Who Ultimately Bears the Burden of Greater Non-Wage Labour costs?*

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Abstract

We investigate the effect of a rise in non-wage labour costs (NWLC) on real manufacturing labour costs in OECD countries, taking into account the degree of coordination in the wage bargaining process. We find that, in countries in which wage bargaining is not highly coordinated, 55% of an increase in NWLC appears to be shifted to workers in the long run, whereas in countries operating under a highly coordinated bargaining regime, full shifting occurs. Overall, our results suggest that high NWLC can be associated with a high equilibrium unemployment rate, but only in those OECD countries that do not have highly coordinated wage bargaining.

JEL classifications: H22, H30, H55, J32.

Keywords: labour costs, tax wedge, wage determination, bargaining coordination.

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1 Introduction

The empirical literature focusing on factors that influence the total unemployment rate frequently finds that the tax wedge[1] can explain a substantial share of the rise in unemployment in most OECD countries (Daveri and Tabellini, 2000; Nickell et al., 2005). From a theoretical perspective, the extent to which an increase in labour taxes generates higher unemployment depends on who ultimately bears the additional tax burden, i.e. employers or workers. The results of Daveri and Tabellini (2000) and Nickell et al. (2005) suggest that greater labour taxes are not entirely passed on to workers in the form of lower gross wages in the short run, otherwise no positive association between a rising tax wedge and unemployment rates would have been found. However, direct cross-country empirical evidence on the impact of the tax wedge on labour costs remains limited. Furthermore, various studies (Layard et al., 1991; Gruber, 1997; Nickell and Bell, 1997) argue for an absence of real wage resistance in the long-run,[2] implying that as long as the tax wedge is kept stable over time, the unemployment rate will progressively converge to an equilibrium unaffected by labour taxes.

The objective of this paper is to provide more direct evidence than previous studies of the impact of a rising tax wedge on labour costs. We focus specifically on the effects of a rise in the implicit non-wage labour costs (NWLC) tax rate on real manufacturing labour costs in OECD countries. Our 'tax wedge' measure is narrower than those used in previous studies, since we only focus on the social welfare costs incurred by employers, but more inclusive, since we not only include costs which have been statutorily imposed on firms and are paid to governmental institutions but also social welfare costs, paid to private social security schemes and insurances, which are a result of collective bargaining agreements or are voluntarily undertaken by firms. Although the latter are not strictly speaking taxes, as they are not compulsory payments to the general government, they nevertheless affect labour costs and unemployment outcomes in broadly the same way.[3] Ignoring these social welfare costs would lead to the omission of a significant fraction of the non-wage costs burden faced by employers in some OECD countries.

We pay particular attention to the issues of non-stationarity, endogeneity, slope heterogeneity, and

[1] The tax wedge is the difference between the real product wage (labour costs per employee normalised on the output price) and the real consumption wage (after tax pay normalised on the consumer price index) (Nickell et al., 2005). In this paper, we adopt a broad view of the tax wedge by including in the latter, in addition to legally-required taxes (social security contributions, income or indirect taxes), other non-wage labour costs.

[2] Interestingly, in an introduction to the second edition of their book *Unemployment*, Layard et al. (2005) do not consider the reduction of labour taxes as a potential strategy for tackling unemployment.

[3] For instance Ooche et al. (2003) cannot statistically reject that a rise in statutory or non-statutory (collectively agreed, contractual and voluntary) social security contributions paid by employers in six European countries would have similar tax incidence, i.e. a partial (backward) shifting to employees. At a more microeconomic level, Baicker and Chandra (2005)'s results suggest that in the United States, where most of the active population is covered by employer-provided health insurance, rising health premiums in the late nineties have reduced both wages and employment.

time dynamics. We also take into account the degree of coordination of the wage bargaining process, which may influence how trade unions take into account the implications of their wage demands in terms of unemployment and/or may play a role in their internalisation of the fact that greater NWLC are associated with greater benefits for their members. Finally, we crucially distinguish between the short-run and the long-run effects of an increase in NWLC.

We find that, in countries in which wage bargaining is not highly coordinated, an increase in NWLC is associated with higher labour costs in both the short and long run. At the sample mean, a 1 percentage point rise in the NWLC tax rate (a 0.78% rise at the sample mean) leads to a 0.42% fall in gross wages and to a 0.36% rise in labour costs in the long run, i.e. a 55/45% split of the tax burden. However, in countries operating under a highly coordinated bargaining regime, the entire tax burden appears to be shifted immediately to workers. Hence, high NWLC can help to explain a high equilibrium rate of unemployment, but only in some OECD countries.

The remainder of the paper is organised as follows. In Section 2 we briefly discuss the theory of payroll taxes and mandates and then review the empirical literature on the incidence of labour taxes on wages. In Section 3, we describe the data and the econometric methodology employed. In Section 4 we report and interpret the empirical findings, and we provide concluding comments in the last section.

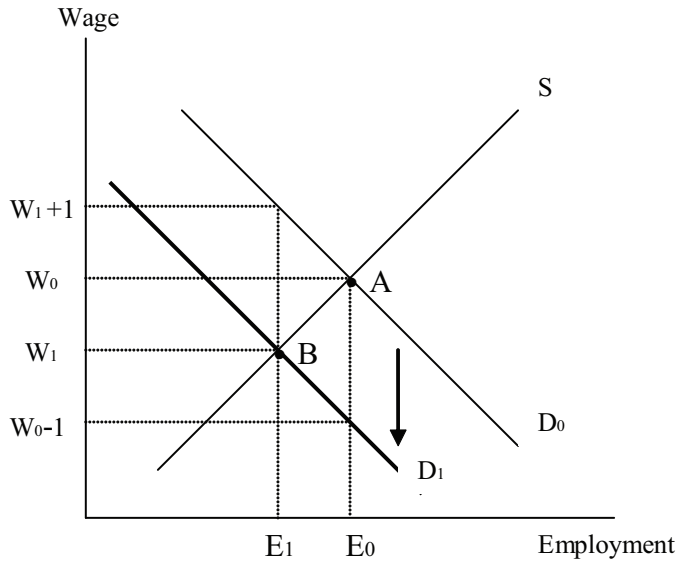
2 Theory and empirical cross-country evidence

In standard payroll tax incidence models,[4] a rise in employer costs reduces the demand for labour, generally leading to a decrease in both gross wages and employment. To illustrate this relationship, suppose that the employer has to pay a payroll tax of \$1 for every hour worked. In Figure 1, at the initial equilibrium A, employers are willing to hire E_0 workers for a total labour cost of W_0. With the payroll tax of \$1, the employers are disposed to pay a wage rate of $W_0 - 1$ dollars to the workers to hire E_0 of them, leading to a downward shift in the labour demand curve to D_1. The implementation of the payroll tax modifies the equilibrium of the labour market (reached in B), decreasing wages to W_1 and employment to E_1. The wage actually received by workers falls to W_1, but the total labour cost rises to $W_1 + 1$. With $W_1 + 1 < W_0 + 1$, both employers and employees share the cost of the payroll tax. The magnitude of the tax burden passed on to workers depends on the wage elasticities of the labour supply and demand

[4] See Borjas (2008) for a very good introduction of the labour market consequences of payroll taxes and mandated benefits.

curves. The more inelastic the supply curve, the higher the tax burden shifted to employees. A total shift of payroll taxes to employees can occur if the supply curve of labour is perfectly inelastic.

