The employment effect of minimum wage using 77 international studies since 1992: A meta-analysis

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Abstract

Until the early 90's a strong consensus existed among economists that minimum wage has negative employment effects. However, in 1992, the studies by Card (1992a) and Katz and Krueger (1992), who found insignificant and slightly positive effects, respectively, came to create a schism. Since then a divergence of views expressed by conflicting empirical studies exists in the literature. In our paper, we use a meta-sample of 77 international studies from 18 countries to investigate this relationship. Our analysis suggests that there is evidence of publication selection, but no effect of minimum wages on employment measures. Additionally, using 27 moderators as potential explanatory variables in order to explain the variation among studies, we find that study characteristics related to the data, the model specifications and the group concerned, diversify the degree of the effect.

JEL Classification: J38, J21, C12.

Keywords: Minimum wage, Employment, Meta-analysis.

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1. Introduction

Until the early 90's a strong consensus existed among economists that an increase in the minimum wage would cause an increase in unemployment. This neoclassical approach was the prevailing theory in labor economics and the studies that were conducted to investigate this relationship used basically time-series data. However, at the beginning of 90's the studies by Card (1992a) and Katz and Krueger (1992) came to create a schism as they didn't find evidence of adverse employment effects of minimum wages. Since then, a divergence of views exists in the literature, which is expressed by conflicting empirical studies.

In this frame of opposing results triggered by Card, Katz and Krueger, it seemed quite interesting to us to approach this issue with meta-analysis techniques, which are very useful statistical tools for reviewing empirical results. In our research, we found seven studies that use meta-analysis methods to investigate the employment effects of minimum wages, and remarkable is the fact that apart from two studies, conducted by Boockmann (2010) and Belman and Wolfson (2014), no other study uses worldwide studies as a meta-sample.

In general, we would say that the scientific work on the employment effect of minimum wages using meta-analysis methods, usually deals with USA studies or a homogeneous group of countries. Concisely, it seemed intriguing to approach this issue using meta-analysis techniques with studies from all over the world. In our analysis we found that there is evidence of publication selection, but no effect of minimum wages on employment measures. In addition, using 27 moderators as potential explanatory variables in order to explain the variation among studies, we found that study characteristics related to the data, the model specifications and the group concerned, diversify the degree of the effect. This conclusion is drawn from a meta-sample of 77 studies from 18 countries, which provided 1.521 elasticities with their standard errors or t-statistics.

2. Review of meta-analysis literature on the employment effect of minimum wage

During our research, we found seven studies that use meta-analysis methods to investigate the employment effects of minimum wages. Firstly, it is Card and Krueger's study in 1995, which analyzes 15 earlier studies on minimum wages and found publication bias in favor of studies that provided a statistically significant negative employment effect. All the studies which the authors used as a meta-sample were conducted for the USA and the structure of the data was time-series. Card and Krueger suggested that later studies, which had more data and lower standard errors, did not show the expected increase in t-statistic (almost all the studies had a t-statistic of about two, just above the level of statistical significance at the 5%). Card and Krueger's study created a schism among economists by providing evidence that minimum wage increases did not decrease employment.

The second meta-analysis on the employment effect of minimum wages is found 14 years later, in 2009, when Hristos Doucouliagos and Tom D. Stanley conducted a similar meta-analysis of 64 U.S. studies that offered 1.474 estimates of the employment elasticity and concluded that Card and Krueger's initial claim of publication bias was still correct. Moreover, they concluded that once this publication selection was corrected, an adverse employment effect was not supported by this large and rich research record on the employment effects of minimum-wage regulation. That study had an important impact on the economic research with the use of meta-analysis techniques and boosted the meta-analysis studies in economics.

Thirdly, Boockmann (2010) conducted a meta-analysis of 55 empirical studies estimating the employment effects of minimum wages in 15 industrial countries since 1995. Almost 67% of the estimations of the meta-sample provided negative signs of the impact of minimum wages on employment. The results were in line with theoretical expectations of the neoclassical theory the degree to which they were robust differed across institutions of the countries, though. That study is the first study which used a sample of international studies and not for a single country, and it incorporated three particular labor market regulations as possible sources of policy complementarities to explain differences between the countries (the benefit replacement ratio, the employment protection and the collective bargaining system).

Fourthly, it is the book by Stanley and Doucouliagos (2012) titled 'Meta-regression Analysis in Economics and Business' where the authors used the same meta-sample as in their paper in 2009 (i.e. 64 US studies with 1.474 elasticities) but implemented additional meta-regression methods which provided extra robustness to their initial results. In that book, Stanley and Doucouliagos tried to give meta-analysis a different orientation in research and characteristically, as they write at page 152: 'we caution researchers from applying widely used estimators, such as random effects weighted averages and random-effects MRA models, to econometrics estimates'.

The last three studies that have used meta-analysis techniques to investigate the employment impact of minimum wages were published in 2014. The first one was conducted by Nataraj, Perez-Arce, Srinivasan and Kumar (2014), on low-income-countries. Their meta-sample included fifteen studies from individual countries and two cross-country studies, and the results showed an ambiguous effect of minimum wages on total employment as a total outcome of positive impact on informal employment and negative on formal employment.

The second study earlier in the year was conducted by Leonard, Stanley and Doucouliagos (2014). The authors used meta-analysis methods to investigate the effect of increases in the UK minimum wage on employment using studies conducted for the United Kingdom alone. The meta-sample consisted of 16 studies which provided 710 partial correlations and 236 elasticities and according to the results no adverse effect of minimum wage could be found by the increases of the UK minimum wages apart from the residential home-care sector. In comparison to Doucouliagos and Stanley (2009), this study did not find evidence or publication bias as the larger US study does. Nevertheless, both studies practically indicated absence of significant adverse employment effect of minimum wages.

Finally, we would refer to Belman and Wolfson (2014) who used data from 23 international studies since 2000. The meta-sample provided 439 estimations and the majority of the studies concerned the USA. Generally, we could say that the authors found negative and statistically significant effects of minimum wage which were very small, though. The largest reliable employment elasticities were about -0.07 and the smallest -0.04 (youth employment) and -0.01 (in the food & drinking sector).

Closing this section, we would say that the literature on the employment effect of minimum wages is growing. In this frame we tried to investigate the effect of minimum wage on employment measures and hours worked since 1992, when the studies by Card (1992a) and Katz and Krueger (1992) came to create a schism, as their results opposed to the traditional neoclassical theory which suggests negative impact of minimum wage increases to employment level. Before presenting the results of our meta-analysis, we discuss about the methodology, the identification, the coding and the descriptive characteristics of the meta-analysis data in the following section.

3. The meta-sample

The process of the identification of the studies which constitute the meta-sample is the first but very important step in the meta-analysis. We began our research using the search machine Google Scholar, and afterwards the economic databases Econlit, Sciencedirect, RePEc and Jstor. Mainly the keywords used in the search were "minimum wage" and "employment" and we used and other several flections as a keyword. Before entering into the details of the identification, it has to be pointed out that we restricted the research only to those studies published since 1992 which is the year when the studies by Card (1992a) and Katz and Krueger (1992), made the economic thinking reconsider the relationship, as until then a strong consensus existed which accepted that minimum wages had negative effect on employment.

Concerning the identification of the studies, our objective was to find those studies which investigate the effect of minimum wage on employment measures but not on unemployment or other measures, such as labor force participation rates. Furthermore, we had to exclude from our meta-sample the studies which did not mention a direct minimum wage effect. For example, some of the studies reported estimations of the impact of wages generally on employment or, in other cases, the effect of distribution of income on employment measures. In addition to this, we followed Doucouliagos and Stanley (2009) and our analysis focuses on employment elasticities drawn from studies using a continuous measure of employment or hours. Moreover, we excluded those studies which use a binary dependent variable, reporting employment probabilities. However, in this way, many studies were excluded but we kept the meta-sample more homogeneous.

Another aspect which has to be mentioned is that we chose elasticities as size effects which has some disadvantages, as there are many studies that report only partial correlation coefficients, and if the calculation of the elasticities was not possible, it was another reason for exclusion. However, as Doucouliagos and Stanley (2009) refer at p. 412, the choice of elasticities as the common metric to measure the employment effect, is considered more appropriate, since they are often assumed to be relatively stable parameters. Furthermore, we excluded those studies which did not report standard errors or t-statistics which are both needed for publication selection bias correction.

These filters kept the meta-sample relatively homogenous and the results more reliable. In the end our meta-sample consisted of 77 studies for individual countries which investigate the effect of minimum wages on employment measures or hours worked. The studies which are included in the meta-sample are presented in table A.1 at the appendix, by country, with a brief reference of the structure of the data used to obtain the elasticities. In addition to this, we present the studies that were dropped out of the meta-sample with the reason for exclusion in table A.2. The 77 studies of the meta-sample provided 1.521 elasticities with their standard errors or t-statistics.

Table 1 presents the summary statistics of the studies in the meta-sample, by country. In table 1 it is reported the name(s) of the author(s), the year of publication of the study, the country that the employment elasticities concern, the minimum and maximum values of the elasticities in the study, and their means, medians and standard deviations.

Table 1. Summary statistics of the studies in the meta-sample, by country.

No	Author(s)	*Year*	Country	*Minimum elasticity*	*Maximum elasticity*	Average	*Median*	*Standard deviation*
1	Card	1992b	USA	-0.060	0.190	0.091	0.110	0.092
2	Katz and Krueger	1992	USA	1.734	2.643	2.176	2.164	0.451
3	Neumark and Wascher	1992	USA	-0.190	-0.030	-0.150	-0.170	0.054
4	Williams	1993	USA	-0.624	0.090	-0.248	-0.302	0.206
5	Card, Katz and Krueger	1994	USA	0.093	0.370	0.231	0.231	0.196
6	Neumark and Wascher	1994	USA	-0.190	0.250	-0.105	-0.120	0.090
7	Kennan	1995	USA	-0.037	-0.004	-0.021	-0.020	0.012
8	Kim and Taylor	1995	USA	-0.962	0.898	-0.687	-0.874	0.562
9	Neumark and Wascher	1995a	USA	-0.230	-0.030	-0.163	-0.230	0.115
10	Hsing	1997	USA	-0.205	-0.205	-0.205	-0.205	
11	Bernstein and Schmitt	1998	USA	-0.095	-0.029	-0.058	-0.058	0.025
12	Partridge and Partridge	1998	USA	-1.240	0.600	-0.255	0.003	0.926
13	Partridge and Partridge	1999a	USA	-0.677	0.183	-0.114	-0.036	0.221
14	Partridge and Partridge	1999b	USA	-0.340	0.130	-0.105	-0.105	0.332
15	Bernstein and Schmitt	2000	USA	-0.061	-0.001	-0.031	-0.028	0.022
16	Burkhauser, Couch and Wittenburg	2000	USA	-0.481	0.300	-0.233	-0.229	0.167
17	Zavodny	2000	USA	-0.116	0.241	0.017	-0.028	0.142
18	Keil, Robertson and Symons	2001	USA	-0.915	0.147	-0.261	-0.219	0.255
19	Bazen and Marimoutou	2002	USA	-0.122	0.027	-0.089	-0.098	0.043
20	Dodson	2002	USA	-0.333	-0.086	-0.147	-0.109	0.093
21	Orazem and Mattila	2002	USA	-0.105	-0.060	-0.083	-0.083	0.032
22	Abdulahad and Guirguis	2003	USA	-0.662	-0.171	-0.357	-0.296	0.213
23	Pollin, Brenner and Wicks-Lim	2004	USA	-0.049	0.290	0.085	0.014	0.180
24	Sabia	2006	USA	-0.885	0.454	-0.194	-0.141	0.265
25	Dube, Naidu and Reich	2007	USA	0.010	0.120	0.049	0.040	0.036
26	Neumark and Nizalova	2007	USA	-0.383	-0.019	-0.175	-0.174	0.112
27	Singell and Telborg	2007	USA	-0.108	0.161	0.012	-0.021	0.117
28	Addison, Blackburn and Cotti	2008	USA	-0.230	0.148	-0.058	-0.059	0.112
29	Addison, Blackburn and Cotti	2009	USA	-0.391	0.484	0.123	0.148	0.169
30	Bazen and Le Gallo	2009	USA	-0.589	0.089	-0.116	-0.101	0.151
31	Sabia	2009	USA	-0.357	0.080	-0.087	-0.091	0.111
32	Giuliano	2011	USA	-0.790	-0.090	-0.427	-0.470	0.273
33	Kalenkoski and Lacombe	2011	USA	-0.211	-0.179	-0.195	-0.195	0.023
34	Dickens, Machin and Manning	1994	UK	0.152	0.540	0.364	0.376	0.117
35	Machin and Manning	1994	UK	-0.451	0.986	0.293	0.291	0.466
36	Dickens, Machin, Manning, Metcalf, Wadsworth and Woodland	1995	UK	-0.147	0.286	0.108	0.144	0.162
37	Gowers and Hatton	1997	UK	-0.730	-0.450	-0.580	-0.580	0.100
38	Dickens, Machin and Manning	1999	UK	0.027	0.434	0.205	0.201	0.103
39	Balcombe & Prakash	2000	UK	-6.070	-6.070	-6.070	-6.070	
40	Connolly and Gregory	2002	UK	-0.032	0.056	-0.011	-0.024	0.027
41	Machin, Manning and Rahman	2003	UK	-0.561	-0.080	-0.282	-0.260	0.154
42	Galindo-Rueda and Pereira	2004	UK	-3.356	1.476	-0.339	-0.072	0.697
43	Machin and Wilson	2004	UK	-0.952	-0.042	-0.354	-0.265	0.341
44	Neumark and Wascher	2004	UK	-0.250	-0.090	-0.170	-0.170	0.113
45	Georgiades	2006	UK	-1.740	1.480	-0.174	-0.111	0.828
46	Islam and Nazara	2000	Indonesia	0.136	0.497	0.375	0.383	0.130

