Does the UK Minimum Wage Reduce Employment? A Meta-Regression Analysis

Megan de Linde Leonard[1]
T.D. Stanley[2]
Hristos Doucouliagos[3]

Abstract

The employment effect from raising the minimum wage has long been studied but remains in dispute. Our meta-analysis of 236 estimated minimum-wage elasticities and 710 partial correlation coefficients from sixteen UK studies finds no overall practically significant adverse employment effect. Unlike US studies, there seems to be little, if any, overall reporting bias. Multivariate meta-regression analysis identifies several research dimensions that are associated with differential employment effects. In particular, the residential home care industry may exhibit a genuinely adverse employment effect.

Keywords: Minimum wage, employment, meta-regression analysis

[1]Corresponding Author: Department of Economics and Business, Hendrix College, Conway, AR, USA. Leonard@hendrix.edu

[2]Department of Economics and Business, Hendrix College, Conway, AR, USA. Stanley@hendrix.edu

[3]School of Accounting, Economics and Finance, Deakin University, Melbourne, Australia. douc@deakin.edu.au

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1. Introduction

There is a long and rich tradition of investigating the employment consequences of a government mandated minimum wage (Moore, 1971; Lovell, 1972; Welch, 1976; Mincer, 1976; Card and Krueger, 1995a; Neumark and Wascher, 2008). A decrease in employment is the clear implication of the theory of the firm and profit maximization under competition. Few economic relations are more strongly held or more vigorously defended than the adverse employment consequence of a rise in the minimum wage. "(I)n the past, studies were divided between those estimating large employment losses and those estimating small losses" (Machin and Manning, 1994:320). Since the early 1990s and the contributions of several scholars including Card and Krueger (1995a) for the US and Machin and Manning (1994) for the UK, "the focus now is on whether minimum wage laws have negative effects or no effects on employment (Machin and Manning, 1994:320).

In 2009, the *British Journal of Industrial Relations* devoted a special issue to the history, effectiveness, and consequences of the first century of minimum wage laws in Britain (Deakin and Green, 2009). One paper offered a comprehensive and statistically rigorous assessment of all the empirical estimates of the employment effects of the minimum wage in the US and found no evidence of a practically meaningful adverse employment effect attributable to the minimum wage (Doucouliagos and Stanley, 2009). Reported evidence of such an adverse effect is shown to be the result of what is called 'publication selection' or reporting bias. These findings are shown to be remarkably robust and even remain if the reviewer were to ignore hundreds of positive minimum wage employment elasticities reported in this research literature.

Nonetheless, it remains to be investigated whether this clear finding of no employment effect applies to the UK minimum-wage law as well. The purpose of this paper is to provide a comprehensive systematic review and meta-analysis of all the empirical estimates of the employment effect of raising the minimum wage in the UK. When 710 estimates from sixteen studies are combined and statistically analyzed, no evidence of an overall adverse employment effect can be found for the British minimum wage. However, there is evidence that the residential home care industry is more adversely affected by minimum wage increases. Unlike US research, no evidence of any aggregate reporting bias is found in the UK literature.

2. Meta-regression analysis

> "Meta-analysis refers to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies that typify our attempt to make sense of the rapidly expanding research literature" (Glass, 1976:3).

Meta-analysis is a type of systematic review that employs the full range of statistical methods to summarize and to help researchers understand, deeply, what an entire empirical literature means. Systematic reviews are distinguished from conventional narrative reviews in that they require that all research results be included and identified through an explicit and comprehensive search strategy. Meta-regression analysis (MRA) is the regression analysis of previously published regression analyses. "(M)eta-regression analysis is a form of meta-analysis especially designed to investigate empirical research in economics" (Stanley, 2001, p.131). By now, many hundreds of MRAs of economics research have been published (Roberts and Stanley, 2005; Nelson and Kennedy, 2009; Stanley and Doucouliagos, 2012).

Meta-regression analysis is designed to model the effects of observed econometric specifications. Its central objective is to directly estimate the associated misspecification biases and thereby filter out these potential distortions from our empirical knowledge (Stanley and Jarrell, 1989). Meta-regression analysis is a systematic and comprehensive review of all comparable econometric findings. It models any potential bias or systematic variation, thereby explaining the excess variation always observed among reported econometric results.

Take, for example, the previous meta-regression of the employment effects of the US minimum wage. Doucouliagos and Stanley (2009) identified 1,474 empirical estimates and their standard errors of the minimum-wage employment elasticity contained in 64 US studies. The simple average of these 1,474 elasticites is -0.19, representing a small adverse employment effect. However, there is also a very clear statistical trace of selective reporting of statistically significant negative effects, called reporting bias or 'publication bias.' Once this selective reporting is accommodated, no evidence of an adverse employment effect remains. This central finding was further corroborated in several ways through multivariate meta-regression modelling and robustness checks. Doucouliagos and Stanley (2009) coded 22 factors that were thought to have the potential to reflect specification biases or genuine heterogeneity. They allowed all of these factors to influence both observed variation in reported elasticities and also the propensity to select a statistically negative effect. After employing a general-to-specific estimation strategy, 14 moderator variables proved statistically significant. Substituting any defensible notion of 'best practice' into the estimated MRA coefficients finds no support for a practically significant adverse employment effect. Here, we wish to investigate whether this absence of any meaningful employment effect from minimum wage in the US will also be found in a comprehensive assessment of all the relevant research results for the United Kingdom.

