

## ORIGINAL ARTICLE

# How collective bargaining shapes poverty: New evidence for developed countries

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Email: [kevin.pineda.hernandez@ulb.be](mailto:kevin.pineda.hernandez@ulb.be)**Abstract**

Although many studies point to the significant influence of collective bargaining (CB) institutions on earnings inequalities, evidence on how these institutions shape poverty rates across developed economies remains surprisingly scarce. This paper explicitly addresses the relationship between CB systems and working-age poverty rates *before* and *after* taxes and transfers in 24 developed countries over the period 1990–2015. Our results show that countries with a more centralized CB system, a more extended bargaining coverage rate and/or a higher trade union density display significantly lower poverty rates. However, these results only hold in a post-tax benefit scenario. Controlling for country and time fixed effects and a wide range of covariates, our estimates indeed suggest that the poverty-reducing effect of CB institutions stems from the political strength of trade unions in promoting public social spending rather than from any direct effect on earnings inequalities. Sensitivity tests for endogeneity and overlapping samples support this conclusion.

## 1 | INTRODUCTION

How do collective bargaining (CB) systems affect inequality and poverty in developed countries? The answer to this question is still largely uncertain and much debated. Some scholars argue that the upward trend in inequality and poverty observed since the 1980s is mainly due to skill- and task-biased technical change, globalization and specific economic reforms, leaving a marginal

role for trade unions and CB (Blank et al., 2007; DiNardo & Lee, 2004; Moller et al., 2009). However, other studies come to quite a different conclusion and attribute a more central role to the characteristics of collective relations (Brady, 2009; Eichhorst & Marx, 2015; Kristal, 2010; OECD, 2018; Piketty et al., 2014). It should be noted, however, that although the impact of CB systems on wage inequalities has been widely studied, surprisingly few studies have explicitly focused on the impact of CB systems on poverty rates.

There is a widespread view that centralized and coordinated CB systems are associated with less wage dispersion and greater job security. This idea is often justified by the fact that, in countries with such bargaining systems, workers can increase their bargaining power by grouping together within companies and/or sectors, and social partners can achieve a higher degree of synchronization thanks to defined strategies and objectives (Berg, 2015; Bosch, 2015; Hayter, 2011; OECD, 2017; Visser, 2016). Furthermore, it is argued that these systems reduce earnings disparities by compressing the wage structure of workers covered by collective agreements and by raising the earnings of low-paid workers, for example through higher minimum wages (Garnero et al., 2015; Teulings & Hartog, 1998; Wallerstein, 1999). Many empirical studies corroborate these premises (Antonczyk et al., 2010; Busemeyer & Iversen, 2012; Domínguez & Gutiérrez, 2020; Garnero, 2021; Golden & Londregan, 2006; OECD, 2018).

Another strand of the literature suggests that even though greater bargaining coverage may increase the earnings of the population covered by the agreements, a so-called 'excess' coverage (relative to union density) may also increase unemployment, thus leading to greater inequality (Aidt & Tzannatos, 2008; Bouis et al., 2012; Chang & Hung, 2016; Jaumotte & Osorio, 2015).<sup>1</sup> The argument is that, in this setup, trade unions would limit employers' discretion in hiring and firing decisions and fail to internalize the macro-economic effects of their decisions. In other words, unions would be strong enough to reinforce employment protection and secure wage increases, but not sufficiently encompassing to ensure that these gains do not come at the expense of overall employment levels.<sup>2</sup> In the same vein, the insider–outsider theory argues that CB can produce greater inequalities by exclusively addressing the interests of the employed (i.e. by raising minimum wages or granting wage increases for specific job titles and sectors), thus hindering access to the labour market for outsiders (i.e. the unemployed) and decreasing total employment in equilibrium (Bertola, 1999; Lindbeck & Snower, 2001). Some empirical papers do support these predictions, but other studies provide a more nuanced view by highlighting the positive role of bargaining coordination in overall employment performance (Boeri & van Ours, 2021; Bouis et al., 2012; Devicienti et al., 2019; Jaumotte & Osorio, 2015; Laroche et al., 2019; OECD, 2018).

Overall, many empirical studies point to a significant influence of CB institutions on earnings inequalities in developed countries (Garnero, 2021; OECD, 2018). However, these studies alone are insufficient to draw clear conclusions about the potential effects of these institutions on poverty rates. There are several reasons for this. First, in terms of measurement, the relationship between earnings inequalities and poverty is not straightforward (Marx, 2018; McKnight et al., 2016). Indeed, while (gross and net) earnings inequalities are measured at the individual level and always refer to those in employment, poverty rates (*before* and *after* taxes and transfers) are calculated at the household level on the basis of equivalized (market and disposable) incomes and usually also refer to other groups of the population, such as the unemployed or inactive.<sup>3</sup> Moreover, *after* taxes and transfers, many low-paid workers are actually not recorded as poor. This is because the incomes of other household members, family composition, net social transfers and other income sources are also taken into account in the calculations of equivalized disposable incomes (Marx & Nolan, 2012; Salverda, 2016).