47	Bird and Manning	2003	Indonesia	-0.270	0.580	0.081	0.045	0.230
48	Suryahadi, Widyanti, Perwira and Sumarto	2003	Indonesia	-0.364	1.000	-0.011	-0.073	0.324
49	Harrison and Scorse	2004	Indonesia	-0.184	-0.021	-0.106	-0.124	0.054
50	Alatas and Cameron	2008	Indonesia	-0.550	0.648	0.171	0.357	0.473
51	Caprio, Nguyen and Wang	2012	Indonesia	-0.292	0.600	0.023	-0.023	0.162
52	Lemos	2004a	Brazil	-0.580	1.310	0.162	0.020	0.374
53	Lemos	2004b	Brazil	-0.230	0.160	-0.002	-0.010	0.095
54	Lemos	2007	Brazil	-1.230	0.500	-0.028	0.010	0.225
55	Lemos	2009	Brazil	-0.228	0.358	0.035	0.023	0.099
56	Baker, Benjamin and Stanger	1999	Canada	-0.435	0.074	-0.225	-0.264	0.130
57	McDonald and Myatt	2004	Canada	-0.421	-0.083	-0.263	-0.264	0.106
58	Campolieti, Gunderson and Riddell	2006	Canada	-0.588	0.418	-0.129	-0.136	0.167
59	Sen, Rybczynski and Van de Waal	2011	Canada	-0.530	0.070	-0.119	-0.100	0.127
60	Maloney	1995	New Zealand	-0.293	0.276	0.026	0.043	0.144
61	Chapple	1997	New Zealand	-0.472	0.663	-0.023	-0.036	0.212
62	Maloney	1997	New Zealand	-0.377	0.245	-0.041	0.008	0.314
63	Leigh	2004	Australia	-1.426	0.217	-0.317	-0.265	0.358
64	Lee and Suardi	2010	Australia	-2.528	2.469	-0.202	-0.389	1.605
65	Bell	1997	Mexico	-1.519	0.058	-0.192	-0.009	0.480
66	Feliciano	1998	Mexico	-1.702	0.167	-0.575	-0.479	0.545
67	Castillo-Freeman and Freeman	1992	Puerto Rico	-0.910	0.200	-0.417	-0.540	0.565
68	Krueger	1994	Puerto Rico	-0.910	0.070	-0.120	-0.045	0.253
69	Eriksson and Pytlikova	2004	Slovak Republic	-0.098	0.507	0.059	0.006	0.136
70	Volorokosova	2010	Slovak Republic	0.102	0.119	0.111	0.111	0.012
71	Dolado, Kramarz, Machin, Manning, Margolis, Teulings and Keen	1996	Spain	-0.216	0.136	-0.022	0.036	0.122
72	Cuesta, Heras and Carcedo	2011	Spain	-1.888	2.031	0.123	0.033	0.981
73	Eriksson and Pytlikova	2004	Czech Republic	-0.083	0.135	-0.013	-0.025	0.037
74	Wang and Gunderson	2011	China	-1.042	0.489	-0.040	0.043	0.408
75	Bell	1997	Colombia	-2.927	-0.030	-0.542	-0.288	0.852
76	Jones	1997	Ghana	0.005	0.139	0.050	0.027	0.063
77	Gindling and Terrell	2009	Honduras	-0.549	0.508	-0.149	-0.354	0.385
78	Van Soest	1994	Netherlands	-0.590	-0.340	-0.474	-0.485	0.100
79	Majchrowska and Zolkiewski	2012	Poland	-0.500	0.330	-0.105	-0.090	0.162

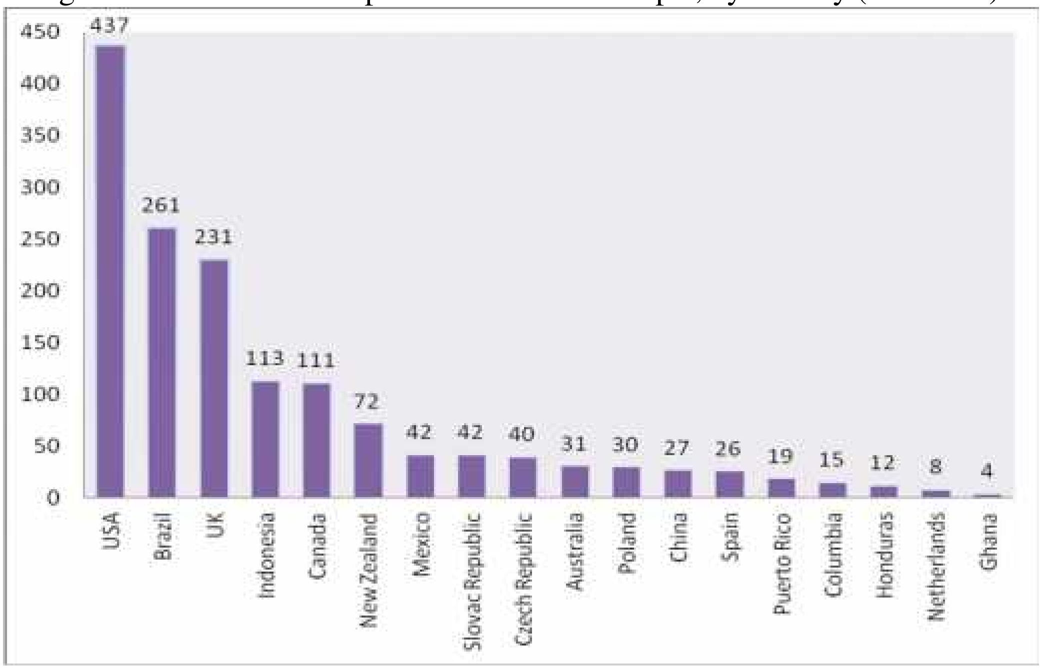
Note: It has to be pointed out that actually the studies that are included in the meta-sample are not 79 but 77 because of the fact that two studies investigate the employment effect of minimum wages for two different countries in the same study. These studies are:

i) Bell, L. A. (1997) The impact of minimum wages in Mexico and Colombia. *Journal of Labor Economics* 15(3): 102-35. → Colombia and Mexico.

ii) Ericson, T. and Pytlikova, M. (2004) Firm-level consequences of large minimum-wage increases in the Czech and Slovak Republics. *Labour* 18(1): 75-103. → Czech Republic and Slovak Republic.

Figure 1 depicts the number of data points in the meta-sample, by country. It is obvious that the United States provided the meta-sample with the most elasticities. This uneven distribution of estimates over the countries came not as a surprise as the minimum wage impact on employment has been extensively investigated in the USA which has many states with different minimum wage systems. Moreover, in the USA there is a federal minimum wage but there are also minimum wages across states with variability in levels. Apart from the 28.73% of the observations which concern the USA, another high percentage came from studies for Brazil which yielded 17.16% of the total observations. Another country with many observations is the United Kingdom with 231 observations (15.19%) and other countries with many elasticities are Indonesia, Canada and New Zealand with 113, 111 and 72 elasticities, respectively, while the rest of them provided less than 50.

Figure 1. Number of data points in the meta-sample, by country (n = 1.521).

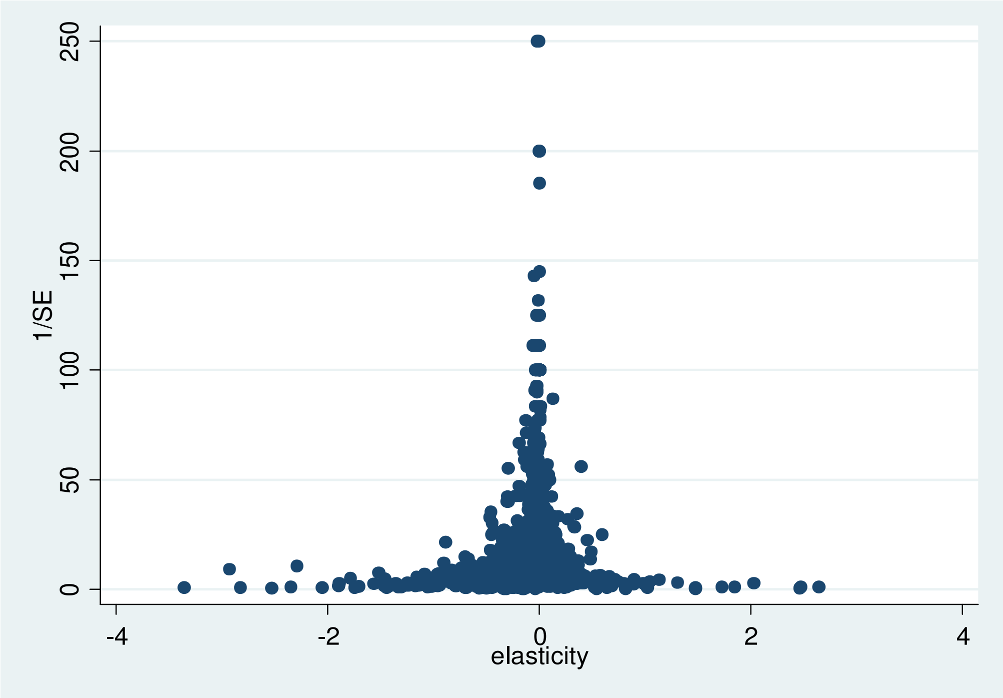


Discussing on the publication bias of the elasticities in the meta-sample, according to Sutton *et al.* (2000), the simplest and most commonly used method to detect publication selection is an informal examination of a funnel plot. A funnel graph is a scatter diagram of all empirical estimates of a given phenomenon and these estimates' precisions (i.e. the inverse of the estimates' standard errors, 1/SE). However, the real problem of publication selection does not lie in the results themselves and in the existence of publication biasness but the importance is in fact that the large biases can impart upon any summary of empirical knowledge if we do not correct it. Therefore, it is essential to investigate if the elasticities of the meta-sample are characterized by publication selection biasness.

In figure 2 we present the funnel graph of the estimated minimum wage elasticities. Clearly the graph looks symmetric, but it reflects publication selection. Most values are gathered in the left portion of the graph which reveals selection for negative employment effects of minimum wages. It should be noticed, though, that these graphs are considered to be quite vulnerable to misjudgments and subjective interpretation and criticism, so in order to test the hypothesis of presence of publication biasness, we have to use the FAT-PET test presented in the following section.

Closing this preliminary analysis, the general picture is that the majority of the studies indicate a negative impact of minimum wages on employment measures. More specifically, from the total 1.521 estimated elasticities: 944 are negative (62.06%), 564 are positive (37.08%) and 13 are equal to zero (0.85%). This means that the impact of the neoclassical theory in the new minimum wage research is still quite strong. However, this is only descriptive statistics analysis and in order to reach at more reliable conclusions we conduct meta-regression analysis techniques in the next two sections to find if there is publication bias and which factors affect the sign of the impact.

Figure 2. Funnel graph of minimum-wage effects (n=1.521).



Note: We excluded one observation with values: elasticity = -6.07 and 1/SE = 0.433.

4. Publication bias and FAT-PET tests

The tests that appear at the title of this section are nothing more than two tests of publication bias and authentic effect, respectively. The FAT test is a Funnel Asymmetry Test and estimates equation (1) with the assumption that all the β_1 are zero, meaning that there is no heterogeneity. In other words, it is t-test of β_0. On the other hand, the PET test is a Precision Effect Test of β_1 and it tests the genuine or authentic effect, beyond publication bias.

$$t_i = \beta_0 + \beta_1(1/SE_i) + v_i \qquad (1)$$

Where, t is the t-statistic of the elasticity of the i study, SE is the standard error of the elasticity, and v is the error term.