3. A meta-analysis of the minimum wage's employment effect in the UK

The Research Data

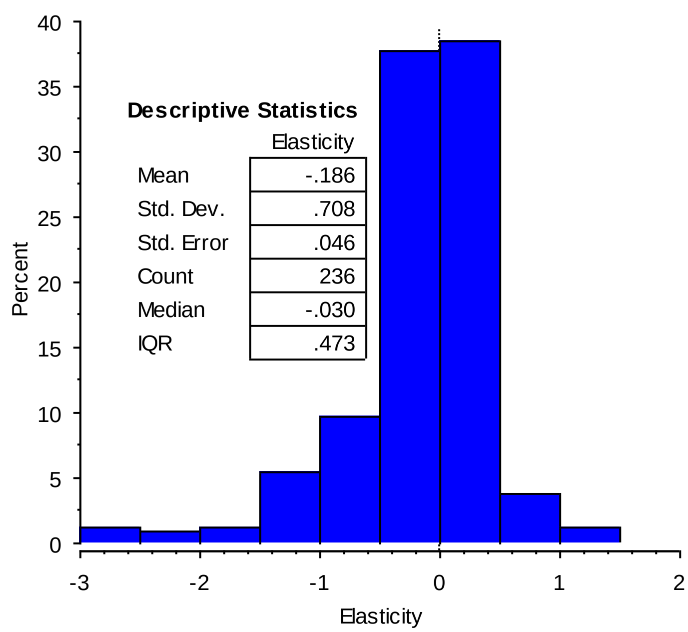
Our systematic review of the UK's minimum wage effects began by searching ECONLIT, Google Scholar, Scopus and various other search engines. In addition to these search engines, we also searched references from identified studies. Keywords for the search included various combinations of "minimum wage", "employment", "teenage employment", "Wages Councils", "minimum wage legislation" and "Low Pay Commission". To be included in our systematic review, a study must contain a new empirical estimate of the employment effect attributable to minimum wage changes in the United Kingdom. Pure policy and theoretical papers, by definition, do not contain empirical estimates and cannot, therefore, be added to our meta-analysis database. Furthermore, if an empirical estimate relates to a different country or only a specific portion of the United Kingdom, say Scotland, then it cannot be regarded as equivalent or compatible with those estimates that are more fully representative of the UK. We comply with MAER-Net's recently recommended reporting guidelines for meta-regression analyses in economics (Stanley et al., 2013).[1]

This process identified sixteen relevant and comparable studies that jointly contain 236 estimated minimum-wage elasticities along with sufficient information needed to calculate 710 partial correlation coefficients and their standard errors. The standard errors are required to identify and accommodate potential reporting bias or publication selection bias (Egger et al., 1997; Stanley, 2008; Stanley and Doucouliagos, 2012). Recall that Doucouliagos and Stanley (2009) found that publication selection bias has a dominating effect on the reported employment effects of the US minimum wage. Thus, it is prudent to accommodate this potential effect in the UK research data. The list of these sixteen studies may be found the Meta-Analysis References section below.

Basic Meta-Analysis

First, we report descriptive statistics and simple graphs of the UK minimum wage effects. Figures 1 and 2 reflect the descriptive statistics for this area of research, both in terms of elasticities and partial correlation coefficients. The first and last classes of the histogram are open-ended. Notice first that the average minimum-wage elasticity for this entire empirical literature is -0.19. Coincidentally, this is exactly, to 2 decimal places, the average minimum wage elasticity that Doucouliagos and Stanley (2009) uncovered among 1,474 US estimates. Like the US minimum-wage research, the median is much smaller than the mean. The magnitude of the median (-0.03) is quite small. Such a small effect would allow the minimum wage to be raised by 1/3, before it would result in even a 1% reduction in employment.

Figure 1: UK Minimum Wage Elasticity of Employment



However, we still need to explain the large variation among reported employment estimates and to verify that this overall impression is robust. Many of the studies report empirical estimates of the minimum wage employment effect that are not elasticities and cannot be converted to elasticities. When sufficient information is contained in a paper to convert some empirical estimate to an elasticity, we do so. However, to maximize the number of comparable estimates, we also convert all empirical estimates, which list t-values and degrees of freedom, to partial correlation coefficients.[2] By using partial correlations, our meta-analysis comes as close as possible to reflecting and analyzing ***all*** relevant empirical information.

Figure 2: UK Partial Correlations of the Minimum Wage with Employment

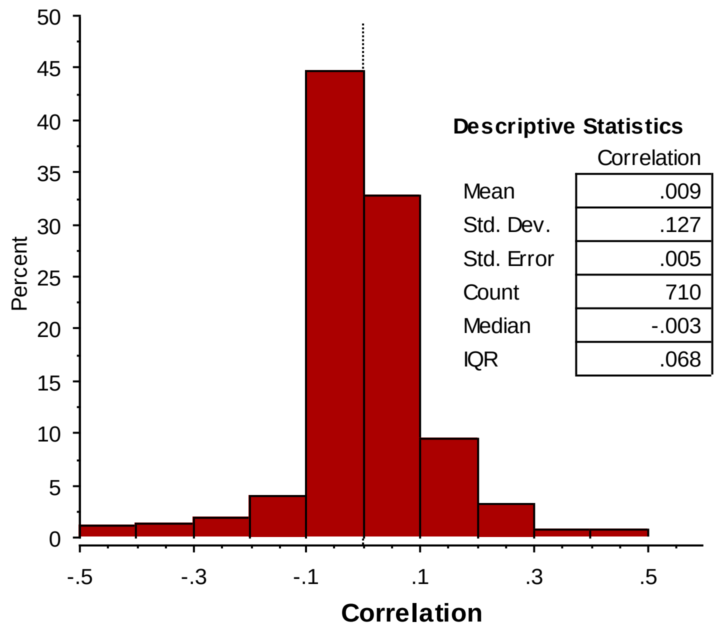


Figure 2 provides the descriptive statistics of 710 partial correlation coefficients. Note that the simple average, 0.009, is actually positive.[3] However, this is so small as to represent practical inconsequentiality. Cohen's guidelines suggest that any correlation less that .1 is negligible. If a partial correlation is 0.1, this means that the variable in question (minimum wage) can explain only 1% of the remaining unexplained variation in employment, after considering all of the other independent variables. Here, the average correlation coefficient suggests that minimum wages marginal explanatory power is less than one one-hundredth of one percent. On the other hand, the median partial correlation is negative, reflecting an adverse employment response; however, the magnitude of this negative effect, -0.003, is even smaller and also practically insignificant. Descriptively, it appears that the minimum wage has virtually no effect, neither positive nor negative, on employment.