Figure 1: The effect of a payroll tax imposed on employers

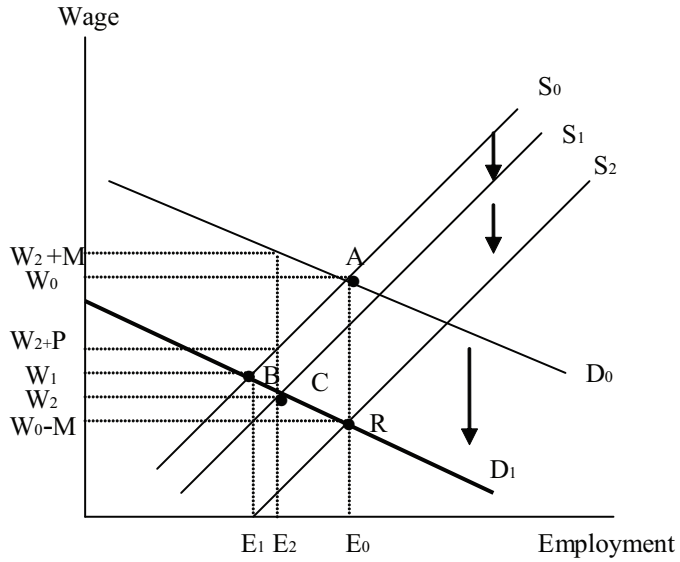


The shift of employer costs to wages mitigates the decline of employment. The extent of this shift can be even more pronounced if employees consider that they will derive some benefits from a tax increase (Summers, 1989). In Figure 2, we illustrate how workers' valuation of the benefit they receive from taxes affects the labour market equilibrium, by considering the basic theory of mandated benefits.[5] As in the previous figure, the initial equilibrium is at point A, with wage W_0 and employment E_0. The government now mandates employers to provide employees with some particular benefits, at cost M dollars per worker. This results in a downward shift of the demand curve to D_1 and implies that employers are now willing to pay $W_0 - M$ to hire E_0 workers. Consider first the case in which workers attach no value to the benefit provided by the mandate. The new equilibrium would then be at point B, reducing the wage that employees are paid to W_1 (the employer paying $W_1 + M$), and employment to E_1. This equilibrium corresponds to the one reached in Figure 1, after the implementation of the payroll tax. Consider now that employees appreciate that they will benefit from these mandates, and that they value the mandated benefit at P dollars, with $P < M$. The E_0 workers are now willing to receive a wage of $W_0 - P$ dollars, leading to a downward shift of the supply curve (by P dollars) to S_1. The new equilibrium is reached at point C, where $E_2 > E_1$ and $W_2 < W_1$. Employees' valuation of the mandated benefit increases

[5] A mandated benefit is a benefit that employers are required by law to provide to their employees. However the tax-benefit linkage reasoning is applicable to any increase in NWLC which are perceived by employees as benefiting them.

the shift to wages and full shifting occurs if their valuation equals the cost of the mandate ($P = M$), corresponding to the equilibrium R. This leads to a more pronounced downward shift of the supply curve (by M dollars) to S_2. At R, employment is not affected by the implementation of the mandate. Therefore, in addition to the wage elasticities of labour demand and supply, the shifting also depends on the value workers assign to the benefits they expect to derive from the increase in employers' social expenditures.

Figure 2: The effects of a mandated benefit, depending on workers' valuation



The recent cross-country empirical literature (see Nickell and Layard (1999) and Daveri and Tabellini (2000) for literature surveys) mostly investigates the impact of a higher total tax wedge, i.e. the sum of employer, employee and indirect tax rates, on gross wages or total compensation costs. Countries are usually distinguished according to their wage bargaining structure as it is expected that the economy-wide employment implications of higher labour costs (Calmfors and Driffill, 1988) and/or workers' perception of the link between the taxes they pay and the benefits that they receive (Summers et al., 1993; Alesina and Perotti, 1997) increase with the degree of centralisation/coordination of wage bargaining. Studies typically find that the additional tax burden is not entirely shifted to workers in countries that operate under a decentralised/non-coordinated bargaining regime, so labour costs are greater. However it remains unclear whether this effect is permanent. For instance Layard et al. (1991) and Nickell (2004), argue on the basis of OECD (1990)'s results, that real wage resistance is long-lasting but not permanent.[6]

[6]Gruber (1997) provides, at the microeconomic level, some support for this conclusion. He investigates the incidence of payroll taxes on wages in Chile before and after the privatisation of the social security system. This privatisation, which occurred

This short literature review suggests that some gaps remain to be filled. First, employees' and employers' social security contributions, personal income taxes and consumption taxes have generally been lumped together while in general only compulsory payments to public sector schemes have been taken into account. The incidence of non-wage labour costs, including those resulting from collective bargaining agreements, remain to be determined. Second, results of previous studies also need to be updated and complemented, using data more recent than the mid-nineties. Third, the possibility that the tax variable is endogenous, due to omission of a relevant variable, measurement error or reverse causality, needs to be investigated. Fourth, additional evidence regarding the possible vanishing effect of real wage resistance in the long run appears essential. In a dynamic panel data context, this requires particular attention to be paid to the potential presence of slope heterogeneity, which can be a strong threat to the consistency of the usual (fixed effects, IV/GMM) pooled estimators (Pesaran and Smith, 1995). The rest of the paper is devoted to addressing these four issues.