Now, in order to identify if there is publication bias in the meta-sample we follow Stanley *et al.* (2008) and Efendic *et al.* (2011) and we estimate equation (1). The results are presented in table 2 and indicate presence of publication bias as the coefficient of the constant is statistically significant. In addition, it has negative sign for all the estimation methods that we used which clearly implies publication selection for negative employment effects of minimum wages.

As far as the precision of the estimated empirical effect (i.e. *1/SE*) is concerned, we performed the PET test which shows in nine out of ten estimation methods that there is no statistically significant effect of minimum wages on employment measures. Furthermore, the coefficients in all specifications are extremely small which is a sign that there are no adverse employment effects of minimum wage, results that are in agreement with the results of Doucouliagos and Stanley's study in (2009).

However, like any regression model, the estimates of FAT-PET tests can become biased when important explanatory variables are omitted. Clearly, a model cannot be explained by a single independent variable, therefore the previous model in equation (1) should be expanded to include moderator variables that explain variation in elasticities. For this reason the results of the FAT-PET tests should be treated with caution and without making strong and definite conclusions. In the following section we add into the model 27 possible moderators that take into account the study heterogeneity and we present the results of our analysis.

Table 2. Funnel Asymmetry Test (FAT) and Precision Effect Test (PET).

	Column 1 OLS	*Column 2 Robust*	*Column 3 Cluster (studies)*	*Column 4 Cluster (authors)*	*Column 5 WLS*	*Column 6 FE-Cluster (study)*	*Column 7 FE-Cluster (authors)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
Dependent variable: t-stat										
1/SE	0.000485 (0.003157)	0.000485 (0.003232)	0.000485 (0.006373)	0.000485 (0.006493)	0.005703*** (0.001792)	-0.006805 (0.006164)	-0.006805 (0.004570)	0.000661 (0.003177)	0.000631 (0.003644)	0.000662 (0.003163)
Constant	-0.7632*** (0.097471)	-0.7632*** (0.084035)	-0.7632*** (0.232064)	-0.7632** (0.296838)	-1.0168*** (0.123090)	-1.5254*** (0.099392)	-1.5254*** (0.073687)	-0.7720*** (0.098634)	-0.7705*** (0.113005)	-0.7720*** (0.098204)
Observations	1521	1521	1521	1521	1521	1521	1521	1521	1521	1521
R-squared	0.0000	0.0000	0.0000	0.0000	0.0066	0.4298	0.4298	-	-	-
Linktest	P>|t| of hatsq =0.072	P>|t| of hatsq =0.072	P>|t| of hatsq =0.072	P>|t| of hatsq =0.072	P>|t| of hatsq =0.121	P>|t| of hatsq =0.720	P>|t| of hatsq =0.968	P>|t| of hatsq =0.082	P>|t| of hatsq =0.082	P>|t| of hatsq =0.082

Notes: *, **, *** denote statistical significance at 10%, 5% and 1% level of significance respectively. Standard errors are reported in parentheses.
Column 1 presents the results using the ordinary-least-squares estimation method.
Column 2 reports the robust regression version of the OLS estimation.
Column 3 presents clustered data analysis to account for within-study dependence with cluster-robust standard errors in parentheses (79 clusters).
Column 4 presents clustered data analysis to account for within-author dependence with cluster-robust standard errors in parentheses. This method is using author identifiers to allow for dependence within a given author's, or group of authors', reported elasticities. (64 clusters).
Column 5 presents the results using the weighted-least-squares estimation method.
Columns 6 and 7 present the results of columns 3 and 4, respectively using fixed (study) effects.
Column 8 presents the results with restricted maximum likelihood (REML).
Column 9 presents the results with the moment estimator (MM).
Column 10 presents the results with the empirical Bayes iterative procedure (EB).
Linktest accepts the null at the 5% and 1% levels of statistical significance in all specifications, indicating a correct specification of the dependent variable.

5. Meta Regression Analysis (MRA) and results

The Funnel Asymmetry Test (FAT) and the Precision Effect Test (PET) performed in the previous section suggested evidence of publication selection and no genuine effect of minimum wages on employment measures, respectively. However, these tests do not take into account the heterogeneity across the studies which arises from the fact that the expected value of a reported estimate will often depend on many other factors like the estimation method, measurement of the dependent variable, presence of additional controllers in the specification, business circle indicators, structure of the data, country or a region, a group or the total population. If the researcher does not tackle the problem of heterogeneity, bias can arise in any meta-regression analysis estimation. However, identification of the potential variables that can explain heterogeneity across the results is a difficult and cost-timing task.

In our analysis, we try to take into account as many as possible sources of heterogeneity and we identified 27 moderators as potential explanatory variables of the heterogeneity across the elasticities of the studies. These moderators which diversified the degree of the employment effect of minimum wages, concern mainly the study characteristics related to the data, the model specifications and the group of interest and are presented in table 3 with their definitions and some statistics.

Table 3. Moderator variables for meta-regression analysis.

Moderator variable	*Definition*	*Mean (standard deviation)*	*Number of elasticities*	*Percent on total 1.521 elasticities*
1/SE	the inverse of the standard error of the elasticity; it is used to measure elasticity's precision	19.61 (23.86)		
MWlag	= 1, if estimate relates to a lagged minimum-wage effect	0.120 (0.325)	183	12.03%
MWplusLag	= 1, if estimate relates to the cumulative effect of both the current and the lagged minimum-wage effect	0.024 (0.156)	38	2.50%
Double	= 1, if estimate comes from a double log specification	0.733 (0.442)	1115	73.31%
Panel	= 1, if estimate relates to panel data with cross-section as the base	0.819 (0.384)	1281	84.22%
TimeSeries	= 1, if estimate relates to time-series data with cross-section as the base	1.757 (9.745)	128	8.42%
Teens	= 1, if estimate relates to teenagers	0.215 (0.411)	328	21.56%
Youth	= 1, if estimate relates to youth	0.061 (0.239)	93	6.11%
YoungAdults	= 1, if estimate relates to young adults (20-24)	0.029 (0.169)	45	2.96%
Males	= 1, if estimate relates to males	0.023 (0.149)	35	2.30%
Females	= 1, if estimate relates to females	0.047 (0.213)	73	4.80%
Region	= 1, if estimate relates to a specific region of a country	0.089 (0.285)	136	8.94%
DepLagged	=1, if estimate employs lagged dependent variable	0.232 (0.422)	353	23.21%
Hours	= 1, if the dependent variable is hours worked	0.162 (0.368)	247	16.24%
AveYear	the average year of the time period that is used to estimate each elasticity	1991.2 (7.96)		
TimeTrend	= 1, if time trend is included	0.188 (0.391)	287	18.87%
TimeEffect	= 1, if time-specific fixed effects are used	0.571 (0.495)	869	57.13%
RegionEffect	= 1, if region/state/industry fixed effects are used	0.697 (0.459)	1061	69.76%
Un	= 1, if a model includes an unemployment measure as a business circle indicator	0.333 (0.471)	508	33.40%
Educ	= 1, if a model includes a schooling/educational variable	0.316 (0.465)	481	31.62%
Kaitz	=1, if the Kaitz measure of the minimum wage is used	0.278 (0.448)	426	28.01%
Dummy	= 1, if a dummy variable measure of the minimum wage is used	0.082 (0.274)	125	8.22%
Level	= 1, if the level of the minimum wage is used	0.328 (0.469)	499	32.81%
Published	=1, if the elasticity comes from a study that has been published in a journal	0.756 (0.429)	1150	75.61%
Retail	= 1, if estimates are for the retail industry	0.057 (0.233)	88	5.79%
Food	= 1, if estimates are for the food, beverage or drinking industry	0.051 (0.221)	79	5.19%
Manufacturing	= 1, if estimates are for the manufacturing industry	0.073 (0.261)	112	7.36%
SpecificIndustry	= 1, if estimates are for a specific industry or a group of industries	0.313 (0.464)	477	31.36%

Commenting on the structure of the data, it is obvious that the vast majority of the elasticities has been drawn from *panel* datasets (84.22%), while only the 8.42% of the observations were derived from *time-series* data which were largely used until the early 90's but since then they have been relatively abandoned in the minimum wage research. The rest 7.36% of the elasticities of the meta-sample came from cross-section datasets. The estimations that came from minimum wage variables which were in *lagged* form were 183 from the total 1.521 and the cases where the estimates related to the total effect of both the *current and the lagged* minimum-wage effect were only 38. Generally, the lagged form of the minimum wage variable is considered to provide a long-term impact which triggered some researchers to investigate the effect of minimum wages not only in the short-term, but also in the long-run.

The 73.31% of the elasticities of the meta-sample came from a *double log* specification while the rest 26.69% came either from single log specification (semi-elasticities measure the percentage change in the dependent variable when the dependent one changes by one unit) or the classic elasticity definition calculating $n_i = a_i . \overline{X}/\overline{Y}$. We also included moderators relating to the age group of the population sample providing 328 observations relating only to *teenagers*, 93 observations relating to *youth*, and 45 elasticities relating to *young adults* aged 20-24 years-old. Sub-group demographic estimates relating to elasticities to only *males* or *females* provided only 35 and 73 observations in the meta-sample, respectively.

The explanatory variable *region* was included to control for any differences between region-specific and whole country elasticities, and according the data only 8.94% of the elasticities related to a specific region of a country. The variable *DepLagged* was used to show that the estimate came from a specification that employed a lagged dependent variable implying a dynamic estimation. Remarkably, 353 observations of the total 1.521 came from specifications that used a lagged dependent variable as a dependent one, i.e. almost one to four.

In the literature, as Doucouliagos and Stanley (2009) at p. 418 refer, there is some debate about the need to control for cyclical effects and school enrolment. Therefore, we included the variables *Un* and *Educ* to catch these effects. As indicated in table 3, 508 observations came from a model that included an unemployment measure as a business circle indicator, and 481 observations came from models which included a schooling or educational variable. Furthermore, 83.76% of the elasticities where taken form specifications that used an employment measure as dependent variable, but 16.24% used as dependent variable the *hours* worked.

Characteristics related to the sample period of the estimation where also taken into account and we included the average year (*AveYear*) of the time period that was used in each study, or to be more precise in each specification in the studies. The effects of the use of fixed effects and time-trend in the studies were explored through *TimeTrend*, *TimeEffect* and *RegionEffect* variables. A large group of estimates came from studies that used cross-section fixed effects as 1.061 elasticities were taken from studies which used region, state, or industry fixed effects in the specification of the estimated model. In addition to this, large is also the group of elasticities taken from studies which used time specific fixed effects (mostly year-fixed effects) providing 869 elasticities. Lastly, 287 elasticities were taken from studies which included a time trend.

Across the studies we found a great variability of the minimum wage measure that was used to investigate the impact on employment. We tried to categorize the potential minimum wage measurements into the following groups: 32.81% of the elasticities employed the minimum wage *level*, 28.01% used a *kaitz* measure of the minimum wage (minimum/average wage), while 8.22% used a *dummy* variable measurement of the minimum wage. The rest 30.96% used other minimum wage measures such as proportion at or below minimum wage, minimum wage*crisis dummy and others.

The majority of the elasticities of the meta-sample came from studies that have been *published* in an academic journal (75.61%). However, there are elasticities that come from unpublished studies which are mainly working papers cited in article papers and books, and some of them will be published in a journal. Therefore, we found it appropriate to include them into the meta-sample.

Closing our analysis on the moderators, we would say that the all-set meta-sample includes elasticities for specific industries of a country; therefore we should include controls to investigate any such differences. We used three moderators *Retail*, *Food*, and *Manufacturing* which provided the most elasticities in comparison to the other industries, and an addition one *SpecificIndustry* if estimates are generally for a specific industry or a group of industries. Numerically, 88 elasticities are for the retail industry, 79 are for the food, beverage or drinking industry, 112 are for the manufacturing industry, and totally 477 elasticities are related to the employment effect of minimum wages in a single industry or a group of industries but not the whole economy.

Now, taking into account the study heterogeneity, we follow Adam *et. al.* (2013) and we incorporate the moderator variables as potential explanatory variables of this heterogeneity. Then, the meta-regression model we estimate takes the form:

$$t_i = \beta_0 + \beta_1(1/SE_i) + \sum_{k=1}^{K} \frac{a_k Z_{jk}}{SE_j} + v_j \qquad (2)$$

Where, t is the t-statistic of the elasticity of the i study, SE is the standard error of the elasticity of the i study, Z_k are the K moderator variables, and v_j is the error term.