Publication Selection Bias

In Doucouliagos and Stanley's (2009) meta-analysis of the US's minimum wage, publication bias was found to be an important contributor to the appearance of an adverse employment effect. Thus, we would be remiss not to investigate the possibility of selective reporting of some of the estimates of the UK's employment effect.

Publication selection is a widely accepted fact in the social science, medical research, and economics (Rosenthal, 1979; Glass, McGaw and Smith, 1981; Hedges and Oklin, 1985; Begg and Berlin, 1988; DeLong and Lang, 1992; Card and Krueger, 1995b). Publication bias arises from the selection of statistically significant research findings, and it can cause great exaggerations to the size of the empirical phenomena in question (Havranek, 2010; Doucouliagos and Stanley, 2012; Doucouliagos, Stanley, and Giles, 2012). Perhaps, the clearest statement of publication bias in economics comes from Card and Krueger (1995b: 239).

1. Reviewers and editors may be predisposed to accept papers consistent with the conventional view.
2. Researchers may use the presence of a conventionally expected result as a model selection test.
3. Everyone may possess a predisposition to treat 'statistically significant' results more favorably.

Fortunately, a simple meta-regression model has been shown to be effective in identifying and filtering publication selection bias (Egger et al., 1997; Stanley, 2008; Stanley and Doucouliagos, 2012).

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

MRA model (1) accommodates selective reporting through the $\beta_1 SE_i$ term. The idea is that studies with smaller samples and thereby larger standard errors, SE_i, will be required to engage more intensively in selection through remodeling, resampling, and further estimation in order to achieve statistical significance. $\beta_1 SE_i$ is a rough approximation to the amount of publication bias. The funnel-asymmetry test (FAT) is the conventional way to identify publication selection bias—H_0: $\beta_1 = 0$ (Egger et al., 1997; Stanley, 2008). On the other hand, testing H_0: $\beta_0 = 0$ provides a valid method to identify whether there is any genuine empirical effect remaining after potential reporting bias is removed (Stanley, 2008).

Table 2 gives the estimated results for MRA model (1). Heteroskedasticity is always an issue for meta-regression, because estimates, which are the dependent variable, come from very different datasets with different sample sizes and different estimation techniques. Thus, some version of weighted least squares (WLS) should always be employed. Furthermore, authors in this literature typically report multiple estimates; therefore, estimates within a study cannot be assumed to independent from one another. To account for these data complexities, Table 2 only reports WLS estimates that adjusts for this within-study dependence, through cluster-robust standard errors and random-effects unbalanced panels. Typically, we prefer fixed-effects panel MRA models, because random-effects are quite likely to be correlated with the MRA independent variables (for example, SE_i) (Stanley and Doucouliagos, 2012). Here, however, the Hausman test for choosing between fixed-and random-effects panel models allows us to accept random-effects ($\chi^2(1)$ = {0.04; 0.08}; p-values>>.05). See Feld and Heckemyer (2011) and Stanley and Doucouliagos (2012) for a more detailed discussion of these issues.

Table 2: WLS of Meta-Regression Model (1)

Variables	*Elasticity Cluster*	*Elasticity RE-Panel*	*Partial Correlation Cluster*	*Partial Correlation RE-Panel*
Intercept: $\hat{\beta}_0$	-0.008	-0.006	-0.005	-0.003
{PET}	(-0.70)	(-0.54)	(-6.70)	(-2.83)
SE_i: $\hat{\beta}_1$	-0.42	-0.49	0.11	0.13
{FAT}	(-0.73)	(-0.94)	(0.45)	(0.33)
n	236	236	710	710

Notes: Cells report coefficient estimates for Equation 2. The dependent variable in the first two columns is the minimum wage elasticity and the dependent variable in the last two columns is the partial correlation. The t-values are reported in parenthesis. Standard errors are adjusted for data clustering. FAT is a test for publication selection bias. PET is a test for the existence of a minimum wage effect corrected for selection bias. RE-Panel is the random effects panel meta-regression model. n is the number of observations.

There is no statistical evidence of publication selection bias for either measure of employment effects—see FAT in Table 2. That is, we accept H_0: $\beta_1 = 0$ at p>>.05 for both research samples and MRA models. Doucouliagos and Stanley (2012) find that the majority of economics research contains substantial or severe publication selection bias, and Doucouliagos and Stanley (2009) found that this selection dominates reported employment elasticities in the US minimum-wage literature. Thus, it is very refreshing to find no evidence of publication selection in the UK research literature. The more important question is whether there is a genuine effect after accommodating and filtering potential reporting bias. Among 236 estimates of the minimum-wage employment elasticity, there is no evidence of a genuine nonzero effect (accept H_0: $\beta_0 = 0$; p>>.05) —see PET in Table 2. However, with triple the number of estimates, the partial correlation coefficients contain a statistical signal of an adverse employment effect—see the last two columns of Table 2. Yet, statistical significance is not practical significance (McCloskey, 1985; McCloskey, 1995). The magnitude of these adverse effects, -0.005, is so small that it is entirely negligible. When a research literature passes the PET, a better corrected estimate uses the variance in place of the standard error in equation (1) (Stanley and Doucouliagos, 2012). The resulting corrected estimate of the partial correlation is also -0.005 and again is of no practical importance.