3 Empirical Model and Data Description

On the basis of standard theoretical wage bargaining models (see for instance Wulfsberg (1997)), it is assumed that hourly labour compensation is given by:

$$\begin{aligned} \text{Ln(Compensation)}_i^t &= \beta_1 \text{Ln(Labour productivity)}_i^t + \beta_2 [\text{Ln(CPI} - \text{Ln(PPI)}]_i^t \\ &+ \beta_3 \text{Unemployment rate}_i^t + \beta_4 \text{Ln(GDP per capita)}_i^t + \\ &\beta_5 \text{Ln(Trade openness)}_i^t + \beta_6 \text{Ln(1+NWLC tax rate)}_i^t \\ &+ T^t + \epsilon_i^t \end{aligned} \tag{1}$$

where T^t are country-invariant time-specific *t* fixed effects and $\epsilon_i^t = C_i + \upsilon_i^t$ is the overall error term, with time-invariant country-specific *i* fixed effects C_i and idiosyncratic shocks υ_i^t. Real hourly compensation is expected to be positively and closely related to hourly labour productivity whereas a larger unemployment rate should negatively influence it as the growing lack of outside opportunities reduces the bargaining power of workers. Workers evaluate the wage offers in terms of the purchasing power that they will deliver, implying that a wedge between the consumer price index (CPI) and the

in 1981, reduced the payroll tax burden on Chilean firms from 30% to 5% over a six years period. His results indicate a full shifting of lower payroll taxation to blue and white collar workers in the form of higher wages. See also Gruber (1994), in which the costs of newly-introduced mandated maternity benefits is shown to be fully shifted to women of childbearing age.

producer price index (PPI) is likely to raise wage pressures. GDP per capita and trade openness are included in order to capture time-varying factors which may influence compensation, such as labour market institutions or the increased competition from developing countries in the production of goods intensive in unskilled labour. Signs of both variables are ambiguous. A boost in employment and output can be achieved through a reduction in the bargaining power of workers (fall in the replacement ratio) or in the market power of firms (increase in the degree of product market competition), leading to changes in the real wage diametrically opposite despite similar outcomes. Higher trade openness may be due to larger imports, larger exports, or both, with each scenario having a different impact on labour demand. Time-varying factors common to all countries are captured by time dummies. Finally, the main variable of interest is the implicit NWLC tax rate. Holding other factors constant, a rise of 1 percentage point in the NWLC tax rate will lead to a fall in gross wages of $100 * (\beta_6 - 1) Ln(\frac{1.01+\text{NWLC tax rate}}{1+\text{NWLC tax rate}})\%$. It is expected that the coefficient β_6 will be bounded between 0 (employees bear the full burden of greater NWLC) and 1 (employers bear the full burden).

Estimation of equation 1 by OLS would produce biased and inconsistent estimators for several reasons. First, regressors are likely to be correlated with the country-specific effect included in the error term. Second, most variables are non-stationary,[7] potentially generating a spurious regression problem. Third, the error term appears to follow a random walk, according to an autocorrelation test. Fourth, our tax variable may be endogenous due to an omitted variable or simultaneity.

The first three problems can be resolved by first-differencing equation 1:

$$\begin{aligned} \Delta\text{Ln(Compensation)}_i^t &= \beta_1 \Delta\text{Ln(Labour productivity)}_i^t + \beta_2 \Delta[\text{Ln(CPI} - \text{Ln(PPI)}]_i^t \\ &+ \beta_3 \Delta\text{Unemployment rate}_i^t + \beta_4 \Delta\text{Ln(GDP per capita)}_i^t + \\ &\beta_5 \Delta\text{Ln(Trade openness)}_i^t + \beta_6 \Delta\text{Ln(1+NWLC tax rate)}_i^t \\ &+ T^t + \Delta\upsilon_i^t \end{aligned} \tag{2}$$

The country-specific effect is eliminated, series become stationary and the differenced errors should be serially uncorrelated. The fourth problem can be handled through an instrumental variable approach in which the first lag of the troublesome variable (ΔLn(1+NWLC tax rate)$_i^{t-1}$), and the first lag squared, are used as 'internal' instruments for ΔLn(1+NWLC tax rate)$_i^t$. In the absence of both serial correlation

[7] Fisher type unit root tests for panel data developed by (Maddala and Wu, 1999) show that most variables are *I(1)*.

of the differenced error term $\Delta\upsilon_i^t$ and a potential 'weak instruments' problem, these variables are valid instruments. Validity of the instruments can be assessed *via* the *F*-statistic on the excluded instrument, an autocorrelation test and a Sargan test of overidentifying restrictions.

Estimation of equation 2 only allows us to estimate the short-run impact of a change in the NWLC tax rate on labour compensation, as the regression model ignores any long-run relationship between the two variables. As shown by Hendry (1995), omission of the long-run information is unlikely to severely affect the estimation of β_6 but generates a lag distribution, i.e. a distribution of the effect of taxes on compensation across time, which does not seem plausible since 100% of the effect is constrained to occur 'immediately'. Estimation of an autoregressive distributed lag model ADL(p=1, q=1, k=6) provides much more dynamic flexibility (Hendry, 1995; De Boef and Keele, 2008):

$$\begin{aligned}\text{Ln(Compensation)}_i^t &= \theta_i\text{Ln(Compensation)}_i^{t-1} + \sum_{j=0}^{q}\delta_{ji}'x_i^{t-j} + \psi_{10i}\text{Ln(1+NWLC tax rate)}_i^t \\ &\quad + \psi_{11i}\text{Ln(1+NWLC tax rate)}_i^{t-1} + T^t + C_i + \upsilon_i^t \qquad (3)\end{aligned}$$

where x_i^t is the (*k*-1) x 1 vector of control variables for country *i* and δ_{ji} are (*k*-1) x 1 coefficient vectors. Equivalently, the ADL model can be reparametarised as an error-correction model, written in terms of current levels of the exogenous regressors (Pesaran et al., 1999):[8]

$$\begin{aligned}\text{Ln(Compensation)}_i^t &= \phi_i[\text{Ln(Compensation)}_i^{t-1} - \gamma_i'x_i^t - \omega_i\text{Ln(1+NWLC tax rate)}_i^t] \\ &\quad - \delta_{1i}'\Delta x_i^t - \psi_{11i}\Delta\text{Ln(1+NWLC tax rate)}_i^t + C_i + T^t + \upsilon_i^t \qquad (4)\end{aligned}$$

where $\phi_i = -(1-\theta_i)$, γ_i and ω_i are the long-run effects, e.g. $\omega_i = \frac{\psi_{10i}+\psi_{11i}}{1-\theta_i}$. From a cointegration perspective, whose assumption is nevertheless not required to estimate equation 4, the term in brackets is the error correction term and ϕ_i measures the speed of adjustment to equilibrium after a shock.