Table 4 presents the results of the meta-regression analysis using all the moderators in the model estimations. In order to improve further the robustness of the results, we applied 10 estimation methods which generally did not cause variability in the estimated coefficients. In column 1, we present the results using the ordinary-least-squares estimation method which indicates that effects that relate to teenagers, youth and young adults tend to report a negative and statistically significant impact of minimum wage on employment measures. The same appears for elasticities related to females, and for a specific region of the country. In addition, specifications that employ a timetrend or fixed region effects, that use unemployment as controller, if minimum wage is a dummy variable, or in case the study is published, then they report a negative relationship between minimum wages and employment. Those elasticities which are related to retail sector, food, beverage or drinking industry or manufacturing, report negative minimum wage effects.

On the other hand, elasticities from minimum wage variables in lagged form, or if they report the cumulative effect of both current and lagged minimum wage, they both indicate positive effect of minimum wages on employment. Moreover, studies with time-series data, elasticities from dynamic specifications, specifications with time fixed effects, or if they employ an educational variable, they seem to report positive employment effects of minimum wages. Furthermore, kaitz index measures or the minimum wage level report positive impact and the same happens when generally the elasticity comes from a specific industry or a group of industries. The coefficient of the average year is positive and statistically significant implying that with time the effect of minimum wages tends to provide positive estimations. Finally, panel, males and hours variables do not appear to explain any heterogeneity of the minimum wage elasticities.

In column 2 we present the robust regression version of the OLS estimation which provides almost the same results with slight differences. In column 3 clustered data analysis is reported to account for within-study dependence with cluster-robust standard errors in parentheses. In the literature of meta-analysis, it is a usual phenomenon to be reported estimation results with clusters across the studies. However, having so many studies in the meta-sample may mean that some of them have the same author or authors, fact which causes biasness of the results. Therefore, we implemented cluster data analysis in column 4 using author identifiers to allow for dependence within a given author's, or group of authors', reported elasticities. The analysis showed that the 79 studies of the meta-sample were written by 64 author(s), therefore we also used clustered data analysis to account for within-author dependence. Results in columns 3 and 4 do not change in sign and magnitude but the moderators: TimeSeries, YoungAdults, Females, DepLagged, AveYear, TimeTrend, TimeEffect, Educ, Dummy, Level, Retail and Kaitz (divided by SE) are no longer statistically significant.

Column 5 presents the results using the weighted-least-squares estimation method used first time in the meta-analysis literature of minimum wages in Stanley and Doucouliagos (2012). Estimation results do not alter in sign but there are changes in the magnitudes to both directions. Nevertheless, in this estimation method the linktest accepts the null only at the 5% and 1% levels of statistical significance.

In columns 6 and 7 we present the results of columns 3 and 4, respectively using fixed (study) effects. Fixed effects in meta-analysis are not generally recommended. Fixed effects models assume that there is one true and common effect that all studies are estimating and that all the variability and differences between effect sizes is due to sampling error. This means that they essentially assume homogeneity. This would have seen reasonable if the studies were the almost same and identical and had same measures and same features. In this case the differences would arise from the errors in the samples. Despite that, Stanley and Doucouliagos in their book in 2012 imply that fixed effects are more suitable in economics meta-analysis but not in psychology and medicine and use fixed effects specification in their book extensively. Now, in the clustered data analysis with fixed effect presented in columns 6 and 7 many moderators lost their indicator of statistical significance but they do not change in sign and some of them remain statistical significant.

In columns 8, 9 and 10 we apply random effects models. Random effects assume that there are multiple effects which the studies are estimating and that variability between effect sizes is due to sampling error plus some variability from true study differences. There are genuine differences among studies so random effects models, generally, are preferred in meta-analysis to take into account this variability. Column 8 shows the results with Restricted Maximum Likelihood (REML) and column 9 presents the results with the moment estimator (MM) which is the only non iterative method which is fast and robust, but according to Mavridis and Salanti (2012) the Maximum Likelihood methods are often preferred to MM methods as the former have higher probability of being close to the quantities to be estimated. Column 10 presents the results with the empirical Bayes iterative procedure (EB). All these three random effects methods provided very similar results with the OLS estimation with only minor and rare differences, which happens when moderate or large heterogeneity across studies exist.

Commenting on the reliability of the models presented in table 4, we performed linktests which accepted the null hypothesis at all levels of statistical significance in nine of the ten methods, and at the 5% and 1% levels of statistical significance in one, indicating a correct specification of the dependent variable. Towards the same direction are the results of the F-test which is zero in all cases, and the values of R-squared being over 25% in columns are considered to be more than satisfactory for meta-analysis. At this point we have to point out that in columns 8-10 only the adjusted R-squared are provided from the program STATA and therefore we report them as being R-squared. As a final comment on table 4 we would say that the coefficient of 1/SE which indicates the minimum wage effect, in six columns it is negative and statistically significant, implying a negative relationship. When cluster data analysis is used in columns 3 and 4 it is no longer significant and when fixed effects are employed in the clustered data analysis in columns 6 and 7, the coefficients become positive but are statistical insignificant.

Table 4. Multivariate, Meta-regression analysis using all moderators (Dependent variable: t-statistic).

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies)*	*Column 4 Cluster (authors)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies)*	*Column 7 FE-Cluster (authors)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	-5.182***	-5.182**	-5.182	-5.182	-2.426*	4.997	4.997	-5.174***	-5.174***	-5.174***
MWlag/SE	0.022**	0.022**	0.022*	0.022	0.019***	0.015	0.015	0.022**	0.022**	0.022**
MWplusLag/SE	0.071*	0.071***	0.071**	0.071**	0.045	-0.012	-0.012	0.071*	0.071*	0.071*
Double/SE	-0.020**	-0.020*	-0.020	-0.020	-0.003	-0.021	-0.021	-0.020**	-0.020**	-0.020**
Panel/SE	0.004	0.004	0.004	0.004	-0.013	-0.062	-0.062***	0.004	0.004	0.004
TimeSeries/SE	0.074***	0.074**	0.074	0.074	0.017	-0.035	0.035	0.073***	0.073***	0.073***
Teens/SE	-0.073***	-0.073***	-0.073**	-0.073**	-0.050***	-0.068*	-0.068**	-0.072***	-0.072***	-0.072***
Youth/SE	-0.130***	-0.130***	-0.130***	-0.130***	-0.115***	-0.115***	-0.115***	-0.130***	-0.130***	-0.130***
YoungAdults/SE	-0.064**	-0.064***	-0.064	-0.064	-0.028	-0.083**	-0.083**	-0.064**	-0.064**	-0.064**
Males/SE	0.010	0.010	0.010	0.010	-0.002	-0.001	-0.001	0.010	0.010	0.010
Females/SE	-0.039***	-0.039**	-0.039	-0.039	-0.043***	-0.061*	-0.061*	-0.039***	-0.039***	-0.039***
Region/SE	-0.093***	-0.093***	-0.093**	-0.093**	-0.079***	-0.033	-0.033	-0.093***	-0.093***	-0.093***
DepLagged/SE	0.022***	0.022***	0.022	0.022	0.009*	-0.003	-0.003	0.022***	0.022***	0.022***
Hours/SE	0.004	0.004	0.004	0.004	-0.008***	0.005	0.005	0.004	0.004	0.004
AveYear/SE	0.002***	0.002**	0.002	0.002	0.001*	-0.002	-0.002	0.002***	0.002***	0.002***
TimeTrend/SE	-0.031**	-0.031*	-0.031	-0.031	-0.046***	-0.030	-0.030	-0.031**	-0.031**	-0.031**
TimeEffect/SE	0.041***	0.041**	0.041	0.041	0.035***	0.061**	0.061**	0.041***	0.041***	0.041***
RegionEffect/SE	-0.088***	-0.088***	-0.088***	-0.088***	-0.097***	-0.073**	-0.073*	-0.088***	-0.088***	-0.088***
Un/SE	-0.065***	-0.065***	-0.065**	-0.065**	-0.088***	-0.021	-0.021	-0.065***	-0.065***	-0.065***
Educ/SE	0.052***	0.052**	0.052	0.052	0.057***	0.029	0.029	0.052***	0.052***	0.052***
Kaitz/SE	0.033**	0.033	0.033	0.033	0.051***	0.036	0.036	0.033**	0.033**	0.033**
Dummy/SE	-0.042**	-0.042**	-0.042	-0.042	-0.002	0.034	0.034	-0.042**	-0.042**	-0.042**
Level/SE	0.069***	0.069**	0.069	0.069	0.093***	0.037	0.037	0.070***	0.070***	0.070***
Published/SE	-0.015*	-0.015	-0.015	-0.015	-0.016***	-0.034	-0.034	-0.015*	-0.015*	-0.015*
Retail/SE	-0.062***	-0.062**	-0.062	-0.062	-0.021	-0.046*	-0.046*	-0.062***	-0.062***	-0.062***
Food/SE	-0.073***	-0.073***	-0.073	-0.073*	-0.079***	-0.119***	-0.119***	-0.073***	-0.073***	-0.073***
Manufacturing/SE	-0.129***	-0.129***	-0.129***	-0.129***	-0.122***	-0.055**	-0.055**	-0.129***	-0.129***	-0.129***
SpecificIndustry/SE	0.073***	0.073***	0.073**	0.073**	0.046***	0.032	0.032	0.073***	0.073***	0.073***
Constant	-0.378***	-0.378***	-0.378*	-0.378	-0.693***	-0.593	-0.593	-0.381***	-0.381***	-0.381***
Observations	1521	1521	1521	1521	1521	1521	1521	1521	1521	1521
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.2648	0.2648	0.2648	0.2648	0.3913	0.5006	0.5006	0.2507	0.4335	0.2519
Linktest	P>|t| of hatsq = 0.145	P>|t| of hatsq =0.145	P>|t| of hatsq =0.145	P>|t| of hatsq =0.145	P>|t| of hatsq =0.086	P>|t| of hatsq =0.551	P>|t| of hatsq =0.551	P>|t| of hatsq =0.149	P>|t| of hatsq =0.149	P>|t| of hatsq =0.149

Notes: See notes of table 2. We do not report standard errors or t-stats for economy space reasons, but are available upon request.
Linktest accepts the null at the 5% and 1% levels of statistical significance in all specifications, indicating a correct specification of the dependent variable.

In table 5 we apply the General-to-Specific approach following Stanley and Doucouliagos (2012) and Benos and Zotou (2014). This method begins having all the explanatory variables in the equation that we want to estimate. Afterwards, we removed the least statistically significant, one at time, until all variables which remained to be statistically significant. It may not seem ideal but as Charemza and Deadman (1997) refer at page 78 of their book: 'the strength of general to specific modeling is that the model construction proceeds from a very general model in a more structured, ordered fashion, and in this way avoids the worst of data missing'. Additionally, as Stanley and Doucouliagos (2012) state at page 91 in their book: 'the other sensible approach is to report only the MRA model that includes all coded moderator variables', which is what we did in table 4.

Generally, the results in table 5 are similar to those of table 4. Ten moderators (MWlag, MWplusLag, TimeSeries, DepLagged, AveYear, TimeEffect, Educ, Kaitz, Level and SpecificIndustry, divided by SE) have positive coefficients and fifteen moderators (Double, Panel, Teens, Youth, YoungAdults, Females, Region, TimeTrend, RegionEffect, Un, Dummy, Published, Retail, Food and Manufacturing, divided by SE) report negative coefficients. Moderator related to Hours has a small but statistically significant negative coefficient in only the WLS column, and moderator related to Males does not provide a statistical significant estimation in any column.

Table 5. Multivariate, General-to-Specific, Meta-regression analysis (Dependent variable: t-statistic).