Table 3 reports other subsamples to ensure the robustness of our findings. Columns 1 and 3 present the MRA estimates after removing outliers defined by the cluster-robust FAT-PET-MRA models in Table (2) for the absolute value of the standardized residual being greater than 2.5. Columns 2 and 4 report the cluster-robust, WLS-FAT-PET-MRA for only negative elasticities.[4] Again, there is no evidence of a practically significant adverse employment effect for any of these samples, although there is now the strong signal of selection for adverse employment effects for those samples where we select only adverse employment effects. It is comforting to learn that these MRA methods do so well to filter known radical selection.

Table 3: Robustness Checks for Meta-Regression Model (1)

Variables	*Elasticity Outliers (1)*	*Elasticity Negative (2)*	*Partial Correlation Outliers (3)*	*Partial Correlation Negative (4)*
Intercept: $\hat{\beta}_0$ **{PET}**	-0.01 (-1.23)	0.005 (0.70)	-0.006 (-6.52)	-0.0005 (-0.33)
SE_i : $\hat{\beta}_1$ **{FAT}**	-0.25 (-0.46)	-2.02 (-19.1)	0.45 (1.45)	-1.93 (-4.80)
n	231	133	690	376

Notes: See the notes to Table 2. Columns 1 and 3 remove outliers. Columns 2 and 4 use only estimates of an adverse employment effect.

When the entire UK research literature on minimum-wage effects is investigated, no overall evidence of a practically relevant employment effect is found. Perhaps this absence of an adverse employment effect from the UK's minimum wage should have been anticipated? For example, Metcalf (2008) takes it for granted that there is no meaningful employment effect and offers twelve possible reasons. Furthermore, we agree entirely with Metcalf (2008) that "the impact of minimum wage on employment should primarily be an empirical issue" (Manning, 2003, p. 347). It is the central purpose of this meta-analysis to provide a comprehensive and rigorous summary and assessment of these empirical studies. In the explanatory multiple meta-regression analysis (MRA) reported in the next section below, we code and control for several of the factors identified by Metcalf (2008) including: 'toughness,' as measured by the ratio of minimum to average wage, short run vs. long run effects, and hours rather than employment.

Another possible explanation for the absence of an overall adverse effect is that existing research does not adequately account for the potential simultaneity (or endogeneity) between employment and the minimum wage. That is, perhaps the minimum wage tends to be raised only when employment is high or expected to grow? If the minimum wage level is affected by employment, then unsophisticated regression estimates of the employment effect from minimum wage might be biased. However, any such bias is likely to be small because the magnitude of the bias will be proportional to regression coefficient on minimum wage in the reverse employment equation (Wooldridge, 2006). Dickens, Machin, and Manning (1999) control for this endogeneity but fail to find that it matters. Nonetheless, we code and model the potential bias associated with the failure to control adequately for this endogeneity in several ways.

First, those studies that attempt to control for any endogeneity between minimum wage and employment use either IV or VAR, where lagged minimum wages and employment are used. Our multiple MRA codes and accounts for the presence of these lags. Secondly, it is quite possible that the Wages Councils that existed throughout most of the twentieth century were more sensitive to raising the minimum wage in a sector that had employment problems than the current the national minimum wage regime. Another of our multiple MRA's independent variable is whether the minimum wage was set by the Wages Councils. Third, this potential endogeneity bias will be larger if the minimum wage has a lot of 'bite' as defined by 'toughness;' therefore, those studies that use toughness for the minimum wage variable will have already adjusted for some of this bias. Lastly, one could argue that difference-in-difference estimates also control for the potential endogeneity between minimum wage and employment (Stewart and Swaffield, 2008), and we also code for whether an estimate comes from a difference-in-difference quasi-experiment. No doubt, this is a very rich research literature, and if we drill down into this research we will find other differential employment effects and research dimensions that affect the reported estimates. To identify potential differential employment effects, we next turn to multiple meta-regression analysis.

Multiple MRA

To accommodate a potentially complex employment effect, misspecification biases and differential propensities to report adverse employment effect, the simple MRA model (1) can be greatly expanded.

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

In effect, β_0 is replaced by $\beta_0 + \sum \beta_k Z_{ki}$. The Z-variables allow for heterogeneity and misspecification biases, and the $SE_i K_{j_i}$ terms may represent any factor that is associated with the researchers' decision to report a statistically significant adverse employment effect. Here, we do not add K-variables because we can find no net publication bias in this research. Besides adding K-variables causes very large multicollinearity (VIF > 10^8). See Stanley and Doucouliagos (2012) for a more detailed discussion of this Z/K MRA model and Table 4 for a list of coded moderator variables.

But which variables should we use for these Z-variables? First, we begin with all those research dimensions that Doucouliagos and Stanley (2009) found to be relevant for the US research literature. Second, to their multiple MRA model we added three new research dimensions: *DID, WageCouncil* and *HomeCare.* Third, as an additional control we add a labour market regulation variable. The effect of a minimum wage on employment could be conditioned by the degree of labour market regulation. *Regulation* is the overall measure of labour market regulation as reported by the Fraser Institute (series 5B "Labour Market Regulation" from their *Economic Freedom of the World 2011 Annual Report*). This is a composite measure of regulation comprising the minimum wage bite, hiring and firing regulations, centralized collective bargaining, unemployment insurance and mandated costs of worker dismissal. See Table 4 for a list of all the variables coded.