Equation 4 can be estimated using a dynamic fixed effects estimator, which amounts to imposing the constraints that short-run and long-run coefficients are the same across countries and that only the intercepts can vary. It is well known that the fixed effects estimator for dynamic panel models is biased and inconsistent for fixed *T* time periods, due to the correlation of the within transformed lagged dependent

[8] In a time series context, note that the inclusion of lagged values of both the dependent and independent variables eliminates the spurious regression problem even if some of the variables are *I(1)* (Hamilton, 1994).

variable with the within transformed error term. Hence, we use the bias-corrected fixed effects estimator developed by Bruno (2005). Bruno's monte-carlo simulations show that it outperforms other estimators, e.g. GMM estimators, in unbalanced panels with small *N* number of units. However, the constraints imposed by the dynamic fixed effects estimator may be too strong. Short-run and long-run coefficients may vary across countries and, under slope heterogeneity, the dynamic fixed effects estimator will be inconsistent, even if the slope coefficients are distributed independently of the regressors and the errors and *N* and *T* are large (Pesaran and Smith, 1995; Pesaran et al., 1999).[9] Slope estimates may be very misleading and this issue cannot be resolved by using IV/GMM panel estimators. A straightforward alternative approach could be then to estimate separate regressions for each country and then average the individual estimates to obtain consistent estimates of the mean values of the parameters (Pesaran and Smith, 1995; Pesaran et al., 1999). Given that this 'mean group' (MG) estimator can be severely biased for relatively small *T*, the alternative solution that we adopt is to assume that long-run equilibrium relationships between variables are the same across countries belonging to the same, yet to be defined, group ($\gamma_i = \gamma$ and $\omega_i = \omega, \forall i$) but that the short-run dynamics, intercepts and error variances differ across countries. The 'pooled mean group estimator' (PMG) developed by Pesaran et al. (1999) preserves the efficiency of pooled estimation to estimate long-run coefficients while avoiding the inconsistency generated by pooling heterogenous dynamics. They show that their PMG estimator is consistent and asymptotically normal for both stationary and non-stationary *I(1)* regressors.

The dependent variable is the average hourly compensation cost per worker in the manufacturing sector, as calculated, and kindly provided, by the U.S. Bureau of Labor Statistics (BLS). Values come from the underlying 2006 revised data used by the BLS to construct trend indexes and annual percent changes of output per hour, hourly compensation, unit labour costs in manufacturing, and other variables for sixteen economies. Data have been prepared specifically to allow international comparisons of labour costs and productivity in the manufacturing sector and have been described by the International Labour Organisation as the most reliable available series (International Labour Office, 2009). Hourly compensation costs include (Bureau of Labor Statistics, 2006): (i) hourly direct pay (all payments made directly to the worker, before payroll deduction, consisting in pay for time worked and other direct pay such as pay for time not worked); (ii) employer social insurance expenditures for legally required insurance programs, contractual and private benefit plans,[10] and other taxes on payrolls or employment. Labour

[9] On the other hand, the 'static' fixed effects estimator or the 'static' first difference estimator is consistent, even if the individual-specific slopes are correlated with the regressors, as long as they are mean-independent of the time–demeaned/-differenced regressors (Wooldridge, 2005).

[10] Including: retirement and disability pensions, health insurance, income guarantee insurance and sick leave, life and accident

productivity has also been provided by the U.S. BLS and corresponds to the average value added per worker in the manufacturing sector. Both measures have been deflated by the manufacturing producer price index (PPI, base year 2000) given in the OECD Factbook 2007. Unemployment rate series come from the IMF World Economic Outlook database (October 2008), the consumer price index (CPI, base year 2000) from the World Bank Development Indicators database while trade openness and income per capita come from the Penn World Table v6.2 (Heston et al., 2006).

The variable of interest, the implicit NWLC tax rate, is calculated on the basis of additional data provided by the Bureau of Labor Statistics (2006) on the structure of hourly compensation costs for production workers in the manufacturing sector. It corresponds to the sum of employers' social security expenditures and other taxes on payrolls or employment as a share of the gross wage paid to the employee. In comparison with other studies, our tax variable not only include costs which have been statutorily imposed on firms and are paid to governmental institutions but also social welfare costs, paid to private social security schemes and insurances, which are a result of collective bargaining agreements or are voluntarily undertaken by firms. Beyond our desire to use a tax variable specific to the manufacturing sector and suitable for international comparisons, this choice is motivated by the relative importance of contributions to social security schemes outside the general government sector in some countries.[11]

Figure 3 presents the evolution of the NWLC tax rate for each country of the sample between 1980 and 2004. The average NWLC tax rate was close to 25% in 1980 and had increased by approximately 7 percentage points to reach 32% in 2004. The relative level of NWLC also varies substantially from one country to another, with higher levels in France, Italy, Belgium, or Sweden and lower levels in Australia, Canada, U.K. or Denmark.

