables, their means and standard deviations is provided in Table 5. The selection of moderator variables was driven by the effort to cover all possible areas from which the heterogeneity and specification biases might originate. In general terms, the aim was to account for potential region-specific, data-type-specific, group-specific and industry-specific effects, and the potential effects of different measures (operationalization) of minimum wage. Thus, variables *East* and *South* are meant to capture the region-specific effects, *PanelorCS* and *TS* control for data-type-specific effects, *TeenorYouth* and *Female* control for group-specific effects, *Homecare, Retail,* and *Otherindustry* help control for industry-specific effects, and finally *Kaitz, Share,* and *MWlevel* capture potential bias caused by different operationalization of minimum wage.

Table 5: Descriptive statistics of moderator variables

Moderator variable	*Definition*	*Mean (standard deviation)*
SE	is the standard deviation of the reported elasticity	0.14 (0.15)
East	=1, if estimate relates to a country from the Eastern region	0.27 (0.45)
South	=1, if estimate relates to a Southern region country	0.21 (0.41)
PanelorCS	=1, if estimate comes from panel or cross-sectional data	0.93 (0.26)
TS	=1, if estimate comes from time series	
DID	=1, if it is difference-in-differences estimate	0.37 (0.48)
TeenorYouth	=1, if estimate relates to teenagers or youth	0.22 (0.41)
Female	=1, if estimates relates to females only	0.12 (0.33)
Hours	=1, if hours worked were used as dependent variable instead of employment	0.24 (0.43)
UR	=1, if a model includes unemployment	0.30 (0.46)
Kaitz	=1, if Kaitz measure of minimum wage is used	0.61 (0.49)
Share	=1, if a share of employees affected or minimum-wage gap is used	0.25 (0.43)
MWlevel	=1, if the level of minimum wage is used	0.04 (0.19)
Homecare	=1, if estimate relates to residential home care industry	0.15 (0.36)
Retail	=1, if estimate relates to retail industry	0.02 (0.13)
Otherindustry	=1, if estimate relates to an industry other than residential home care or retail	0.13 (0.34)

Notes: By teenagers (youth) are understood individuals at the age 15-19 (20-24). Share of employees affected and minimum-wage gap are used as operationalization of minimum wage to capture to what extent individual companies are affected by a minimum wage hike. Minimum-wage gap was defined by Card (1992) as (10th decile limit — minimum wage)/minimum wage.

Furthermore, previous meta-regression analysis (de Linde Leonard et al., 2014; H. Doucouliagos & Stanley, 2009; Giotis & Chletsos, 2015) were also consulted to help identify all variables that might be of some importance. Based on the review of their results, several variables were added, namely *Hours, UR,* and *DID.* Including *Hours*, as already mention in previous chapter, allows to capture the minimum wage's effect on hours worked rather then on employment. *UR* is included as de Linde Leonard et al. (2014) showed that including unemployment into employment regression[4] leads to a significant bias in the estimate. And

[4] Some studies (Addison & Demet Ozturk, 2012; Cuesta, Heras, & Carcedo, 2011; Karageorgiou, 2004; Majchrowska & Żółkiewski, 2012; Neumark & Wascher, 2004) include unemployment in their employment regression as a proxy for business cycle.

finally, as already argued above that diff-in-diff setting can effectively cope with possible endogeneity of minimum wage, *DID* is used to control for a potential bias introduced by not controlling for the endogeneity.

The first column of table 6 provides estimation results for a specification where all moderator variables[5] are included. As there is too much multi-collinearity in such specification (de Linde Leonard et al., 2014), some accommodations are needed in order to determine the more important research dimensions.

For that purpose, general-to-specific (G-to-S) modelling strategy is deployed, analogously to other similar studies (Benos & Zotou, 2014; de Linde Leonard et al., 2014; H. Doucouliagos & Stanley, 2009; Giotis & Chletsos, 2015). The general-to-specific strategy means that after the equation with all explanatory variables is estimated, the variables with the largest p-value are being removed, one at a time, until only variables with $p \leq 0.05$ remain (de Linde Leonard et al., 2014). The results obtained by this method are reported in the second column of table 6. For all these estimations, WLS with cluster-robust standard errors were used.