Table 4: Moderator Variables for Minimum-Wage Research

Moderator Variable	***Definition***	***Mean (standard deviation)***
	Variables used by Doucouliagos and Stanley (2009)	
SE	is the standard error of the reported estimated elasticity.	0.33 (0.52)
Panel	=1, if estimate relates to panel data.	0.94 (0.24)
Adults	=1, if estimate relates to adults.	0.99+ (0.07)
Region	=1, if estimate relates to region specific data.	0.42 (0.50)
Lag	=1, if estimate relates to a lagged minimum wage effect.	0.11 (0.31)
Double	=1, if estimate comes from a double log specification.	0.40 (0.49)
AveYear	is the average year of the data used. 2000 is the base year.	1993 (12.5)
Time	=1, if time trend is included.	0.66 (0.48)
Yeareffect	=1, if year specific fixed effects are used.	0.01 (0.09)
Un	=1, if a model includes unemployment.	0.01 (0.09)
Published	=1, if the estimate comes from a published study.	0.47 (0.50)
Toughness	=1, if the ratio of minimum to average wage is used.	0.29 (0.45)
Hours	=1, if hours worked was used in the place of employment.	0.34 (0.47)
Agriculture	=1, if the estimate comes from the agricultural sector.	0.02 (0.14)
Food	=1, if the estimate comes from the retail food sector.	0.01 (0.11)
	New Research Dimensions	
DID	=1, if it is a difference-in-difference estimate.	0.57 (0.50)
WageCouncil	=1, if the minimum wage was set by the Wages Council.	0.27 (0.45)
HomeCare	=1, if the estimate comes from residential home care data.	0.19 (0.39)
	Regulation Variable	
Regulation	is a measure of the degree of labour market regulation, using series 5B from the Fraser Institute.	7.00 (0.06)

Table 4 lists the moderator variables with their means and standard deviations, calculated from the elasticity data. For the multiple MRAs listed in Tables 5 and 6, we begin with the variables found significant in the US research literature, eliminate statistically insignificant variables, add the new variables unique to this study, and, lastly, we also include the regulation variable. Before any of this, we removed outliers defined by the FAT-PET-MRA model (1). If the absolute value of the standardized residual is greater than 2.5, we delete it from the multiple MRA for fear that a single typo in the published research might make some coincidentally correlated research dimension seem important. Five outliers were removed in this way from the elasticity data, and twenty partial correlations outliers were identified and removed.

The first column of Tables 5 and 6 replicates the multiple MRA model reported in Doucouliagos and Stanley (2009) for the US minimum wage, using partial correlations and elasticities, respectively. Next, we employed a general-to-specific modeling strategy, removing the variable that had the largest p-value until all p-values are $\leq$0.05. Because there so much multicollinearity, especially as the UK and regulation variables are added, some accommodation must be made to identify the more important research dimensions. All along the way, weighted least squares with cluster-robust standards errors were used. The resulting cluster-robust WLS-MRA models are shown in column 2 of Tables 5 and 6. Column 3 of Tables 5 and 6 add the specific variables that we coded for the UK research literature (*DID*, *WageCouncil* and *HomeCare*). Lastly, *Regulation* is added to all of these previous moderator variables to see if the severity of regulation provides any further explanation of the variation seen among the reported employment effects of the UK minimum wage.

Table 5: Multiple MRA of UK Minimum-Wage Partial Correlations: Cluster-Robust WLS

Moderator Variables:	*Column 1: D&S (2009)*	*Column 2: G-to-S*	*Column 3: +UK variables*	*Column 4: +Regulation*
		Heterogeneity (Z-variables)		
Un	-0.24 (-5.52)	-016 (-13.4)	-0.23 (-14.9)	-0.24 (-12.1)
Toughness	0.049 (2.58)	0.052 (2.22)	0.035 (3.38)	0.034 (3.65)
Lag	-0.004 (-4.04)	-0.004 (-3.38)	-0.004(-3.99)	-0.004(-3.86)
Published	0.057 (2.04)	0.006 (3.74)	0.003 (2.90)	0.027 (2.26)
Adults	-0.043 (-1.63)	-0.009 (-3.61)	-0.017 (-7.46)	-0.025 (-1.29)
Time	0.051(1.85)	—	—	—
AveYear	-0.001 (-0.78)	—	—	—
Panel	-0.019(-1.13)	—	—	—
Double	-0.022 (-0.41)	—	—	—
Region	0.002 (0.80)	—	—	—
YearEffect	-0.003(-1.28)	—	—	—
DID	—	—	0.01(13.9)	0.01(13.9)
HomeCare	—	—	-0.10(-9.00)	-0.10 (-8.44)
WageCouncil	—	—	0.084 (4.63)	0.091 (5.05)
Regulation	—	—	—	0.001 (0.42)
$SE(\beta_1)$	0.32 (0.65)	0.23 (0.72)	0.40 (1.67)	0.38 (1.50)
n	690	690	690	690
k	16	16	16	16
R^2	.21	.21	.27	.27

Notes: t-values are reported in parenthesis using standard errors adjusted for data clustering. The dependent variable in the partial correlation. n is the number of observations. k is the number of studies. See Table 4 for variable definitions. The R^2s are in terms of t-values.

4. Discussion

Several clear patterns emerge from this comprehensive meta-analysis of the UK minimum-wage research. Most striking is the large negative MRA coefficient on *Un*. The effect of including the unemployment rate in the employment equation is especially large (-.23 to -.44

for elasticities and -.16 to -.24 for partial correlations), but this practice must be considered questionable. First, the unemployment rate is a simple function of employment and the labour force, so it cannot be considered an exogenous explanatory variable for employment. For the inclusion of the unemployment rate in the employment equation to make statistical sense, researchers would have to control for the simultaneity between unemployment and employment, which they do not do in this area of research. Secondly, with the exception of one paper, (Neumark and Wascher, 2004), researchers in this field do not believe that it is appropriate to include the unemployment rate in the employment equation. Hence, *Un* is as much a dummy for this one study as it is for the unique use of unemployment in the employment equation.