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies)*	*Column 4 Cluster (authors)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies)*	*Column 7 FE-Cluster (authors)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	-5.129***	-5.057***	0.032**	0.032**	-1.751*	0.061**	0.061**	-5.120***	-5.120***	-5.120***
MWlag/SE	0.022**	0.028***			0.018***			0.022**	0.022**	0.022**
MWplusLag/SE	0.071*	0.085***	0.055*	0.055*				0.071*	0.071*	0.071*
Double/SE	-0.018**							-0.018**	-0.018**	-0.018**
Panel/SE					-0.018***	-0.057**	-0.057**			
TimeSeries/SE	0.068***	0.057***						0.068***	0.068***	0.068***
Teens/SE	-0.074***	-0.074***	-0.046*	-0.046*	-0.037***	-0.062*	-0.062**	-0.074***	-0.074***	-0.074***
Youth/SE	-0.132***	-0.127***	-0.107***	-0.107***	-0.090***	-0.102***	-0.102***	-0.132***	-0.132***	-0.132***
YoungAdults/SE	-0.064**	-0.062**				-0.084**	-0.084**	-0.063**	-0.063**	-0.063**
Males/SE										
Females/SE	-0.038***	-0.036***			-0.040***	-0.056**	-0.056**	-0.038***	-0.038***	-0.038***
Region/SE	-0.095***	-0.095***	-0.090***	-0.090***	-0.077***			-0.095***	-0.095***	-0.095***
DepLagged/SE	0.022***	0.018***			0.010**			0.022***	0.022***	0.022***
Hours/SE					-0.009***					
AveYear/SE	0.002***	0.002***			0.0009*			0.002***	0.002***	0.002***
TimeTrend/SE	-0.032***				-0.044***			-0.032***	-0.032***	-0.032***
TimeEffect/SE	0.042***	0.034***	0.024**	0.024**	0.034***	0.062***	0.062***	0.042***	0.042***	0.042***
RegionEffect/SE	-0.088***	-0.081***	-0.095***	-0.095***	-0.102***	-0.064**	-0.064**	-0.088***	-0.088***	-0.088***
Un/SE	-0.065***	-0.060***	-0.078***	-0.078***	-0.100***			-0.065***	-0.065***	-0.065***
Educ/SE	0.050***	0.034***	0.058***	0.058***	0.060***			0.050***	0.050***	0.050***
Kaitz/SE	0.033**				0.051***			0.033**	0.033**	0.033**
Dummy/SE	-0.038**	-0.057***	-0.046***	-0.046***				-0.038**	-0.038**	-0.038**
Level/SE	0.069***	0.050***	0.049*	0.049*	0.093***			0.069***	0.069***	0.069***
Published/SE	-0.015*				-0.017***			-0.015*	-0.015*	-0.015*
Retail/SE	-0.061***	-0.057***				-0.053**	-0.053***	-0.061***	-.0061***	-0.061***
Food/SE	-0.073***	-0.069***			-0.069***	-0.132***	-0.132***	-0.073***	-0.073***	-0.073***
Manufacturing/SE	-0.129***	-0.113***	-0.076***	-0.076**	-0.115***	-0.056***	-0.056***	-0.129***	-0.129***	-0.129***
SpecificIndustry/SE	0.071***	0.065***	0.053***	0.053***	0.043***	0.043*	0.043*	0.071***	0.071***	0.071***
Constant	-0.373***	-0.413***	-0.407*	-0.407	-0.710***	-0.846	-0.846	-0.377***	-0.377***	-0.377***
Observations	1521	1521	1521	1521	1521	1521	1521	1521	1521	1521
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.2643	0.2578	0.2338	0.2338	0.3897	0.4907	0.4907	0.2517	0.4189	0.2530
Linktest	P>|t| of hatsq =0.125	P>|t| of hatsq =0.193	P>|t| of hatsq =0.029	P>|t| of hatsq =0.029	P>|t| of hatsq =0.093	P>|t| of hatsq =0.490	P>|t| of hatsq =0.490	P>|t| of hatsq =0.128	P>|t| of hatsq =0.128	P>|t| of hatsq =0.128

Notes: See notes of table 2. We do not report standard errors or t-stats for economy space reasons, but are available upon request.
Linktest accepts the null at 1% level of statistical significance in all specifications indicating a correct specification of the dependent variable.

6. Robustness checks

In tables 6-9, we examine the sensitivity of the previous results by conducting four robustness checks. Initially, in table 6 we excluded the 10% of the extreme values in the meta-sample. To be more specific, in the first robustness check we excluded the highest 5% and the lowest 5% values of the elasticities, which reduced the meta-sample by 152 elasticities. The general picture is not altered which is very encouraging for the robustness of our previous results, as the signs of the moderators did not change when we excluded the "outliers" of the meta-sample. As slight exceptions we would mention that moderator related to RegionEffect/SE decreased in magnitude, and that moderators related to Educ/SE, Kaitz/SE, Level/SE, Published/SE appear to be statistically significant in only one column out of ten.

In table 7 we excluded all the statistically insignificant elasticities of the meta-sample, which led to the reduction of the sample by 841 elasticities. We performed the General-to-Specific methodology to the remaining 680 elasticities and our previous results generally seemed to hold with only small differences. The only exception is in the case of the moderator related to Panel, where there is a change in the sign. When we keep only the statistically significant elasticities in the meta-sample, this moderator suggests positive employment effect of minimum wage in 8 out of 10 columns. Furthermore, moderator related to Hours is now positive in 5 columns, but generally the results for the other moderators do not seem to change greatly. However, the most remarkable result in this robustness check is that in all columns the moderator Published has negative value, clearly implying that published studies have a tension to report negative employment elasticities of minimum wage. Therefore our initial results, from the FAT test, of presence of publication bias in the literature seem to hold, and we found it interesting to approach this issue with the following robustness check where we exclude all the elasticities that come from unpublished studies.

In the third robustness analysis we exclude all the elasticities that come from an unpublished study and the results are displayed in table 8. In this robustness check we follow Stanley and Doucouliagos (2012) who state at page 19 that: ‘If unpublished studies have been collected, it is probably wise to undertake a sensitivity analysis of the meta-analysis, that is, conduct the meta-analysis with and without unpublished papers’. The unpublished studies provided 371 elasticities in our meta-sample and after the exclusion of them, 1.150 elasticities remained. In comparison to the previous tables, the results are relatively similar with a few exceptions. First of all moderators MWplusLag/SE, Kaitz/SE and Dummy/SE are not statistically significant in any estimation method. Secondly, the results for teens, youth and young adults are almost the same in magnitude and their sign, once again, indicates that if the study focuses on people who belong to these age groups, then the neoclassical theory, which suggests negative employment effect of minimum wage, prevails. In case the study employees a time trend or uses the level of the minimum wage as measurement of the minimum wage, we can see a change in the sign compared to the previous tables. TimeTrend/SE is positive in only one column and Level/SE is negative in only two columns, though. We would mention that the estimation results in columns 1, 8, 9 and 10 are almost the same, and in columns 3 and 4, and 6 and 7 they are exactly the same, respectively.

Finally, in table 9 we perform the General-to-Specific methodology by adding two additional moderators which relate to the country. More specifically, we included the USA/SE moderator if the elasticity comes from a study conducted for the United States, and moderator Europe/SE if the elasticity comes from a European country, with other countries of the world as the base. From our data, 437 elasticities where obtained from US studies (28.7%), 377 from studies conducted for European countries (24.8%) and 707 from studies elsewhere (46.5%). As far as these new two moderators is concerned, it is shown that USA studies do not report a preference for positive or negative employment effects of minimum wage, whereas, studies conducted for European countries seem to report positive minimum wage elasticities. Furthermore, the results of our analysis when we add USA and European moderators do not change greatly. Moderators related to MWlag/SE, MWplusLag/SE, AveYear/SE, TimeEffect/SE, Educ/SE, Level/SE, SpecificIndustry/SE are still positive, implying positive effect of minimum wages, while moderators related to Double/SE, Teens/SE, Youth/SE, YoungAdults/SE, Females/SE, Region/SE, RegionEffect/SE, TimeTrend/SE, Un/SE, Dummy/SE, Published/SE, Retail/SE, Food/SE, and Manufacturing/SE are still negative. Once again, as in table 5, variables Males/SE and Hours/SE do not report a statistically significant coefficient, but now the inclusion of the country moderators make DepLagged/SE and Kaitz/SE moderators lose their statistically significance. Additionally, the two moderators related to the structure of the data (i.e. Panel/SE and TimeSeries/SE) alter their signs across the columns.

Given that the robustness checks generally fail to provide different results, this adds extra robustness and stability to the meta-analysis that has been conducted. However, it should be mentioned that there is still much unobserved heterogeneity across the studies and the road in order to find a model that can locate and explain all the factors of publication bias and heterogeneity in the results is long.

Table 6. Multivariate, General-to-Specific, Meta-regression analysis (Dependent variable: t-statistic).
Robustness check 1: The highest 5% and the lowest 5% values of the elasticities are excluded (152 elasticities dropped out, 1.369 remaining).

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies) (76 clusters)*	*Column 4 Cluster (authors) (61 clusters)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies) (76 clusters)*	*Column 7 FE-Cluster (authors) (61 clusters)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	-5.464***	-6.157***	-7.648**	-5.641*	-3.582***	-0.001	-0.001***	-5.458***	-5.459***	-5.458***
MWlag/SE	0.028***	0.029***	0.033***	0.030**	0.021***			0.028***	0.028***	0.028***
MWplusLag/SE	0.073**	0.080***	0.086***	0.083***				0.073**	0.073**	0.073**
Double/SE	-0.018***							-0.018***	-0.018***	-0.018***
Panel/SE						-0.060***	-0.060***			
TimeSeries/SE	0.100***	0.098***	0.084**	0.074**	0.061***	0.036*	0.036*	0.100***	0.100***	0.100***
Teens/SE	-0.065***	-0.046***		-0.038*	-0.029**	-0.057**	-0.057**	-0.065***	-0.065***	-0.065***
Youth/SE	-0.132***	-0.115***	-0.086***	-0.113***	-0.087***	-0.104***	-0.104***	-0.132***	-0.132***	-0.132***
YoungAdults/SE	-0.062***	-0.044**				-0.083***	-0.083***	-0.062***	-0.062**	-0.062**
Males/SE										
Females/SE	-0.035***	-0.045***	-0.035**	-0.043**	-0.040***	-0.035*	-0.035*	-0.035***	-0.035***	-0.035***
Region/SE	-0.088***	-0.097***	-0.099***	-0.091***	-0.076***			-0.088***	-0.088***	-0.088***
DepLagged/SE	0.024***	0.022***	0.028*	0.026*	0.008*			0.024***	0.024***	0.024***
Hours/SE					-0.011***					
AveYear/SE	0.003***	0.003***	0.004**	0.003*	0.002***			0.003***	0.003***	0.003***
TimeTrend/SE	-0.026***	-0.027**			-0.052***			-0.026***	-0.026***	-0.026***
TimeEffect/SE	0.043***	0.032***	0.035**	0.028*	0.027***	0.065***	0.065***	0.043***	0.043***	0.043***
RegionEffect/SE	-0.049***	-0.050***	-0.047***	-0.048***	-0.070***			-0.049***	-0.049***	-0.049***
Un/SE	-0.050***	-0.074***	-0.094***	-0.075***	-0.090***			-0.050***	-0.050***	-0.050***
Educ/SE					0.045***					
Kaitz/SE					0.038***					
Dummy/SE	-0.056***	-0.043***	-0.062***	-0.053***				-0.056***	-0.056***	-0.056***
Level/SE					0.055***					
Published/SE					-0.010**					
Retail/SE	-0.052***					-0.066***	-0.066***	-0.052***	-0.052***	-0.052***
Food/SE	-0.036**				-0.060***	-0.129***	-0.129***	-0.036**	-0.036*	-0.036**
Manufacturing/SE	-0.100***	-0.088***	-0.097***	-0.081***	-0.108***	-0.053**	-0.053**	-0.100***	-0.100***	-0.100***
SpecificIndustry/SE	0.068***	0.050***	0.065***	0.050***	0.051***	0.056***	0.056***	0.068***	0.068***	0.068***
Constant	-0.329***	-0.342***	-0.488**	-0.439**	-0.704***	0.115	0.115	-0.333***	-0.333***	-0.333***
Observations	1369	1369	1369	1369	1369	1369	1369	1369	1369	1369
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.3424	0.3349	0.3200	0.3269	0.4265	0.5350	0.5350	0.3307	0.5002	0.3324
Linktest	P>|t| of hatsq =0.031	P>|t| of hatsq =0.100	P>|t| of hatsq =0.949	P>|t| of hatsq =0.198	P>|t| of hatsq =0.444	P>|t| of hatsq =0.936	P>|t| of hatsq =0.936	P>|t| of hatsq =0.033	P>|t| of hatsq =0.033	P>|t| of hatsq =0.033

Notes: See notes of table 2. We do not report standard errors or t-stats for economy space reasons, but are available upon request.
Linktest accepts the null at 1% level of statistical significance in all specifications indicating a correct specification of the dependent variable.

Table 7. Multivariate, General-to-Specific, Meta-regression analysis (Dependent variable: t-statistic).
Robustness check 2: All the statistically insignificant elasticities of the meta-sample are excluded (841 elasticities dropped out, 680 remaining).