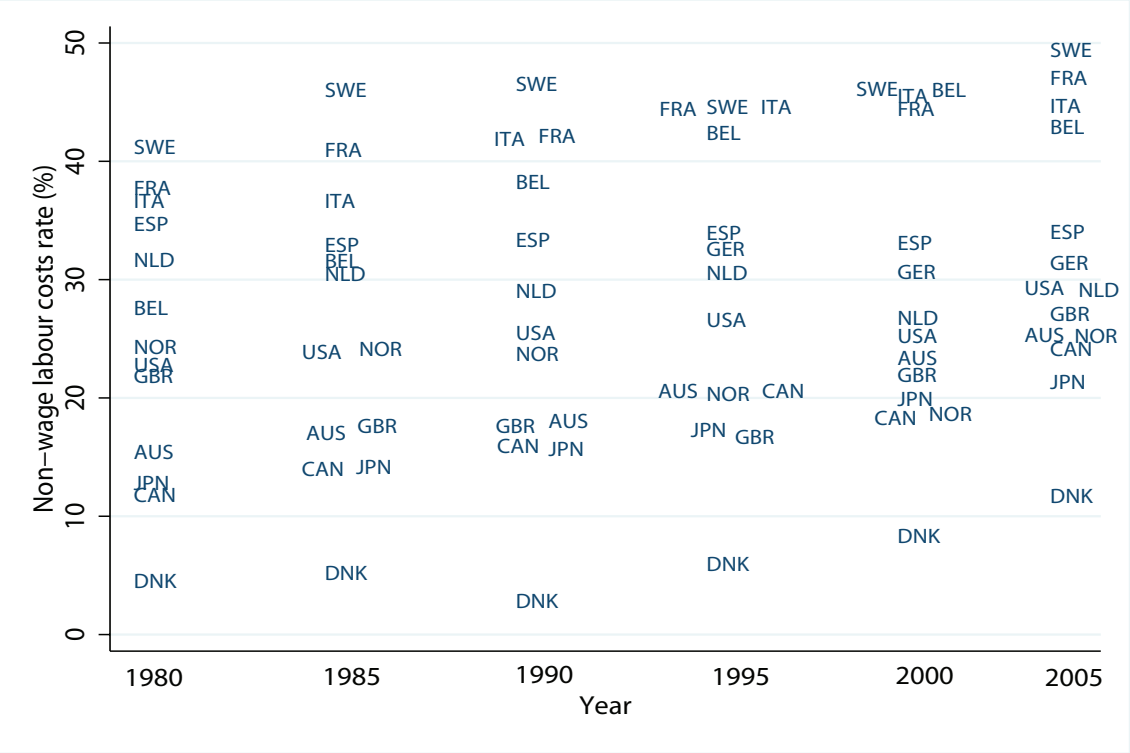
Data are available for 14 OECD countries[12] over the 1980-2004 period. Outliers have been removed according to the DFITS influence measure. A Breush-Pagan/Cook-Weisberg heteroscedasticity test (Breusch and Pagan, 1979) and an Arellano and Bond (1991) autocorrelation test applied to the first-differenced residuals indicate that standard errors do not need to be corrected for heteroscedasticity or autocorrelation. Summary statistics are given in table 1.

insurance, occupational injury and illness compensation, unemployment insurance, family allowances, other social insurance expenditures.

[11] It is for instance well known that most of the working-age population (and their dependants) in the United States are covered by private health insurance provided by their employers. According to the BLS (`http://www.bls.gov/news.release/pdf/ecec.pdf`), health insurance amounted to 8% of total compensation in 2009, a proportion similar to that of all legally required benefits.

[12] The countries are Australia (AUS), Belgium (BEL), Canada (CAN), Denmark (DEN), France (FRA), Germany (GER),

Figure 3: Implicit Non-wage labour costs tax rate in OECD countries, 1980-2004



Source: Bureau of Labor Statistics (2006).

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Ln compensation	3.00	0.35	1.67	3.60
Ln labour productivity	3.38	0.33	2.20	4.04
Ln price wedge	-0.06	0.11	-0.37	0.11
Unemployment rate	0.08	0.04	0.02	0.24
Ln GDP per capita	10.00	0.20	9.38	10.49
Ln trade openness	3.98	0.55	2.77	5.11
NWLC tax rate	28.11	12.02	1.96	49.87
Ln(1+NWLC tax rate)	0.24	0.09	0.02	0.40
Coordination index	3.08	1.12	1.00	4.34

4 Empirical Results

4.1 Short-Run Effects

Results are reported in table 2. All variables are statistically significant at the 5% level. As expected, higher labour productivity, a fall in the unemployment rate or a positive price wedge are associated with higher labour compensation. The negative sign of GDP per capita is consistent with the hypothesis that growth in OECD countries has been partly achieved through reforms in labour market institutions which have weakened the bargaining power of workers. Finally, it appears that trade openness leads to lower compensation, at least in the short run, an effect which can be interpreted within a Heckscher-Ohlin-Samuelson framework as the consequence of the increased competition from developing countries in the production of manufacturing goods. Turning to the variable of interest, its coefficient is positive, statistically significant and lower than 1. According to column (1), at the sample mean, a 1 percentage point increase in the NWLC tax rate would lead to a fall in gross wages of about $100 * (0.30 - 1) * Ln(\frac{1.29}{1.28}) \simeq$0.55% and a rise in labour costs of about $100 * (0.30) * Ln(\frac{1.29}{1.28}) \simeq$0.23%. A natural worry is that our estimates suffer from an endogeneity bias. Column (2) presents the results of an instrumental variable regression, in which the first-difference of the tax variable has been instrumented by its first lag and its lag squared. The absence of autocorrelation of the first-differenced errors, the large Cragg-Donald Wald *F* statistic and the *p*-value of the overidentifying restrictions test suggest that the instruments are valid, whereas a Durbin-Wu-Hausman test cannot reject the exogeneity of the tax variable. Strict exogeneity of all variables can also be checked via the test suggested by Wooldridge (2002) (p.285), which consists of including the current level of the regressors (or a subset of them) in equation 2 and performing an *F*-test of joint significance. Under the null hypothesis of strict exogeneity, the latter should not be correlated with changes in labour compensation. An unreported regression shows that we cannot reject the hypothesis of strict exogeneity of the regressors as coefficients of their current levels are jointly statistically insignificant.

As previously mentioned, one factor that may influence the impact of rising NWLC on labour costs is the extent to which wage bargaining is coordinated. Under highly centralised bargaining, trade unions take into account the implications of their decisions in terms of unemployment and are more likely to internalise the relationship between contributions to be paid and benefits to be received. We therefore investigate the potential moderating influence of coordination of bargaining, by employing the index

Italy (ITA), Japan (JPN), Netherlands (NLD), Norway (NOR), Spain (ESP), Sweden (SWE), United Kingdom (GBR) and United States (USA).