Results

First, it can be checked whether the results of the multiple MRA are consistent with the findings of FAT-PET-MRA model (1) estimated above. The outcome of the publication bias test can be easily compared as it is captured be the same variable, SE. The absence of the coefficient on SE in column 2 indicate that the coefficient was insignificant. Moreover, it remains insignificant under all possible specifications.[6] Thus, this finding is consistent with no evidence of publication bias reported above.

However, comparing the overall employment elasticities is slightly more complicated. We cannot simply compare the intercepts. The reason is that while in model (1) the overall elasticity was captured indeed just by β_0, in the multiple MRA it is broken down in $\beta_0 + \sum_k \beta_k Z_{ki}$. In order to calculate the value of this term, we need to know what values of Z-variables should be inserted. And to get those, best practice research need to be identified.

[5] Except for the variable *TS* which controls for estimates that were obtained from time-series. As all studies use either time-series, panel, or cross-section data and the variable *PanelorCS,* which controls for last two was included, *TS* was omitted to avoid perfect collinearity.
[6] See Appendix for more estimated specifications.

Table 6: Multiple MRA of minimum wage elasticities: Cluster-Robust Weighted Least Squares

Moderator variables	*Column 1: All variables included*	*Column 2: G-to-S*
SE	1.045	-
	(1.730)	
East	-0.279	-0.224**
	(0.294)	(0.105)
South	-0.0400	-
	(0.319)	
PanelorCS	-0.180	-0.245**
	(0.206)	(0.103)
DID	-0.405	-
	(0.451)	
TeenorYouth	-0.401	-
	(0.431)	
Female	-1.033***	-0.691***
	(0.176)	(0.192)
Hours	0.372	-
	(0.253)	
UR	-0.00755	-
	(0.480)	
Kaitz	-0.340	-
	(0.592)	
Share	-0.836	-
	(1.281)	
Mwlevel	0.279	0.936***
	(1.062)	(0.000956)
Otherindustry	-0.713	-
	(0.463)	
Homecare	-0.591	-0.682***
	(0.437)	(0.146)
Retail	-1.020	-1.099***
	(0.817)	(0.103)
Constant	0.816	0.295***
	(0.969)	(0.000956)
Observations	187	187
R-squared	0.106	0.110

Notes: Cluster-Robust standard errors reported in parentheses. Minimum wage elasticities used as dependent variable. WLS used for all estimations. See table 5 for detailed description of variables. Column 1 shows results of estimation when all moderator variables were included. Except for the *female* variable, no coefficient turn out to be statistically significant. Column 2 reports the results for general-to-specific estimation strategy. That means removing variables with the largest p-value until only variables with p-value≤0.05 remain.
*** p<0.01, ** p<0.05, * p<0.1

For that purpose, the specification from column 2 in table 6 is considered. If we wish to identify the overall elasticity, the industry-specific (Homecare, Retail), group-specific (Female), and region-specific (East) variables need to be switched off (=0).

Considering the variable MWlevel, it can be reasonable argued that operationalising minimum wage in levels can be quite problematic since mere levels are unlikely to fully capture the minimum wage bite. At least it is unlikely to do as well as Kaitz index, minimum wage gap or share of workers affected by minimum wage hike in this respect. For that reason and also in order 'to give the possibility of an adverse employment effect its best chance' (de Linde Leonard et al., 2014, p. 512), MWlevel should be also switched off (=0).

The last variable left is PanelorCS. I argue that the variable PanelorCS should be switched on (=1). The reasons are the following. Firstly, in the context of minimum wage research, panel and cross-sectional data usually provide more variation compared to time series. And secondly, as panel data track the same individuals and entities in time, they should allow for more precise identification of the of minimum wage's impact.