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies) (72 clusters)*	*Column 4 Cluster (authors) (58 clusters)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies) (72 clusters)*	*Column 7 FE-Cluster (authors) (58 clusters)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	-0.037	-4.854*	0.028	0.024	-5.431**	0.102***	0.102**	-0.037	-0.037	-0.037
MWlag/SE										
MWplusLag/SE		0.072**	0.075**	0.073**						
Double/SE	-0.080***	-0.075***	-0.074***	-0.073***	-0.107***	-0.071***	-0.071***	-0.080***	-0.080***	-0.080***
Panel/SE	0.160***	0.168***	0.158***	0.160***	0.128***			0.160***	0.160***	0.160***
TimeSeries/SE	0.250***	0.294***	0.260***	0.271***	0.272***	0.155**	0.155**	0.250***	0.250***	0.250***
Teens/SE	-0.152***	-0.132***	-0.112***	-0.118***	-0.052***	-0.114***	-0.114***	-0.152***	-0.152***	-0.152***
Youth/SE	-0.144***	-0.140***	-0.140**	-0.146***	-0.080**	-0.150***	-0.150***	-0.144***	-0.144***	-0.144***
YoungAdults/SE	-0.124*	-0.132***		-0.095*		-0.157***	-0.157***	-0.124*	-0.124*	-0.124*
Males/SE										
Females/SE						-0.152***	-0.152***			
Region/SE	-0.078**	-0.094***			-0.090***			-0.078**	-0.078**	-0.078**
DepLagged/SE					0.026*					
Hours/SE	0.034**	0.032**						0.034**	0.034**	0.034**
AveYear/SE		0.002*			0.003**					
TimeTrend/SE					-0.103***	-0.075*	-0.075*			
TimeEffect/SE										
RegionEffect/SE	-0.081***	-0.076***	-0.056**	-0.056**	-0.078***			-0.081***	-0.081***	-0.081***
Un/SE	-0.078***	-0.092***	-0.086**	-0.083**	-0.149***			-0.078***	-0.078***	-0.078***
Educ/SE	0.132***	0.121***	0.074**	0.079**	0.120***			0.132***	0.132***	0.132***
Kaitz/SE	0.064**	0.068**			0.134***	0.065**	0.065**	0.064***	0.064**	0.064***
Dummy/SE	-0.148***	-0.160***	-0.167***	-0.166***	-0.088***			-0.148***	-0.148***	-0.148***
Level/SE	0.121***	0.117***			0.126***			0.121***	0.121***	0.121***
Published/SE	-0.058***	-0.050**	-0.062***	-0.062**	-0.102***	-0.092***	-0.092***	-0.058***	-0.058***	-0.058***
Retail/SE	-0.109***	-0.097***				-0.035*	-0.035*	-0.109***	-0.109***	-0.109***
Food/SE	-0.073*	-0.075**				-0.137***	-0.137***	-0.073*	-0.073*	-0.073*
Manufacturing/SE	-0.110***	-0.122***			-0.115***			-0.110***	-0.110***	-0.110***
SpecificIndustry/SE	0.062***	0.066***			0.040***			0.062***	0.062***	0.062***
Constant	-1.038***	-1.019***	-1.215**	-1.170*	-0.987***	-0.973	-0.973	-1.038***	-1.038***	-1.038***
Observations	680	680	680	680	680	680	680	680	680	680
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.3422	0.3460	0.2979	0.3461	0.5141	0.6251	0.6251	0.3228	0.5002	0.3229
Linktest	P>|t| of hatsq =0.226	P>|t| of hatsq =0.315	P>|t| of hatsq =0.733	P>|t| of hatsq =0.597	P>|t| of hatsq =0.844	P>|t| of hatsq =0.751	P>|t| of hatsq =0.751	P>|t| of hatsq =0.226	P>|t| of hatsq =0.226	P>|t| of hatsq =0.226

Notes: See notes of table 2. We do not report standard errors for economy space reasons, but are available upon request.
Linktest accepts the null at all levels of statistical significance in all specifications, indicating a correct specification of the dependent variable.

Table 8. Multivariate, General-to-Specific, Meta-regression analysis (Dependent variable: t-statistic).
Robustness check 3: Elasticities obtained from unpublished studies are excluded (371 elasticities dropped out, 1.150 remaining).

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies) (58 clusters)*	*Column 4 Cluster (authors) (48 clusters)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies) (58 clusters)*	*Column 7 FE-Cluster (authors) (48 clusters)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	0.029*	0.021	-0.007	-0.007	2.285*	-0.001	-0.001	0.028*	0.028*	0.028*
MWlag/SE	0.016*	0.017*			0.018***			0.016*	0.016*	0.016*
MWplusLag/SE										
Double/SE	-0.029***	-0.029***						-0.029***	-0.029***	-0.029***
Panel/SE	-0.033**	-0.036*			-0.049***	-0.100***	-0.100***	-0.033**	-0.033**	-0.033**
TimeSeries/SE	0.072***	0.068**	0.099***	0.099***	0.042**			0.072***	0.072***	0.072***
Teens/SE	-0.109***	-0.121***	-0.125***	-0.125***	-0.089***	-0.062**	-0.062**	-0.109***	-0.109***	-0.109***
Youth/SE	-0.108***	-0.125***	-0.134***	-0.134***	-0.096***	-0.119***	-0.119***	-0.108***	-0.108***	-0.108***
YoungAdults/SE	-0.107***	-0.122***	-0.113***	-0.113***	-0.103***	-0.080***	-0.080***	-0.107***	-0.107***	-0.107***
Males/SE		0.039**			0.038**	0.083*	0.083*			
Females/SE	-0.032**	-0.024*						-0.032**	-0.032**	-0.032**
Region/SE	-0.091***	-0.090***	-0.107***	-0.107***	-0.053***			-0.091***	-0.091***	-0.091***
DepLagged/SE	0.026***	0.028***			0.010**			0.026***	0.026***	0.026***
Hours/SE					-0.013***					
AveYear/SE					-0.001*					
TimeTrend/SE					0.017*					
TimeEffect/SE	0.062***	0.062***	0.026**	0.026**	0.050***	0.093***	0.093***	0.062***	0.062***	0.062***
RegionEffect/SE	-0.069***	-0.066***	-0.053**	-0.053**	-0.073***			-0.069***	-0.069***	-0.069***
Un/SE	-0.022*				-0.045***			-0.022*	-0.022*	-0.022*
Educ/SE	0.033***	0.038***	0.050***	0.050***	0.039***			0.033***	0.033***	0.033***
Kaitz/SE										
Dummy/SE										
Level/SE						-0.034*	-0.034*			
Published/SE	-	-	-	-	-	-	-	-	-	-
Retail/SE	-0.086***	-0.106***	-0.070**	-0.070**	-0.032**	-0.052***	-0.052***	-0.086***	-0.086***	-0.086***
Food/SE	-0.046*	-0.052**			-0.072***	-0.136***	-0.136***	-0.046*	-0.046*	-0.046*
Manufacturing/SE	-0.196***	-0.193***	-0.171***	-0.171***	-0.168***			-0.196***	-0.196***	-0.196***
SpecificIndustry/SE	0.112***	0.118***	0.094***	0.094***	0.096***	0.097***	0.097***	0.112***	0.112***	0.112***
Constant	-0.064	-0.054	-0.131	-0.131	-0.413***	1.038	1.038	-0.060	-0.060	-0.060
Observations	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.2828	0.2825	0.2520	0.2520	0.4022	0.5309	0.5309	0.2713	0.4044	0.2720
Linktest	P>|t| of hatsq =0.004	P>|t| of hatsq =0.002	P>|t| of hatsq =0.003	P>|t| of hatsq =0.003	P>|t| of hatsq =0.029	P>|t| of hatsq =0.005	P>|t| of hatsq =0.005	P>|t| of hatsq =0.004	P>|t| of hatsq =0.004	P>|t| of hatsq =0.004

Notes: See notes of table 2. We do not report standard errors for economy space reasons, but are available upon request.
Linktest accepts the null at 1% level of statistical significance in only one specification (WLS).

Table 9. Multivariate, General-to-Specific, Meta-regression analysis (Dependent variable: t-statistic).
Robustness check 4: Adding country moderators.

Moderator variables	*Column 1 OLS*	*Column 2 Robust*	*Column 3 Cluster (studies)*	*Column 4 Cluster (authors)*	*Column 5 WLS*	*Column 6 FE-Cluster (studies)*	*Column 7 FE-Cluster (authors)*	*Column 8 REML*	*Column 9 MM*	*Column 10 EB*
1/SE	-3.372**	-3.526*	0.017	0.033**	0.005	0.061**	0.061**	-3.362**	-3.362**	-3.362**
USA/SE										
Europe/SE	0.064***	0.052***	0.038*		0.066***			0.065***	0.065***	0.065***
MWlag/SE	0.023**	0.023***			0.019***			0.023**	0.023**	0.023**
MWplusLag/SE	0.073*	0.074***	0.057*	0.055*				0.073*	0.073*	0.073*
Double/SE	-0.017*							-0.017*	-0.017*	-0.017*
Panel/SE	0.064***	0.038*			0.038***	-0.057**	-0.057**	0.064***	0.064***	0.064***
TimeSeries/SE	0.144***	0.095***	-0.067**	-0.047*	0.063***			0.144***	0.144***	0.144***
Teens/SE	-0.074***	-0.071***			-0.045***	-0.063*	-0.063*	-0.074***	-0.074***	-0.074***
Youth/SE	-0.126***	-0.125***	-0.126***	-0.108***	-0.087***	-0.102***	-0.102***	-0.126***	-0.126***	-0.126***
YoungAdults/SE	-0.060**	-0.067***				-0.084**	-0.084**	-0.059**	-0.059**	-0.059**
Males/SE										
Females/SE	-0.038***	-0.036***			-0.038***	-0.056**	-0.056**	-0.038***	-0.038***	-0.038***
Region/SE	-0.091***	-0.095***	-0.081**	-0.090***	-0.074***			-0.091***	-0.091***	-0.091***
DepLagged/SE										
Hours/SE					-0.009***					
AveYear/SE	0.002**	0.002*						0.002**	0.002**	0.002**
TimeTrend/SE	-0.032***				-0.043***			-0.032***	-0.032***	-0.032***
TimeEffect/SE	0.051***	0.049**	0.056**	0.024**	0.042***	0.062***	0.062***	0.051***	0.051***	0.051***
RegionEffect/SE	-0.086***	-0.089***	-0.108***	-0.096***	-0.100***	-0.065**	-0.065**	-0.086***	-0.086***	-0.086***
Un/SE	-0.063***	-0.064***	-0.058**	-0.079***	-0.094***			-0.063***	-0.063***	-0.063***
Educ/SE	0.049***	0.044***	0.050**	0.058***	0.057***			0.049***	0.049***	0.049***
Kaitz/SE					0.024*					
Dummy/SE	-0.100***	-0.091***	-0.073***	-0.046***	-0.062***			-0.100***	-0.100***	-0.100***
Level/SE	0.053***	0.059***	0.066**	0.050*	0.083***			0.053***	0.053***	0.053***
Published/SE	-0.020**				-0.025***			-0.020**	-0.020**	-0.020**
Retail/SE	-0.055**	-0.060**	-0.063*			-0.054**	-0.054**	-0.055***	-0.055***	-0.055***
Food/SE	-0.061**	-0.073***	-0.076*		-0.063***	-0.133***	-0.133***	-0.061**	-0.061**	-0.061**
Manufacturing/SE	-0.117***	-0.117***	-0.112***	-0.076**	-0.107***	-0.057***	-0.057***	-0.117***	-0.117***	-0.117***
SpecificIndustry/SE	0.063***	0.066***	0.073***	0.053***	0.038***	0.044*	0.044*	0.063***	0.063***	0.063***
Constant	-0.373***	-0.437***	-0.443**	-0.408	-0.688***			-0.376***	-0.376***	-0.376***
Observations	1521	1521	1521	1521	1521	1521	1521	1521	1521	1521
F-test	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000	-	-	Prob>F=0.000	Prob>F=0.000	Prob>F=0.000
R-squared	0.2663	0.2605	0.2480	0.2338	0.3960	0.4907	0.4907	0.2537	0.4265	0.2550
Linktest	P>|t| of hatsq =0.113	P>|t| of hatsq =0.026	P>|t| of hatsq =0.022	P>|t| of hatsq =0.029	P>|t| of hatsq =0.021	P>|t| of hatsq =0.490	P>|t| of hatsq =0.490	P>|t| of hatsq =0.116	P>|t| of hatsq =0.117	P>|t| of hatsq =0.117

Notes: Same notes as table 6.

7. Conclusions

Up until now, economists disagree on the direction and the degree of the impact of minimum wages on employment. The objective of this paper was to investigate the relationship between minimum wages and employment with meta-analysis techniques. In our paper, we used a meta-sample of 77 international studies from 18 countries all over the world and our analysis suggests that there is evidence of publication selection, but no effect of minimum wage on employment measures, respectively.