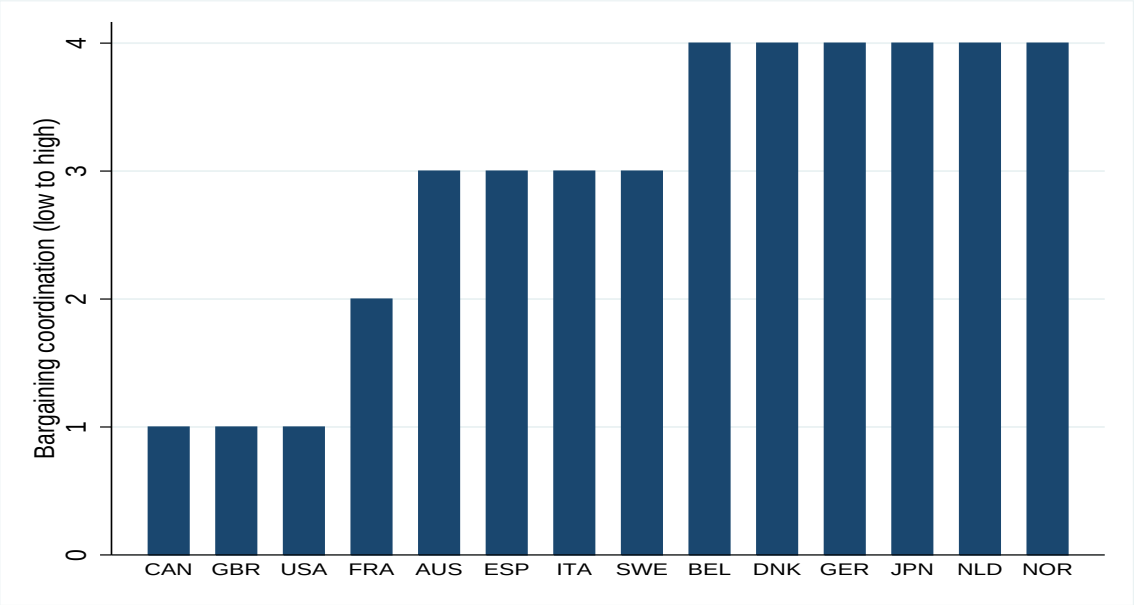
Table 2: Short-run effects of the implicit NWLC tax rate on labour costs in the manufacturing sector

	Δ Ln compensation				
				Bargaining Coordination	
				Low/Medium	High
	(1)	(2)	(3)	(3')	(3")
Δ Ln labour productivity	0.87[a]	0.87[a]	0.87[a]	0.87[a]	0.88[a]
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Δ Price wedge	0.51[a]	0.52[a]	0.52[a]	0.59[a]	0.50[a]
	(0.07)	(0.07)	(0.05)	(0.10)	(0.14)
Δ Unemployment rate	-0.62[a]	-0.62[a]	-0.65[a]	-0.36	-1.12[a]
	(0.18)	(0.18)	(0.21)	(0.23)	(0.14)
Δ Ln GDP per capita	-0.37[a]	-0.36[a]	-0.37[a]	-0.26[c]	-0.59[a]
	(0.10)	(0.10)	(0.11)	(0.13)	(0.16)
Δ Ln trade openness	-0.22[a]	-0.22[a]	-0.22[a]	-0.21[a]	-0.26[a]
	(0.03)	(0.03)	(0.03)	(0.05)	(0.07)
Δ Ln(1+NWLC tax rate)	0.30[b]	0.50	0.28[c]	0.46[b]	-0.20
	(0.15)	(0.38)	(0.15)	(0.18)	(0.30)
Period-average Coordination x Δ ln(1+NWLC tax rate)			-0.30		
			(0.22)		
Constant	-0.02[a]	0.02[a]	-0.00	-0.00	-0.02
	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)
Observations	285	284	285	163	122
R-squared	0.98	0.98	0.98	0.98	0.98
Heteroscedasticity test *p*-value	0.61	0.75	0.64	0.96	0.28
Autocorrelation test AR(1) *p*-value	0.70	0.61	0.78	0.34	0.71
Autocorrelation test AR(2) *p*-value	0.81	0.93	0.81	0.32	0.49
Cragg-Donald Wald *F* statistic	-	23.61	-	-	-
Overidentification test *p*-value	-	0.36	-	-	-
Exogeneity test *p*-value	-	0.55	-	-	-

Notes: [a], [b], [c]denotes respectively significance at the 1, 5 and 10% level. Standard errors are in parentheses. Bootstrap standard errors in column (3). NWLC: Non-Wage Labour Costs. Price wedge: Ln(CPI) − Ln(PPI). Unreported time dummies are included.

of bargaining coordination (BC) created by OECD (2004) and provided in Nickell (2006). This index, ranging from 1 to 5, is increasing in the degree of coordination in the wage bargaining process.[13] As can be seen in figure 4, bargaining operates in very different ways across OECD countries.

Figure 4: Bargaining Coordination



Notes: Values of the bargaining coordination index have been averaged over the sample period.
Source: OECD (2004) and Nickell (2006).

Given the ordinal nature[14] of the index of bargaining coordination variable, we follow Terza (1987)'s approach[15] and replace its initial values, averaged over the sample period 1980-2000, by the conditional mean[16] of the continuous latent variable underlying the observed ranking. The transformed index is then

[13] As defined by OECD (2004), the value 'BC 1' corresponds to a fragmented company/plant bargaining, with little or no coordination by upper-level associates. The value 'BC 2' corresponds to a fragmented industry and company level bargaining, with little or no pattern-setting. The value 'BC 3' is for industry level bargaining with irregular pattern-setting and moderate coordination among major bargaining actors. The value 'BC 4' includes four close patterns: (a) Informal coordination of industry and firm-level bargaining by peak associations; (b) Coordinated bargaining by peak confederations, including government-sponsored negotiations or government imposition of wage schedules; (c) Regular pattern-setting coupled with high union concentration and/or bargaining coordination by large firms; (d) Government wage arbitration. Finally, the value 'BC 5', absent in our sample, corresponds to both: (a) Informal coordination of industry-level bargaining by an encompassing union confederation; (b) Coordinated bargaining by peak confederations or government imposition of a wage schedule/freeze, with a peace obligation.

[14] Values of an ordinal variable reflect a ranking but have no quantitative meaning, in the sense that the original difference between two successive categories cannot be treated as equivalent to the change between two other successive categories.

[15] Terza (1987)'s monte-carlo simulations show that using the conditional mean approach leads to considerable gains in terms of bias and efficiency relative to including a dummy for each category.