Thus, this leaves us with just the constant and the coefficient on PanelorCS. To get the value of the overall elasticity, we add them up and we get 0.05.[7] This size of the effect means that 20% increase in minimum wage would result in 1% increase in employment. Notice, that this effect, although very small, is still positive.

Furthermore, the results also suggest differential employment effects by industries, as can been seen from the coefficients on Homecare and Retail. For these two industries, the employment effect seem to be significantly negative. Specifically, the minimum wage elasticities of employment in the residential home care and retail sector are estimated to be -0.632 and -1.049[8], respectively. The interpretation, then, is that 1 percent increase in minimum wage would cause employment in residential home care (retail) sector to decrease by 0.63% (1.05%). Or we could inversely say that 1.6% (0.95%) increase in minimum wage would be needed to make employment in residential home care (retail) sector decrease by 1%.

Considering the minimum wage's impact on specific social groups, the results demonstrate a significant adverse employment effect for female workers. Specifically, the minimum wage elasticity for women is -0.641, which means that 1% increase in minimum would reduce female employment by approx. 0.64%. Besides women, there was no other social group for which significant effects would be identified.

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[7] 0.295-0.245= 0.05

[8] To arrive at these numbers, the coefficient on respective industry was added to the constant which represents the general effect. Thus, having 0.05-0.682=-0.632 for residential home care and 0.05-1.099=-1.049.

And finally, there is an important finding of differential employment effects across the regions. Although the employment elasticity does not differ significantly across southern and western region of the EU, the elasticity is found to be significantly lower, by 0.224 (t-test, $p < 0.05$), for eastern countries. After subtracting the differential effect from the overall elasticity (0.05), we get the employment elasticity of -0.174. This means that an increase in minimum wage by approximately 5.7% would result in 1% decrease in employment. Even though this negative effect is can be considered mild, the difference in the employment effects between the East on one side, and the West and the South on the other, is significant. It is also worth noting that this East-specific effect seems to be quite robust as it is quite stable in both magnitude and significance throughout most of the specifications[9] for which it was estimated.

Discussion

It should be noticed that the variables included managed to explain only about 10% of the variation of estimated elasticity, as suggested by R-squared. Comparable papers that include some additional variables controlling for the model specification in more detail, report R-squared between 0.25 to 0.5 (de Linde Leonard et al., 2014; Giotis & Chletsos, 2015). Thus, the list of moderator variables here cannot be considered as fully exhaustive. However, the additional moderator variables are unlikely to be correlated with a region of estimation. Thus, omission of these variables should not introduce any bias to the coefficients on regions, which are at the centre of attention in this work.

The most significant limitation of any meta-regression analyses is that they can be only as good as the data that they are fed with. A considerable potential for extending such a study rests in extending the meta-sample e.g. by unpublished papers which was a binding criterion in many cases. Relaxing the criterion requiring studies to be publish could potentially help improve the coverage of the countries within a region and would, thus, lend a higher degree of representativeness to the dummy controlling for a certain region and increase the reliability of region-specific estimates.

[9] Find the results of other specifications in the Appendix.

4 Conclusion

There is a persistent controversy in the minimum wage research as some studies report significant adverse employment effects, while others find no or even positive effects. In this paper, a systematic review in the form of meta-regression analysis was deployed to analyse 187 estimates from 18 studies estimating the impact of minimum wage in the EU countries. The results showed that, overall, there is no evidence for a practically significant employment effect of minimum wage. The finding proves robust to exclusion of outliers and to different models employed. Both basic and more sophisticated models confirm these findings.

These results are in line with those reported by previous studies by H. Doucouliagos & Stanley (2009) and de Linde Leonard et al. (2014). Similarly as in the latter study that analysed the UK minimum wage literature, no evidence of publication selection bias was found in the covered studies.