Additionally, using 27 moderators as potential explanatory variables in order to explain the variation among studies, we found that study characteristics related to the data, the model specifications and the group of population or industry concerned, diversify the degree of the effect. More specifically, moderators related to minimum wage lagged, cumulative effect of minimum wage and minimum wage lagged, time-series, employment lagged as independent, average year, fixed time effects, educational variables, kaitz index, minimum wage level and specific industry or group of industries, reported positive impact of minimum wages on employment measures, while moderators related to log-log specification, teenagers, youth, young adults, females, specific region in country, time trend, fixed region effects, unemployment rate as explanatory variable, dummy variable of minimum wage, published, retail, food-beverage-drinking and manufacturing, reported negative impact of minimum wages on employment measures.

Appendix

Table A.1. Studies included in the meta-regression analysis, by country.

No	Study	Country	Structure of data for the elasticities
1	Card, D. (1992b) Using regional variations in wages to measure the effects of the federal minimum wage. *Industrial and Labor Relations* Review 46(1): 22-37.	USA	Cross-section
2	Katz, L. and Krueger, A. (1992) The effect of the minimum wage on the fast food industry. *Industrial and Labor Relations Review* 46: 6-21.	USA	Cross-section
3	Neumark, D. and Wascher, W. (1992) Employment effects of minimum and subminimum wages: Panel data on state minimum wage laws. *Industrial and Labor Relations Review* 46(1): 55-81.	USA	Panel data
4	Williams, N. (1993) Regional effects of the minimum wage on teenage employment. *Applied Economics* 25(12): 1517-28.	USA	Panel data
5	Card, D., Katz, L. F. and Krueger, A. B. (1994) Comment of David Neumark and William Wascher, "Employment effects of minimum and subminimum wages: Panel data on state minimum wage laws". *Industrial and Labor Relations Review* 47(3): 487-96.	USA	Panel data
6	Neumark, D. and Wascher, W. (1994) Employment effects of minimum and subminimum wages: Reply to Card, Katz, and Krueger. *Industrial and Labor Relations Review* 47(3): 497-512.	USA	Panel data
7	Kennan, J. (1995) The elusive effects of minimum wages. *Journal of Economic Literature* 33(4): 1950-65.	USA	Time-series
8	Kim, T. and Taylor, L. J. (1995) The employment effect in retail trade of California's 1988 minimum wage increase. *Journal of Business and Economic Statistics* 13(2): 175-82.	USA	Panel data
9	Neumark, D. and Wascher, W. (1995a) Minimum wage effects on employment and school enrolment. *Journal of Business and Economic Statistics* 13(2): 199-206.	USA	Panel data
10	Hsing, Y. (1997) Impacts of the minimum wage increase on teenage employment. *Atlantic Economic Journal* 25(3): 329.	USA	Time-series
11	Bernstein, J. and Schmitt, J. (1998) Making work pay: The impact of the 1996-1997 minimum wage increase. Washington D.C.: Economic Policy Institute.	USA	Time-series
12	Partridge, M. D. and Partridge, J. S. (1998) Are teen unemployment rates influenced by state minimum wage laws? *Growth and Change* 29: 359-82.	USA	Panel data
13	Partridge, M. D. and Partridge, J. S. (1999a) Do minimum wage hikes reduce employment? State-level evidence from the low-wage retail sector. *Journal of Labor Research* 20(3): 393-413.	USA	Panel data
14	Partridge, M. D. and Partridge, J. S. (1999b) Do minimum wage hikes raise US long term unemployment? Evidence using state minimum wage rates. *Regional Studies* 33(8): 713-726.	USA	Panel data
15	Bernstein, J. and Schmitt, J. (2000) The impact of the minimum wage: Policy lifts wages, maintains floors for low-wage labor market. Washington D.C. Economic Policy Institute, Briefing Paper.	USA	Time-series
16	Burkhauser, R. V., Couch, K. A. and Wittenburg, D. C. (2000) A reassessment of the new economics of the minimum wage literature with monthly data from the Current Population Survey. *Journal of Labor Economics* 18(4): 653-80.	USA	Panel data
17	Zavodny, M. (2000) The effect of the minimum wage on employment and hours. *Labour Economics* 7(6): 729-50.	USA	Panel data
18	Keil, M., Robertson, D. and Symons, J. (2001) Minimum wages and employment. CEPR Working Paper No. 497.	USA	Panel data
19	Bazen, S. and Marimoutou, V. (2002) Looking for a needle in a haystack? A re-	USA	Time-series

	examination of the time series relationship between teenage employment and minimum wages in the United States. *Oxford Bulletin of Economics and Statistics* 64: 699-725.		
20	Dodson, M. E. (2002) The impact of the minimum wage in West Virginia: A test of the low-wage-are theory. *Journal of Labor Research* 23(1): 25-40.	USA	Panel data
21	Orazem, P. F. and Mattila, J. P. (2002) Minimum wage effects on hours, employment, and number of firms: The Iowa case. *Journal of Labor Research* 23(1): 3-23.	USA	Panel data
22	Abdulahad, F. and Guirguis, H. S. (2003) The living wage and the effects of the minimum wages on part-time and teen employment. *Employee Responsibilities and Rights Journal* 15(1): 1-9.	USA	Time-series
23	Pollin, R., Brenner, M. and Wicks-Lim, J. (2004) Economic analysis of the Florida minimum wage proposal. Center for American Progress, University of Massachusetts.	USA	Panel data
24	Sabia, J. J. (2006) The effect of minimum wage increases on teenage, retail, and small business employment. Employment Policies Institute, May.	USA	Panel data
25	Dube, A., Naidu, S. and Reich, M. (2007) The economic effects of a citywide minimum wage. *Industrial & Labor Relations Review* 60(4): 522-43.	USA	Cross-section
26	Neumark, D. and Nizalova, O. (2007) Minimum wage effects in the longer run. *Journal of Human Resources* 62(2): 435-52.	USA	Panel data
27	Singell, L. D. and Terborg, J. R. (2007) Employment effects of two Northwest minimum wage initiatives. *Economic Inquiry* 45(1): 40-55.	USA	Panel data
28	Addison, J. T., Blackburn, M. L. and Cotti, C. D. (2008) The effect of minimum wages on wages and employment: County-level estimates for the United States. IZA Discussion Paper No. 3300, January.	USA	Panel data
29	Addison, J. T., Blackburn, M. L. and Cotti, C. D. (2009) Do minimum wages raise employment? Evidence from the U.S. retail-trade sector. *Labour Economics* 16: 397-408.	USA	Panel data
30	Bazen, S. and Le Gallo, J. (2009) The differential impact of federal and state minimum wages on teenage employment. Working Papers halshs-00382509, HAL.	USA	Panel data
31	Sabia, J. J. (2009) The effects of minimum wage increases on retail employment and hours: New evidence from monthly CPS data. *Journal of Labor Research* 30(1): 75-97.	USA	Panel data
32	Giuliano, L. (2011) Minimum wage effects on employment, substitution, and the teenage labor supply: Evidence from personnel data. Department of Economics, University of Miami, July.	USA	Panel data
33	Kalenkoski, C. M. and Lacombe, D. J. (2011) Minimum wages and teen employment: A spatial panel approach. IZA DP No. 5933.	USA	Panel data
34	Dickens, R., Machin, S. and Manning, A. (1994) Minimum wages and employment: a theoretical framework with an application to the UK wages councils. *International Journal of Manpower* 15(2): 26-48.	UK	Panel data
35	Machin, S. and Manning, A. (1994) The effect of minimum wages on wage dispersion and employment: Evidence from the UK wages councils. *Industrial and Labor Relations Review* 47(2): 319-329.	UK	Panel data
36	Dickens, R., Machin, S., Manning, A., Metcalf, D., Wadsworth, J. and Woodland, S. (1995) The effect of minimum wages on UK agriculture. *Journal of Agricultural Economics* 46: 1-19.	UK	Time-series
37	Gowers, R. and Hatton, T. (1997) The origins and early impact of the minimum wage in agriculture. *The Economic History Review* 50: 82-103.	UK	Cross-section
38	Dickens, R., Machin, S. and Manning, A. (1999) The effect of minimum wages on employment: Theory and evidence from Britain. *Journal of Labour Economics* 17(1): 1-22.	UK	Panel data

39	Balcombe, K. and Prakash, A. (2000) Estimating the long-run supply and demand for agricultural labour in the UK. *European Review of Agricultural Economics* 27: 153-66.	UK	Time-series
40	Connolly, S. and Gregory, M. (2002) The national minimum wage and hours of work: Implications for low paid women. *Oxford Bulletin of Economics and Statistics* 64: 607-31.	UK	Panel data
41	Machin, S., Manning, A. and Rahman, L. (2003) Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector. *Journal of the European Economic Association* 1(1): 154-80.	UK	Panel data
42	Galindo-Rueda, F. and Pereira, S. (2004) The impact of the national minimum wage on British firms. Final Report to the Low Pay Commission on the Econometric Evidence from the Annual Respondents Data.	UK	Panel data
43	Machin, S. and Wilson, J. (2004) Minimum wages in a low-wage labour market: Care homes in the UK. *Economic Journal* 114: 102-09.	UK	Panel data
44	Neumark, D. and Wascher, W. (2004) Minimum wages, labor market institutions, and youth employment: a cross national analysis. *Industrial and Labor Relations Review* 57(2): 223-48.	UK	Panel data
45	Georgiadis, A. P. (2006) Is the minimum wage efficient? Evidence of the effects of the UK national minimum wage in the residential care homes sector. CMPO Working Paper Series No. 06/160.	UK	Panel data
46	Islam, I. and Nazara, S. (2000) Minimum wage and the welfare of Indonesian workers. ILO Jakarta Office, Occasional Discussion Papers Series No. 3, July.	Indonesia	Panel data
47	Bird, K. and Manning, C. (2003) Impact of minimum wage policy on employment and earnings in the informal sector: The case of Indonesia. Working Paper, Division of Economic, Research School of Pacific and Asian Studies, Australian National University.	Indonesia	Panel data
48	Suryahadi, A., Widyanti, W., Perwira, D. and Sumarto, S. (2003) Minimum wage policy and its impact on employment in the urban formal sector. *Bulletin of Indonesian Economic Studies* 39(1): 29-50.	Indonesia	Panel data
49	Harrison, A. and Scorse, J. (2004) Moving up or moving out? Anti-sweatshop activists and labor market outcomes. NBER Working Paper Series No. 10492, May.	Indonesia	Panel data
50	Alatas, V. and Cameron, L. A. (2008) The impact of minimum wages on employment in a low-income country: A quasi-natural experiment in Indonesia. *Industrial & Labor Relations Review* 61(2): 201-23.	Indonesia	Panel data
51	Caprio, X. D., Nguyen, H. and Wang, L. C. (2012) Does the minimum wage affect employment? Evidence from the manufacturing sector in Indonesia. Policy Research Working Paper 6147.	Indonesia	Panel data
52	Lemos, S. (2004a) Minimum wage policy and employment effects: Evidence from Brazil. *Economia* 5(1): 219-66.	Brazil	Panel data
53	Lemos, S. (2004b) Political variables as instruments for the minimum wage. IZA DP No. 1136, May.	Brazil	Panel data
54	Lemos, S. (2007) Minimum wage effects across the private and public sectors in Brazil. *The Journal of Development Studies* 43(4): 700-20.	Brazil	Panel data
55	Lemos, S. (2009) Minimum wage effects in a developing country. *Labour Economics* 16(2): 224-37.	Brazil	Panel data
56	Baker, M., Benjamin, D. and Stanger, S. (1999) The highs and lows of the minimum wage effect: A time-series cross-section study of the Canadian law. *Journal of Labor Economics* 17(2): 318-50.	Canada	Panel data
57	McDonald, J. T. and Myatt, T. (2004) The minimum wage effect on youth employment in Canada: Testing the robustness of cross-province panel studies. Department of Economics, University of New Brunswick, Working paper, May.	Canada	Panel data
58	Campolieti, M., Gunderson, M. and Riddell, C. (2006) Minimum wage impacts from	Canada	Panel data