[16] Assuming that the latent variable follows a standard normal distribution and that the observed ordinal variable $x = j$ if $\alpha_{j-1} < x^* \leq \alpha_j$ (j=1, ..., J) where $\alpha_0 = -\infty$ and $\alpha_J = \infty$, the conditional mean of the latent variable x^* can be calculated as $E[x^*|x = j] = \frac{\phi(\alpha_{j-1}) - \phi(\alpha_j)}{\Phi(\alpha_j) - \Phi(\alpha_{j-1})}$, where $\phi(.)$ denotes the pdf and $\Phi(.)$ the cdf of the standard normal

interacted with the variable NWLC tax rate, in order to capture the structural impact of this labour market institution on real wage resistance in column (3).[17] Following Brambor et al. (2006), we calculate the elasticity of labour costs with respect to the NWLC tax rate for different values of the transformed bargaining coordination index and present the findings in Figure 5. The central line indicates how this elasticity changes with the degree of wage bargaining coordination, and the upper and lower dashed lines correspond to the bounds of a 95% confidence interval. In line with Daveri and Tabellini (2000), the impact of a rise of the NWLC tax rate on labour costs decreases with bargaining coordination. For instance, we cannot reject the absence of a statistically significant impact[18] in countries operating under high bargaining coordination (BC4) such as Norway, Denmark or Germany. At the sample mean, gross wages would fall by about 0.77% following a 1 percentage point rise in the NWLC tax rate. Conversely, in countries with low degree of bargaining coordination, such as Canada, the U.S. and the U.K. (BC1), gross wages would decrease by about 0.25%.[19] In columns (3') and (3"), we provide another way of identifying the moderating influence of bargaining coordination by dividing the countries in two groups: low/medium (LMBC [BC1,BC3], 8 countries) and high bargaining coordination (HBC [BC4], six countries). It can be seen that a rise of the NWLC tax rate on labour costs has a statistically significant and positive impact on labour costs only in LMBC countries, which is consistent with our previous findings. In this group of countries, at the sample mean, gross wages would fall by about 0.42% following a 1 percentage point rise in the NWLC tax rate, leading to a 55/45 % split of the tax burden between workers and employers.

4.2 Long-Run Effects

Estimates of the long-run coefficients are given in table 3. It can be seen in column (4) that estimation of the dynamic model with the bias-corrected fixed effects estimator generates results which seem implausible. We would expect to find that, in the long run, there is a quasi one for one relationship between productivity and compensation. In addition, the coefficient of the tax variable is outside the [0,1]

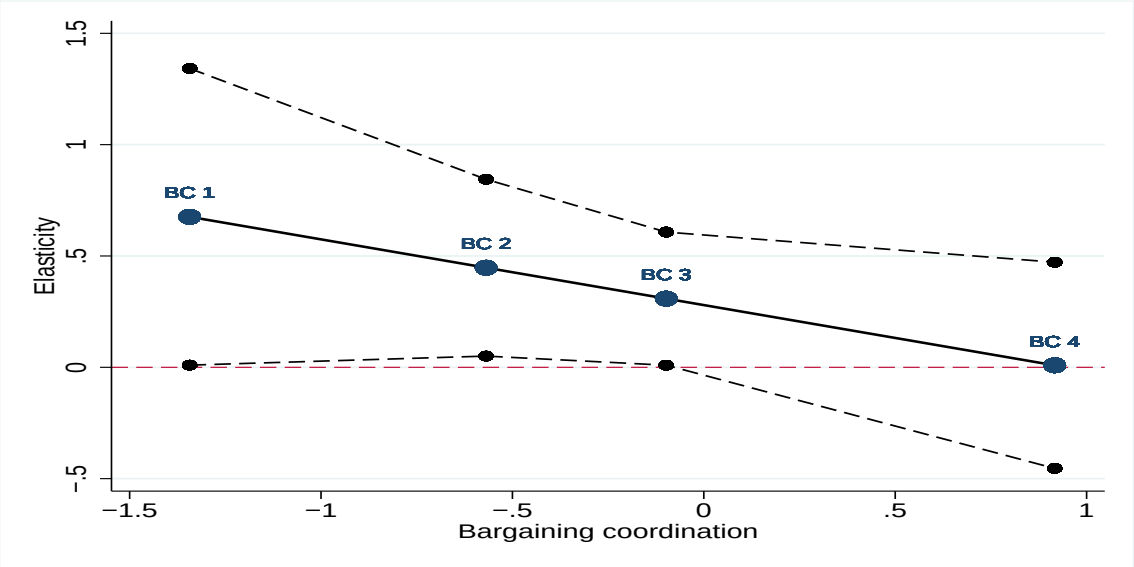
distribution. An estimator of the threshold parameters is $\Phi^{-1}(p_j)$ for *j*=1, ..., *J*-1, where p_j is the proportion of observations for which $x \leq j$.

[17] We estimate the standard errors using a wild cluster bootstrap procedure (Cameron et al., 2008) in order to obtain standard errors which have been corrected for the presence of a generated regressor. 1000 bootstrap replications have been used.

[18] The effect is statistically significant at the 5% level when both upper and lower dashed lines are above the zero dashed line. This is the case for the effect evaluated at (the transformed) bargaining coordination values BC1, BC2 and BC3.

[19] In unreported regressions, we also investigated whether the existence of a minimum wage floor could affect the incidence of a rise in the implicit NWLC tax rate (see Gruber (1997)) by interacting our tax variable with a country-specific 'national minimum wage' dummy. The interaction term was highly statistically insignificant, suggesting that minimum wages in OECD countries were too low to hinder the adjustment of wages in the manufacturing sector. Indeed, in 2005, according to the OECD statistics reported in Boeri and van Ours (2008), the minimum wage was no greater than 41% of the wage of the average production worker in the countries of our sample which have a minimum wage and for which data are available.

Figure 5: Impact of the NWLC tax rate on labour costs depending on the degree of bargaining coordination



Notes: Dashed lines correspond to the upper and lower bounds of a 95% confidence interval.
BC: Bargaining coordination. BC1 to BC4: corresponding values of the original bargaining index.

interval and most variables are highly statistically insignificant. These results suggest that slope heterogeneity bias may be a serious concern (Pesaran and Smith, 1995). The previous section put forward that one source of parameter heterogeneity is the variability of bargaining coordination across countries. We therefore include in column (4') an interaction term between the variable NWLC tax rate and the transformed index of bargaining coordination. The coefficient of the tax variable remains implausible as it would range from -3.81 to 4.82, depending on the degree of bargaining coordination. On the other hand, estimates of the PMG parameters appear much more reasonable (columns (5) and (5)'). The sample has been split between LMBC and HBC countries in order not to violate the assumption of long-run parameter homogeneity. As in the short run, rising NWLC are associated with rising labour costs in LMBC countries, whereas we cannot reject the absence of effect in HBC countries. We finally report in column (6) the estimates using the MG estimator, which places no constraints on country-specific values of coefficients in the short and long run. As expected, the estimates are very imprecisely determined. However, the implied elasticity of labour costs with respect to wages ($\frac{-1.10}{8} \simeq -0.13\%$, at the sample mean) suggests that estimates are not heavily biased, since this elasticity is very close to the 'wage curve' value of -0.1.[20] Furthermore, value of the coefficient on the variable NWLC tax rate is consistent with

[20]The wage curve, which has been described as an 'empirical law of economics' (Blanchflower and Oswald, 1995; Card, 1995), makes reference to the frequently observed negative relationship between wages and unemployment rates across coun-

the PMG estimates, as it is fairly close to the weighted average of the PMG estimates reported in columns (5) and (5)' ($\frac{8*0.88+6*0.07}{14} \simeq 0.53$). Grouping the countries in two groups appears to have been sufficient to deal with the slope heterogeneity issue.