Several explanations for the absence of employment effects might be provided. To begin with, the reality of labour markets could be better described by a model of companies with monopolistic power (rather than by models of perfect competition) and within such a model, an appropriately set minimum wage can lead to increased employment (Card & Krueger, 1995b; Lester, 1946; Metcalf, 2008). Another possible explanation would be that minimum wages are set endogenously (de Linde Leonard et al., 2014).

Furthermore, Metcalf (2008) provides a list of factors through which companies could deal with minimum wage hikes while not decreasing employment. Namely, it can be through improving productivity, increasing prices, compressing profits, and reducing the number of hours worked.

The efficiency wages hypothesis (EWH) would also do as a viable explanation as it entails that minimum wages would have small or no negative employment effects (Akerlof, 1982, 2002). Moreover, a meta-analysis by Peach and Stanley (2009) presents unequivocal evidence that confirms the validity of EWH.

Also, the results reported here support the findings of differential effects for certain industries (de Linde Leonard et al., 2014), specifically for residential home care and retail sector. Such an evidence can be used as an argument to support industry-specific minimum wage. In a similar manner, a minimum wage differentiated for various social groups might be worth considering (although it is conceivable that this would be more politically sensitive) since the results showed a significantly negative effect on female employment.

In addition to that, the findings discovered significant differential effects across EU regions. It showed that the minimum wage elasticity of employment is moderately negative for eastern countries of the EU. Such findings gain practical importance especially in the wake of the debate about EU-wide minimum wage.

As discussed by Fernández-Macías and Vacas-Soriano (2016), the coordination of the minimum wage level across the EU would be probably in the form of a rule specifying the minimum ratio of minimum wage to average or median wage, rather than a fixed amount applicable across the entire EU. While its proponents argue that coordination of minimum wage policies across member states would be 'an important complement of economic integration as it would level the playing field for competition' (Fernández-Macías & Vacas-Soriano, 2016, p. 100), others oppose that a unified policy rule is unlikely to fit the specific needs of each national economy (Fernández-Macías & Vacas-Soriano, 2016). And the findings of this work rather corroborate the latter.

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Apendix

In table A1, all intermediate estimations of the general-to-specific approach are reported.

Table A2 then shows estimation for specifications that were constructed based on the specific-to-general approach. It means that I included the variable of interest first and then kept on adding variables that I assumed might have helped explain a significance part of the variance of dependent variable. As I was adding variable, I also observed how the significance of all the coefficients was changing.