	a prespecified research design: Canada 1981-1997. *Industrial Relations* 45(2): 195-216.		
59	Sen, A., Rybczynski, K. and Van De Waal, C. (2011) Teen employment, poverty, and the minimum wage: Evidence from Canada. *Labour Economics* 18: 36-47.	Canada	Panel data
60	Maloney, T. (1995) Does the minimum wage affect employment and unemployment in New Zealand? *New Zealand Economic Papers* 29(1): 1-19.	New Zealand	Time-series
61	Chapple, S. (1997) Do minimum wages have an adverse impact on employment? Evidence from New Zealand. *Labour Market Bulletin* 2: 25-50.	New Zealand	Panel data & Time-series
62	Maloney, T. (1997) The new economics of the minimum wage? Evidence from New Zealand. *Agenda* 4(2): 185-96.	New Zealand	Time-series
63	Leigh, A. (2004) Employment effects of minimum wages: Evidence from a quasi-experiment - Erratum. *Australian Economic Review* 37(1): 102-05.	Australia	Panel data
64	Lee, W-S. and Suardi, S. (2010) Minimum wages and employment: Reconsidering the use of a time-series approach as an evaluation tool. IZA Discussion Paper No. 4748, February.	Australia	Time-series
65	Bell, L. A. (1997) The impact of minimum wages in Mexico and Colombia. *Journal of Labor Economics* 15(3): 102-35.	Mexico	Panel data & Time-series
66	Feliciano, Z. (1998) Does the minimum wage affect employment in Mexico? *Eastern Economic Journal* 24(2): 165-80.	Mexico	Panel data
67	Castillo-Freeman, A. and Freeman, R. B. (1992) When the minimum wage really bites: The effect of the US-level minimum on Puerto Rico. In: G. Borjas and R. Freeman (eds.): Immigration and the Work Force: Economic Consequences for the United States and Source Areas. Chicago: University of Chicago Press, pp. 177-211.	Puerto Rico	Panel data
68	Krueger, A. (1994) The effect of the minimum wage when it really bites: A re-examination of the evidence from Puerto Rico. Industrial Relations Section, Working Paper No. 330, Princeton University, May.	Puerto Rico	Time-series
69	Ericson, T. and Pytlikova, M. (2004) Firm-level consequences of large minimum-wage increases in the Czech and Slovak Republics. *Labour* 18(1): 75-103.	Slovak Republic	Cross-section
70	Vokorokosová R. (2010) Do minimum wage changes influence employment? *Economic Analysis* 43(1-2): 83-90.	Slovak Republic	Panel data
71	Dolado, J. F., Kramarz, S., Machin, A., Manning, D., Margolis, C., Teulings, G. S.-P. and Keen, M. (1996) The economic impact of minimum wages in Europe. *Economic Policy* 11(23): 317-72.	Spain	Panel data & Time-series
72	Cuesta, M. B., Heras, R. L. and Carcedo, J. M. (2011) Minimum wage and youth employment rates 2000-2008. *Revista de Economía Aplicada* 19(56): 35-57.	Spain	Panel data
73	Ericson, T. and Pytlikova, M. (2004) Firm-level consequences of large minimum-wage increases in the Czech and Slovak Republics. *Labour* 18(1): 75-103.	Czech Republic	Cross-section
74	Wang, J. and Gunderson, M. (2011) Minimum wage impacts in China: Estimates from a prespecified research design, 2000-2007. *Contemporary Economic Policy* 29(3): 392-406.	China	Panel data
75	Bell, L. A. (1997) The impact of minimum wages in Mexico and Colombia. *Journal of Labor Economics* 15(3): 102-35.	Colombia	Panel data & Time-series
76	Jones, P. (1997) The impact of minimum wage legislation in developing countries where coverage is incomplete. Centre for the Study of African Economies, Institute of Economics and Statistics, University of Oxford, WPS/98-2.	Ghana	Time-series
77	Gindling, T. H. and Terrell, K. (2009) Minimum wages, wages and employment in various sectors in Honduras. *Labor Economics* 16(3): 291-303.	Honduras	Panel data
78	Van Soest, A. (1994) Youth minimum wage rates: The Dutch experience. Center for Economic Research, Discussion Paper No. 9422, February.	Netherlands	Cross-section
79	Majchrowska, A. and Zolkiewski Z. (2012) The impact of minimum wage on employment in Poland. *Investigaciones Regionales* 24: 211-39.	Poland	Panel data
Note: See note of table 1.			

Table A.2. Studies excluded from the meta-sample, by country.

No	Study	Country	Reason for exclusion
1	Abowd, J. M., Kramarz, F. and Margolis, D. N. (1999) Minimum wages and employment in France and the United States. NBER Working Paper No. 6996.	USA & France	Binary dependent variable reporting employment probability.
2	Abowd, J. M., Kramarz, F., Lemieux, T. and Margolis, D. N. (2000) Minimum wages and youth employment in France and the United States. NBER Chapters, in: Youth Employment and Joblessness in Advanced Countries, pages 427-472, National Bureau of Economic Research, Inc.	USA & France	Binary dependent variable reporting employment probability.
3	Abowd, J. M., Kramarz, F., Margolis, D. N. and Phillipon, T. (2000) The tail of two countries: Minimum wages and employment in France and the United States. IZA Discussion Paper, No. 203.	USA & France	Binary dependent variable reporting employment probability.
4	Neumark, D. and Wascher, W. (1995b) Minimum wage effects on school and work transitions of teenagers. *American Economic Review Papers and Proceedings* 85(2): 244-49.	USA	Binary dependent variable reporting employment probability. Multinomial logit analysis.
5	Burkauser, R. V., Couch, K. A. and Wittenburg, D. C. (1996) "Who gets what" from minimum wage hikes. *Industrial and Labor Relations Review* 49(3): 547-52.	USA	The paper looks at wage and income distribution effects.
6	Currie, J. and Fallick, B. (1996) The minimum wage and the employment of youth: Evidence from the NLSY. *Journal of Human Resources* 31(2): 404-28.	USA	Binary dependent variable reporting employment probability.
7	Ressler, R. W., Watson, J. K. and Mixon, F. G. (1996) Full wages, part-time employment and the minimum wage. *Applied Economics* 28: 1415-9.	USA	Unable to calculate the employment elasticity.
8	Alpert, W. T. and Guerard, J. B. (1998) Employment, unemployment and the minimum wage: A causality model. *Applied Economics* 20: 1453-64.	USA	Causality study.
9	Lang, K. and Kahn, S. (1998) The effect of minimum-wage laws on the distribution of employment. *Journal of Public Economics* 69: 67-82.	USA	Unable to calculate the employment elasticity.
10	Belman, D. L. and Wolfson, P. (1999) Its bark is worse than its bite. *Australian Economic Papers* 38: 143-63.	USA	Unable to calculate either the t-stat or the standard error of the employment elasticity.
11	Reich, M. and Hall, P. (2001) A small raise for the bottom: The impact of the 1996-1998 California minimum wage increases. In: J. Lincoln and P. Ong (eds.): The State of California Labor. University of California Institute for Labor and Employment: p. 123-148.	USA	Absence of direct minimum wage effects and unable to calculate elasticity.
12	Turner, M. D. and Demiralp, B. (2001) Do higher minimum wages harm minority and inner city teens. *Review of Black Political Economy* 28(4): 95-121.	USA	Binary dependent variable reporting employment probability. Multinomial logit analysis.
13	Wolfson, P. and Belman, D. (2001) The minimum wage, employment, and the AS-IF methodology: A forecasting approach to evaluating the minimum wage. *Empirical Economics* 26(3): 487-514.	USA	Coefficients. There are elasticities, without SE or t-stat though.
14	Brenner, M. D., Wicks-Lim, J. and Polin, R. (2002) Measuring the impact of living wage laws: a critical appraisal of David Neumark' s How Living Wage Laws Affect Low-Wage Workers and Low-Income Families. Working Paper No 43, Political Economy Research Institute.	USA	Absence of direct minimum wage effects on employment measures. Only employment elasticities of living wages

			are reported.
15	Neumark, D. (2002) How living wage laws affect low-wage workers and low-income families. San Francisco, Public Policy Institute of California.	USA	Absence of direct minimum wage effects on employment measures. Only employment effects of living wages are reported.
16	Pabilonia, S. W. (2002) The effects of federal and state minimum wages upon teen employment and earnings. Unpublished paper, Bureau of Labor Statistics.	USA	Binary dependent variable reporting employment probability. Cross-section probit analysis.
17	Neumark, D. and Wascher, W. (2003) Minimum wages and skill acquisition: Another look at schooling effects. *Economics of Education Review* 22(1): 1-10.	USA	Binary dependent variable reporting employment probability. Conditional logit estimates.
18	Ardicianno, P. and Ahn, T. (2004) Minimum Wages and Job Search: What do employment effects really measure? Employment Policies Institute.	USA	Binary dependent variable reporting employment probability.
19	Chapman, J. (2004) Employment and the minimum wage: Evidence from recent state labor market trends. Economic Policy Institute, Briefing Paper.	USA	There are coefficients but elasticities cannot be calculated.
20	Fiscal Policy Institute (2004) State Minimum Wages and Employment in Small Businesses. New York: Fiscal Policy Institute.	USA	Absence of elasticities.
21	Neumark, D., Schweitzer, M. and Wascher, W. (2004) Minimum wage effects throughout the wage distribution. *Journal of Human Resources* 39(2): 425-50.	USA	Binary dependent variable reporting employment probability.
22	Yelowitz, A. S. (2005) How Did the $8.50 Citywide Minimum Wage Affect the Santa Fe Labor Market? Employment Policies Institute.	USA	Binary dependent variable reporting employment probability.
23	Belman, D. L. and Wolfson, P. (2010) The effect of legislated minimum wage increases on employment and hours: A dynamic analysis. *Labour* 24(1): 1-25.	USA	Unable to calculate either the t-stat or the standard error of the employment elasticity.
24	Stewart, M. (2002) Estimating the impact of the minimum wage using geographical wage variation. *Oxford Bulletin of Economics and Statistics* 64: 583-605.	UK	Unable to calculate the employment elasticity.
25	Stewart, M. and Swaffield, J. (2008) The other margin: Do minimum wages cause working hours adjustments for low-wage workers? *Economica* 75: 148-67.	UK	Unable to calculate the employment elasticity.
26	Dolton, P., Bondibene, C. R. and Wadsworth, J. (2010) The UK national minimum wage in retrospect. *Fiscal Studies* 31(4): 509-34.	UK	Unable to calculate the employment elasticity.
27	Dolton, P., Bondibene, C. R. and Wadsworth, J. (2012) Employment, inequality and the UK national minimum wage over the medium-term. *Oxford Bulletin of Economics and Statistics* 74(1): 78-106.	UK	Unable to calculate the employment elasticity.
28	Andalón, M. and Pagés, C. (2008) Minimum wages in Kenya. Discussion Paper No 3390, Institute for the Study of Labor (IZA).	Kenya	Unable to calculate the employment elasticity.
29	Comola, M. and De Mello, L. (2011) How does decentralized minimum wage setting affect employment and informality? The case of Indonesia. *Review of Income and Wealth* 57: 79-99.	Indonesia	Unable to calculate the employment elasticity.
30	Hyslop, D. and Stillman, S. (2004) Youth minimum wage reform and the labour market. IZA Discussion Paper No. 1091.	New Zealand	Unable to calculate the employment elasticity.

31	Alaniz, E., Gindling, T. H. and Terrell, K. (2011) The impact of minimum wages on wages, work and poverty in Nicaragua. *Labour Economics* 18(1): 45-59.	Nicaragua	Binary dependent variable reporting employment probability.
32	Viet, C. N. (2010) The impact of a minimum wage increase on employment, wages and expenditures of low-wage workers in Vietnam. MPRA Paper No. 36751.	Vietnam	Unable to calculate the employment elasticity.
33	OECD (1998) OECD Employment Outlook 1998, Chapter 2, p. 31-79.	Several countries combined	Study deals with several countries and not a single one.
34	Neumark, D. and Wascher, W. (2004) Minimum wages, labor market institutions, and youth employment: a cross national analysis. *Industrial and Labor Relations Review* 57(2): 223-48.	Several countries combined	Study deals with several countries and not a single one.
35	Addison, J. T. and Ozturk O. D. (2012) Minimum wages, labor market institutions, and female employment: A Cross-Country Analysis. *Industrial and Labor Relations Review* 65(4): 779-809.	Several countries combined	Study deals with several countries and not a single one.
36	Dolton, P. and Bondibene, C. R. (2012) The international experience of minimum wages in an economic downturn. *Economic Policy* 27(69): 99-142.	Several countries combined	Study deals with several countries and not a single one.

Note 1: Following Doucouliagos and Stanley (2009) our analysis focuses on employment elasticities drawn from studies using a continuous measure of employment or hours. Therefore, we excluded those studies which use a binary dependent variable, reporting employment probabilities.
Note 2: Furthermore, we had to exclude from the meta-regression analysis the studies for which we were unable to calculate either the employment elasticity or its standard error which are both needed for publication selection bias correction.

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