The long-run effect of an increase in the NWLC tax rate may seem to be stronger than the short-run effect in LMBC countries as, taking the results at face value, a 1 percentage point increase in the NWLC tax rate would lead in the long run to a fall in gross wages of about 0.10% and a rise in labour costs of 0.68%, i.e. a hard to believe 10/90% split. However, this effect corresponds to the impact on an increase in the NWLC tax rate, holding other factors fixed. This *ceteris paribus* condition is very unlikely to hold in the long run as the rise in unemployment generated by rising labour costs in LMBC countries should lead to a weakening of workers' bargaining power and eventually a fall in wages. The permanently negative sign of the unemployment rate variable across regressions supports this textbook sequence of events. Hence, a more realistic long-run effect needs to take into account both the direct and indirect effects of rising NWLC. According to the findings of Daveri and Tabellini (2000) and Nickell et al. (2005), a 1 percentage point rise in labour taxes is likely to increase the unemployment rate by about 0.25 percentage points in LMBC countries. According to the estimates reported in column (5), the total long-run effect is then $0.88 - (2.36 * 0.25 * 0.78) \simeq 0.42$, which is very close to the short-run 55/45% split previously found.

Another way of illustrating this overall effect consists of omitting the unemployment rate variable in the model estimated, allowing the coefficient on the NWLC tax rate variable to pick up any NWLC tax-related unemployment effects. In that way, we avoid 'over controlling' for the long-run determinants of labour costs (see Wooldridge (2009), pp. 203-205). Column (7) reports the MG estimates.[21] The coefficient on the NWLC tax rate is now much smaller, illustrating that a rise in NWLC leads to a higher unemployment rate in the long run and that the overall effect is once again about one-half of that obtained under the assumption that the unemployment rate is fixed.

Using a similar approach, we reran regressions (3) and (3') without the unemployment rate variable, in order to check whether our short-run effects also needs to include an indirect 'unemployment effect'. Omitting the unemployment rate variable barely affect the coefficient value (0.43^b vs. 0.45^b and -0.02 vs. -0.20). The unemployment rate does not seem to be influenced by a rise in the implicit NWLC tax

tries. The unemployment elasticity of wages has been found to be close to -0.1 in most countries.

[21] We did not adopt this approach using the PMG estimator, as it appeared to yield unrealistic values of the coefficient on the NWLC tax rate variable. It is possible that the 'back-substitution' algorithm used by the PMG estimator (see Pesaran et al. (1999)), which makes use of an initial estimate of the long-run coefficients, is strongly sensitive to the omission of a long-run key variable such as the unemployment rate.

Table 3: Long run effects of the implicit NWLC tax rate on labour costs in the manufacturing sector

	Ln Compensation					
			Bargaining Coordination			
			Low/Medium	High		
	(4) LSDVC	(4') LSDVC	(5) PMG	(5') PMG	(6) MG	(7) MG
Ln labour productivity	0.87[a]	0.96[a]	1.11[a]	1.01[a]	1.21[a]	1.14[a]
	(0.26)	(0.17)	(0.03)	(0.03)	(0.20)	(0.15)
Price wedge	0.57	0.58	-0.17	1.10[a]	0.21	0.08
	(1.03)	(0.75)	(0.16)	(0.17)	(0.68)	(0.85)
Unemployment rate	-0.50	-0.40	-2.36[a]	-0.62[b]	-1.10[b]	
	(1.95)	(1.24)	(0.46)	(0.31)	(0.54)	
Ln GDP per capita	0.11	0.07	0.01	-0.64[a]	-0.37	-0.02
	(1.07)	(0.73)	(0.14)	(0.07)	(0.23)	(0.26)
Ln trade openness	-0.25	-0.14	-0.14[b]	0.37[a]	-0.17	-0.17
	(0.44)	(0.30)	(0.07)	(0.11)	(0.16)	(0.19)
Ln(1+NWLC tax rate)	-0.35	-0.32	0.88[a]	-0.24	0.61	0.27
	(1.90)	(1.23)	(0.34)	(0.24)	(0.75)	(0.81)
Period-average Coordination x Δ ln(1+NWLC tax rate)		-3.84				
		(4.18)				
Observations	285	285	163	122	285	285

Notes: [a], [b], [c]denotes respectively significance at the 1, 5 and 10% level. Standard errors are in parentheses. LSDVC: bias-Corrected Least-Squares Dummy Variable estimator. The Anderson-Hsiao estimator is the consistent estimator chosen to initialise the bias correction procedure. Accuracy of the approximation: $O(1/NT)$. Bootstrap standard errors using 1000 replications. PMG: Pooled Mean Group estimator. MG: Mean Group estimator. NWLC: Employer's Social Security Contributions. Price wedge: Ln(CPI) − Ln(PPI). Unreported time dummies are included in columns (4) and (4').

rate in the short run.

Overall, our results suggest that real wage resistance occurs even in the long run, but only in countries that operate under a non highly-coordinated bargaining regime. For those countries, the relative similarity of short-run and long-run effects, and the key role played by unemployment in the long run, suggest that firms are able to maintain in the long run the partial shift to workers of a greater NWLC burden that took place in the short run, thanks to the negative impact that the NWLC tax-related rise in unemployment exerts on bargained wages.

5 Conclusion

In this paper we estimate the short-run and long-run effects of a change in non-wage labour costs (NWLC) on real manufacturing labour costs in OECD countries. We find that about 55% of an increase in NWLC is shifted to workers in the long run in countries where wage bargaining is not highly coordinated. In those countries, given that labour costs increase, as employers bear 45% of the higher tax burden, greater NWLC can lead to a higher equilibrium rate of unemployment. On the other hand, in countries operating under a highly coordinated regime, an increase in NWLC appears to be immediately and entirely shifted to workers, leaving employment unaffected. Our results add support to previous evidence that the wage bargaining regime plays a key mediating role in the influence that the tax wedge exerts on unemployment in OECD countries.

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