Table 6: Multiple MRA of UK Minimum-Wage Elasticities: Cluster-Robust WLS

Moderator Variables:	*Column 1: D&S (2009)*	*Column 2: G-to-S*	*Column 3: +UK variables*	*Column 4: +Regulation*
		Heterogeneity (Z-variables)		
Un	-0.44 (-7.27)	-0.42 (-12.1)	-0.28 (-9.02)	-0.23 (-8.69)
AveYear	0.012 (3.93)	0.008(2.01)	0.009(3.01)	0.006(0.23)
Toughness	0.58 (4.47)	0.44(5.97)	0.31(5.18)	0.16(2.93)
Double	-0.082 (-1.00)	-0.061 (-3.51)	0.076 (7.09)	0.087 (4.69)
Lag	0.009(0.11)	—	—	—
Published	-0.06 (-0.69)	—	—	—
Time	-0.078 (-0.82)	—	—	—
Panel	0.01 (0.08)	—	—	—
Region	0.006 (1.41)	—	—	—
Adults	0.064 (1.04)	—	—	—
DID	—	—	0.011 (1.33)	0.009 (0.57)
HomeCare	—	—	-0.15 (-9.31)	-0.15 (-127.4)
Regulation	—	—	—	-0.002 (-0.57)
***SE*(β_1)**	-0.78 (-3.11)	-0.73 (-3.23)	-0.68 (-2.77)	-0.59 (-1.71)
n— obs.	231	231	231	225
k—studies	11	11	11	11
R^2	.39	.37	.44	.43

Notes: t-values are reported in parenthesis using standard errors adjusted for data clustering. The dependent variable in the minimum wage elasticity. n is the number of observations. k is the number of studies. See Table 4 for variable definitions. The R^2s are in terms of t-values.

Measuring the minimum wage relatively, *Toughness*, lessens the estimated adverse employment effect. This effect is also robust to all variation in the data, MRA models and methods, with one exception as additional sectors and measures are added to the elasticity data (Appendix Table 1). For the elasticity data, this effect is also very large, roughly the same size but in the opposite direction as *Un*. The third very robust effect is seen in *HomeCare*. Residential home care has a significantly greater adverse employment effect, reducing elasticity by 0.15 and the partial correlations by 0.10. This differential employment effect might even rise to be of practical significance. The issue of how best to interpret the overall meaning of these multivariate MRA findings is discussed in more detail below.

Like conventional econometrics, MRA coefficient estimates are sensitive to changes in data, independent variables and methods. Thus, we believe that only those few research dimensions that are entirely robust can be regarded as genuine. Nonetheless, there appear to be other patterns to the UK minimum wage research. In Table 6, note that the coefficient on SE is always statistically negative. This might reflect that fact that, after allowing for other research characteristics that affect the reported employment elasticity, researchers favor reporting adverse employment elasticities. However, no such tendency is seen among the partial correlation coefficients. Perhaps, there is no selection of coefficients when researchers conduct robustness checks; yet, there remains some selection of which estimates to convert to elasticities and thereby to discuss explicitly? In any case, this effect is relatively small and not robust (see Appendix Tables 2 and 3).

On the other hand, the effect of *WageCouncil* seems more robust. The positive effect of *WageCouncil* is clearly seen in Table 5 among partial correlation coefficients; however, due to its high multicollinearity with *Toughness* in the elasticity data, we omitted it from the multiple MRA reported in Table 6. When *Toughness* is omitted instead, *WageCouncil* is also robustly positive among the reported elasticities. The history of the UK minimum wage gives credence to a smaller adverse employment effect when Wage Councils set the minimum wage. Throughout most of the twentieth century, Wage Councils set the level of the minimum wage for low pay industries. But the minimum wage was often differentiated by region, occupation and age (Machin and Manning 1996:668). Thus, it is not surprising that the minimum wage had a smaller adverse employment effect during this period.

Regulation is not statistically significant when either the elasticity or the partial correlation data are used. Apparently, the use of a relative measure of minimum wage (*Toughness*) does an adequate job of controlling for the regulatory climate, at least when the other moderator variables are also included.

As further robustness checks, we include additional low-wage industrial sectors (*Agriculture* and *Food*) and measures of employment (*Hours*) with the multiple MRA models reported in Tables 5 and 6—see Appendix Table 1. For the partial correlation research data, *Food* has a very similar adverse employment effect as does the home care industry; thus it too might deserve special consideration. As theory would suggest, hours worked (*Hours*) gives a small, but significantly greater, adverse employment effect than does the number of workers employed, which is the conventional dependent variable in this literature. Otherwise, the same overall results apply to these expanded meta-regression models.

Best Practice Research

Perhaps most importantly, these multivariate results are consistent with the simple MRA findings that there is no meaningful adverse employment effect from minimum wage raises. To see this, substitute plausible values for the moderator variables. Although it seems rather clear to us that this will not lead to a practically meaningful adverse employment effect, one must at some point discuss what can be reasonably regarded to be 'best practice' for this area of labour research. While reasonable researchers might have some differences in their judgments, our finding of no practical adverse overall employment effect arising from the UK's minimum wage is robust to many variations in one's assessment of 'best practice research.' When considering these multiple MRAs, one must always substitute 0 in for SE. The SE terms represent publication or selection bias, therefore these biases need to be driven to zero, and secondly, as we have more and more information ($n \rightarrow \infty$), estimates become more and more accurate ($SE \rightarrow 0$). In other words, SE=0 represents the perfect study. This leaves the question of which values of the Z-variables should be substituted into the MRA. So what are the best values to use for these Z-variables?

As discussed above, there are several good reasons for not including the unemployment rate into the employment equation. Following 99% of the UK minimum-wage research literature, one must regard the omission of the unemployment rate (*Un*=0) as one dimension of 'best practice' research. Next, *Toughness* needs to be set to one. Labour economists agree that some allowance must be made for the effectiveness of the minimum wage (*i.e.*, its size relative to market wages); doing so is coded as *Toughness* =1. The only real question is whether the conventionally defined toughness variable fully accounts for the 'bite' of the minimum wage.