Table A 1: General-to-specific strategy - intermediate steps

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	elasticity	elasticity	elasticity	elasticity	elasticity	elasticity	elasticity	elasticity	elasticity
se	1.019	1.008	0.839						
	(1.513)	(1.445)	(1.109)						
east	-0.293	-0.270**	-0.221	-0.248**	-0.264**	-0.252***	-0.172***	-0.224*	-0.224**
	(0.258)	(0.107)	(0.128)	(0.108)	(0.111)	(0.0461)	(0.0393)	(0.107)	(0.105)
south	-0.0427								
	(0.274)								
PanelorCS	-0.181	-0.144	-0.133	-0.113***	-0.116***	-0.166***	-0.244***	-0.206*	-0.245**
	(0.175)	(0.162)	(0.118)	(0.0233)	(0.0235)	(0.0158)	(0.0247)	(0.105)	(0.103)
DID	-0.383	-0.332	-0.202	-0.236	-0.228	-0.190			
	(0.312)	(0.229)	(0.184)	(0.142)	(0.144)	(0.145)			
TeenorYouth	-0.378	-0.333	-0.220	-0.0669	-0.0587				
	(0.432)	(0.434)	(0.166)	(0.198)	(0.195)				
female	-1.025***	-1.007***	-0.937***	-0.905***	-0.899***	-0.792***	-0.727***	-0.811***	-0.691***
	(0.161)	(0.192)	(0.254)	(0.267)	(0.264)	(0.135)	(0.129)	(0.121)	(0.192)
Hours	0.369	0.392*	0.410*	0.343	0.324	0.316*	0.319**	0.298	
	(0.245)	(0.224)	(0.234)	(0.225)	(0.226)	(0.172)	(0.151)	(0.190)	
Kaitz	-0.310	-0.233							
	(0.678)	(0.602)							
share	-0.703	-0.718	-0.407	0.0632					
	(1.038)	(1.035)	(0.371)	(0.316)					
Mwlevel	0.321	0.477	0.797***	0.853***	0.855***	0.940***	0.958***	0.938***	0.936***
	(0.962)	(0.780)	(0.159)	(0.198)	(0.195)	(0.00132)	(0.00114)	(0.00115)	(0.000956)
Otherindustry	-0.688**	-0.679**	-0.611**	-0.559***	-0.558***	-0.385*	-0.327*		
	(0.317)	(0.273)	(0.249)	(0.172)	(0.170)	(0.183)	(0.163)		
Homecare	-0.689*	-0.563*	-0.604**	-0.809**	-0.741***	-0.646***	-0.645***	-0.693***	-0.682***
	(0.359)	(0.270)	(0.240)	(0.330)	(0.149)	(0.129)	(0.0647)	(0.121)	(0.146)
Retail	-1.043	-1.151**	-1.319***	-1.337***	-1.323***	-1.303***	-1.418***	-1.435***	-1.099***
	(0.620)	(0.499)	(0.262)	(0.275)	(0.278)	(0.192)	(0.145)	(0.202)	(0.103)
Constant	0.777	0.620	0.314	0.378*	0.376*	0.290***	0.272***	0.293***	0.295***
	(0.885)	(0.700)	(0.209)	(0.198)	(0.195)	(0.00132)	(0.00114)	(0.00115)	(0.000956)
Observations	187	187	187	187	187	187	187	187	187
R-squared	0.107	0.104	0.103	0.117	0.117	0.114	0.110	0.106	0.110

*Notes: Cluster-robust standard error in parenthesis. Each column represents an intermediate step in the general-to-specific modelling strategy. The leftmost one contains all variables, and then with each step to the right, a variable that had the highest p-value is excluded. WLS with cluster-robust st.er. are used all along. *** p<0.01, ** p<0.05, * p<0.1*

Table A 2: Specific-to-general modelling strategy

VARIABLES	(1) m1 elasticity	(2) m2 elasticity	(3) m3 elasticity	(4) m4 elasticity	(5) m5 elasticity
east	-0.340	-0.317	-0.429	-0.757**	-0.594*
	(0.486)	(0.415)	(0.392)	(0.341)	(0.317)
south	-0.0128	0.111	-0.0877	-0.379	-0.297
	(0.497)	(0.441)	(0.391)	(0.272)	(0.289)
se		-1.100	-1.684	0.0718	0.613
		(1.392)	(1.101)	(0.893)	(1.018)
TeenorYouth			0.367	-0.702**	-0.428
			(0.435)	(0.319)	(0.264)
female			-1.047*	-1.540***	-1.158***
			(0.499)	(0.338)	(0.326)
Otherindustry				-1.332***	-0.991**
				(0.410)	(0.388)
Homecare				-1.835***	-1.414***
				(0.376)	(0.397)
Retail				-1.310***	-0.577**
				(0.347)	(0.263)
PanelorCS					-0.489
					(0.367)
DID					-0.292
					(0.223)
Constant	0.174	0.489	0.630	1.195***	1.231***
	(0.485)	(0.591)	(0.561)	(0.356)	(0.202)
Observations	187	187	187	187	187
R-squared	0.003	0.021	0.066	0.129	0.127

Notes: Cluster-robust standard error in parenthesis. When following specific-to-general strategy, I included the variable of interest first and then kept on adding variables that I assumed might have helped explain a significance part of the variance of dependent variable. As I was adding variable, I also observed how the significance of all the coefficients was changing. WLS with cluster-robust st.er. are used all along. *** p<0.01, ** p<0.05, * p<0.1

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