This is the reason why we have added a measure of regulation in the last column of Table 5 and 6. Although the time trend is so small that it will not be important, we will assume that *AveYear* =0, which means that our 'predictions' relate to the year 2000. For now, we will assume that *HomeCare*=0, but will also consider *HomeCare*=1, below. *HomeCare* needs to be zero if we wish to generalize to most occupations and industries rather than this one small industry. There are several moderator variables: *Double, Published, WageCouncil and DID* that have positive coefficients. Although we could easily make the case that most of these moderator variables should be one for best practice research, we will assume that all are zero to give the possibility of an adverse employment effect its best chance. Lastly, we make *Adults* =1, because this too will give the adverse employment effect its best chance (the MRA coefficient for *Adults* is negative). Because *Regulation* is insignificant, we use the MRA model that does not include it, column 3 of Tables 5 and 6. Besides, its MRA coefficients are so small that its value will have no material effect on this assessment.

When these values are substituted into the MRA that is represented by column 3 in Tables 5 and 6, we get positive values for minimum wage's employment elasticity and partial correlation (0.31; 0.018, respectively). Needless to say, this represents a very sizeable, policy-relevant, *positive* association for employment elasticities, but a practically insignificant one for partial correlations. Even more importantly, the absence of a relevant adverse employment effect results no matter what values we substitute into the MRA, as long as *SE* and *Un* are held to zero.[5] Even for the residential home care industry, we still have a positive employment elasticity. On the other hand, for partial correlations, employment in the residential home care industry is assessed to have negative correlation with minimum wage, -0.082. Although this is still a rather small partial correlation, our findings do serve as a caution in applying the national minimum wage to this industry.

5. Conclusion

A systematic and comprehensive meta-analysis of the UK's minimum wage research literature finds no evidence of a practically meaningful adverse employment effect, overall. This general finding is robust to the research sample used and the meta-regression model employed. Descriptive statistics, simple meta-regression analysis (MRA), and more nuanced multiple MRAs of 710 partial correlation coefficients and 236 minimum-wage employment elasticities all confirm the absence of a practically significant adverse employment effect. Our results are consistent with a previous meta-analysis of the larger US minimum-wage research literature (Doucouliagos and Stanley, 2009). However, unlike the US minimum-wage research, there is no evidence of reporting bias in the UK research literature.

What explains this lack of the expected negative employment response to a rise in mandated wages? Several explanations can be offered. First there is the issue of endogeneous policy. It appears that policy makers have implemented minimum wage adjustments in a fashion that minimized their employment effect (Low Pay Commission 2000: vii). Second, Metcalf (2008) argues that any adverse employment effects were probably offset by movements in productivity, prices, profits, and adjustments to hours worked. Lemos (2008) finds that the minimum wage has a small effect on prices. Hence, Metcalf's conjecture remains to be proven through further independent replications or meta-analyses. Another explanation is that perhaps the competitive labour market model is not an accurate representation of the UK labour market. Lester (1946), Card and Krueger (1995a), OECD (1998), and Metcalf (2008), among others, discuss how monopsonistic power in the labour market might easily be responsible for the absence of an employment effect. Alternatively, Akerlof (1982 and 2002) argues that the efficiency wage hypothesis (EWH) implies that the minimum wage would have little or no adverse employment effect.

Recall that EWH is the idea that businesses pay workers more than market-clearing wages in order to increase their productivity and loyalty. The efficiency wage hypothesis may be regarded as antithetical to the old Soviet workers' joke: 'They pretend to pay us, and we pretend to work.' With efficiency wages, we pay them well, and they work harder. A similar meta-analysis of EWH finds robust and clear evidence of its validity (Krassoi-Peach and Stanley 2009). The efficiency-wage elasticity only gets stronger when researchers control for the simultaneity between wages and productivity; thus, the observed support for EWH in the research literature cannot be dismissed as the artifact of reverse causation or the marginal productivity theory of wages. Although there is also clear evidence of publication selection bias in the EWH literature, a strong positive effect remains (an efficiency-wage elasticity of approximately 0.3) after publication selection is filtered from the research record (Krassoi-Peach and Stanley 2009).

There is one potentially important exception to this overall finding of the absence of an adverse employment effect. Our MRA discovers clear evidence that the employment effect is significantly more negative in the residential home care industry, and this might also be true for retail food. Perhaps, these differential employment effects may be large enough to suggest special treatment?

Of course, the full story of this area of research is more complex and nuanced than any simple overall summary. Our MRA identifies several research dimensions that affect the magnitude of the reported employment effect. Aside from the home care and food industries, the use of a relative measure of minimum wage (*Toughness*), and the inclusion of the unemployment rate in the employment equation have relatively large consequences for the employment effect. As discussed above, we have reason to believe that the effect of including the unemployment rate represents misspecification bias and/or the signal of selective reporting bias. There may also be several other important differential effects, including *WageCouncil*; however, these effects are not as robust and have a smaller impact on the employment effect.

Lastly, what are the policy implications of this systematic review and meta-analysis of the minimum wage? Our meta-analysis implies that routine and modest rises in the minimum have had no adverse effect on employment in the UK. Against this positive policy assessment, there is some indication that the residential home care industry should be treated differently to avoid small adverse effects. Perhaps, sector-specific minimum wage regulations, such as in the Wages Councils approach, is preferable to a single statutory minimum wage, and that possibly the UK legislators might bear this in mind when contemplating any reform to the national minimum wage?

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Appendix Table 1: Multiple MRA with Hours and Sectors, Cluster-Robust WLS

Moderator Variables:	*Partial Correlations*	*Elasticities*
	Heterogeneity (Z-variables)	
Un	-0.25 (-16.5)*	-0.25 (-4.97)*
Toughness	0.023 (10.2)	0.20 (1.14)
Lag	-0.004 (-4.23)	—
Published	0.024 (2.69)	—
Adults	-0.009 (-0.71)	—
AveYear	—	0.003 (0.31)
Double	—	0.10 (4.77)
DID	0.009 (9.77)	-0.001(-0.09)
HomeCare	-0.10 (-8.56)	-0.17 (-16.1)
WageCouncil	0.12 (6.17)	—
Regulation	-0.0005 (-0.28)	-0.002 (-0.37)
Hours	-0.022 (-2.25)	0.016 (0.62)
Argiculture	-0.028 (-1.22)	-0.020 (-0.15)
Food	-0.099 (-10.6)	-0.53 (-1.82)
$SE(\beta_1)$	0.08 (0.27)	-0.48 (-1.50)
n	684	225
k	16	16
R^2	.29	.48

Notes: t-values are reported in parenthesis using standard errors adjusted for data clustering.

Appendix Table 2: Multiple MRA of UK Minimum-Wage Elasticities: Robustness Checks

Moderator Variables:	*2 : G-to-S RE-Panel*	*2 : G-to-S Robust*	*3 : +UK Variables RE-Panel*	*3 : +UK Variables Robust*	*4: +Regulation RE-Panel*	*4: +Regulation Robust*
		Heterogeneity (Z-variables)				
Un	-0.37 (-2.34)*	-0.43 (-3.81)*	-0.23 (-1.67)*	-0.29 (-2.54)*	-0.23 (-2.11)*	-0.24 (-2.07)*
AveYear	0.011 (4.00)	0.008 (4.57)	0.011 (4.31)	0.009 (5.11)	0.006 (0.19)	0.005 (0.15)
Toughness	0.40 (4.84)	0.44 (8.90)	0.23 (2.67)	0.32 (5.05)	0.16 (2.12)	0.16 (1.93)
Double	-0.053 (-1.29)	-0.066 (-2.07)	0.098 (1.68)	0.071 (1.55)	0.087 (1.84)	0.090 (1.84)
DID	—	—	0.001 (0.15)	0.012 (1.58)	0.009 (0.47)	0.004 (0.19)
HomeCare	—	—	-0.17 (-3.69)	-0.15 (-4.32)	-0.15 (-4.15)	-0.16 (-4.14)
Regulation	—	—	—	—	-0.002 (-0.67)	-0.002 (-0.54)
SE(β_1)	-0.23 (-0.60)	-0.63 (-5.08)	-0.082 (-0.27)	-0.58 (-4.25)	-0.60 (-3.85)	-0.49 (-3.06)

Notes: t- or z-values are reported in parenthesis using standard errors adjusted for data clustering. Robust denotes robust regression.

Appendix Table 3: Multiple MRA of UK Minimum-Wage Partial Correlations: Robustness Checks

Moderator Variables:	*2 : G-to-S RE-Panel*	*2 : G-to-S Robust*	*3 : +UK Variables RE-Panel*	*3 : +UK Variables Robust*	*4: +Regulation RE-Panel*	*4: +Regulation Robust*
	Heterogeneity (Z-variables)					
Un	-0.13 (-1.32)*	-0.17 (-2.59)*	-0.21 (-2.16)*	-0.24 (-3.65)*	-0.24 (-2.90)*	-0.24 (-3.76)*
Toughness	0.027 (2.89)	0.063 (8.73)	0.024 (2.61)	0.047 (6.75)	0.034 (3.88)	0.046 (6.69)
Lag	-0.005 (-4.73)	-0.004 (-4.97)	-0.005 (-4.78)	-0.004 (-5.35)	-0.004 (-3.92)	-0.004 (-5.38)
Published	-0.006 (-0.17)	0.006 (3.83)	-0.001 (-0.40)	0.003 (1.47)	0.003 (2.26)	0.002 (1.27)
Adults	-0.005 (-0.15)	-0.009 (-5.79)	-0.007 (-1.76)	-0.014 (-6.46)	-0.025 (-0.98)	-0.025 (-1.26)
DID	–	–	0.007 (2.18)	0.008 (3.19)	0.010 (3.02)	0.009 (3.25)
HomeCare	–	–	-0.11 (-3.52)	-0.095 (-7.35)	-0.10 (-6.28)	-0.094 (-7.28)
WageCouncil	–	–	0.080 (1.49)	0.078 (4.10)	0.091 (3.72)	0.084 (4.40)
Regulation	–	–	–	–	0.001 (0.34)	0.002 (0.55)
SE(β_1)	0.18 (0.62)	0.23 (2.67)	0.39 (1.27)	0.36 (3.96)	0.38 (3.31)	0.33 (3.68)

Notes: t- or z-values are reported in parenthesis using standard errors adjusted for data clustering. Robust denotes robust regression.

[1] In addition to various search engines, we also conducted a cited reference search on the papers that we found to have viable estimates and we cross-referenced the references of relevant studies. The search for studies ended in June 2012.

[2]

$$r = \frac{t}{\sqrt{t^2 + df}}$$

Where t is the t-value of the regression coefficient on the minimum-wage variable, and df is its degrees of freedom.

[3] If we were to take these simple descriptive statistics at face value, then we could be 95% confident that there is a marginally positive average employment effect from the minimum wage (t=1.83; one-tail p-value<.05).

[4] We do not advocate throwing out all contrary evidence, or any relevant, comparable research result, from a meta-analysis. We do so only to take our tests of the overall findings to their farthest extreme to see if they can still hold up.

[5] SE must be set to zero because it reflects selection bias. Because only one study in this literature uses the unemployment rate in the employment equation, it would not seem to be appropriate to set Un = 1 to derive an overall estimate of the employment effect. Nonetheless, we still find a *positive* employment elasticity effect even when Un=1.