Second, CB institutions, and in particular unions, can affect poverty rates through mechanisms other than those by which they influence wage inequality (i.e. mechanisms for setting wages and working conditions). Indeed, the evidence suggests that unions, when they represent a large share of the workforce and bargain at the sectoral or national level, tend to exhibit sufficient political strength to influence the level of public social spending (Ahlquist, 2017; Brady et al., 2016; Crouch, 2017; Engler & Voigt, 2022; Pontusson, 2013). In other words, the relationship between CB and poverty may also stem from the influence of unions on the size of the welfare state, particularly in countries with extensive bargaining coverage. As an example, Belgium, with its predominantly centralized CB system, features an elaborate national network of consultation structures and social dialogue platforms (e.g. the National Labour Council, the Central Economic Council and the European Semester), which allows trade unions to be deeply involved in all governing bodies in charge of workers' protection and welfare (i.e. social security institutions) (Eurofound, 2021; Faniel, 2018; Peña-Casas & Ghailani, 2019).<sup>4</sup> Similar legal frameworks and mechanisms linking the level of bargaining to strong union involvement in social security (e.g. unemployment, sickness and injury benefits, parental leave and retirement) are notably found in Denmark, Finland, Iceland, Sweden and Switzerland (Afonso, 2013; Aðalsteinsson & Guðlaugsson, 2019; Van Rie et al., 2011). Furthermore, a less developed literature highlights the potential role of employers' associations in the relationship between CB systems and social expenditure (Demougin et al., 2019; Fanfani et al., 2021; Martins, 2020). The argument is that employers' associations (which tend to be dominated by the most productive/performing firms) have more power, and hence are more influential political actors, in more centralized CB environments. Moreover, in such environments, employers' associations may also be in favour of higher social expenditure insofar as they provide a means of publicly financing costly fringe benefits (e.g. health insurance, family support, disability benefits, pension schemes, etc.) that would otherwise be funded by employers (particularly the most productive/performing ones) on an individual basis for their workers.

Needless to say, the role of CB, and in particular unions, in shaping public social spending can only be tested by focusing on poverty rates *after* taxes and transfers. Overall, while the influence of CB on earnings inequalities can be ascribed to wage-setting dispositions directly (as highlighted by a large strand of the literature, see, e.g. Garnero, 2021), the link to poverty is likely to be only indirect and mediated by the abovementioned mechanisms. The interplay between CB systems, trade unions and poverty is, therefore, not straightforward and requires careful attention.

To our knowledge, the link between CB systems and poverty rates has been studied in only six empirical papers so far: four papers adopting a cross-country perspective and two papers focusing on the United States (Brady, 2003; Brady, 2009; Brady et al., 2013; Lohmann, 2009; Plasman & Rycx, 2001; VanHeuvelen & Brady, 2022). These empirical studies suggest that CB is a crucial determinant of poverty reduction because of its positive role in encouraging government social spending, particularly on social security, in a post-tax benefit scenario. However, caution is required as almost all studies on the relationship between CB and poverty focus on rather old, unbalanced data over short periods.<sup>5</sup> Furthermore, to our knowledge, no cross-country study has so far accurately controlled for country fixed effects and endogeneity problems. Therefore, our study contributes to this literature by providing new empirical evidence on how CB systems shape poverty among the working-age population, using macro-level panel data for 24 developed countries over the period 1990–2015 and relying on more robust estimation techniques.<sup>6</sup> Since the main components of CB systems (namely, bargaining coverage, bargaining centralization, wage-setting coordination and trade union density) tend to be relatively stable over time within countries, we first investigate the long-run relationship between these components and the four following outcomes: the incidence of low pay, working-age poverty rates *before* and *after* taxes and transfers, and

the level of public social spending. To do so, we use a pooled OLS estimator with time fixed effects and relevant covariates (e.g. demographics, labour market characteristics and macro-economic performance indicators). Second, for CB components with sufficient variability within countries over time (i.e. a relevant signal-to-noise ratio; Swann, 2006), we use a two-way fixed effects (2FE) estimator in order to control for country-level unobserved heterogeneity and common time shocks among countries (i.e. a specification with country and time fixed effects in addition to previously mentioned covariates). Finally, two-way fixed effects two-stage least squares (2FE-2SLS) regressions, along with a bootstrap technique, and estimations in overlapping samples are implemented as sensitivity analyses to deal with endogeneity issues and potential sample composition effects, respectively.

The remainder of this paper is organized as follows. The next section provides a brief review of the literature on the relationship between CB systems and poverty, which further supports the motivation and contribution of our analysis. Section 3 presents our dataset and descriptive statistics. Our empirical strategy and the results of our econometric investigation are shown and discussed in Section 4. The last section concludes.

## 2 | MOTIVATION AND LITERATURE REVIEW

In order to reduce overall poverty, one of the main goals of policymakers and stakeholders in developed countries is to prevent in-work poverty.<sup>7</sup> This is because most poor people are in wage-earning households and in-work poverty has risen sharply over the last decade, especially among the young, the low-skilled and those with an immigrant background (Brady et al., 2010; Peña-Casas et al., 2019). According to Eurofound (2017), in-work poverty is based on three core pillars: (1) family, (2) public welfare and (3) employment. A widespread idea among labour economists is that CB influences poverty, *before* taxes and transfers, primarily through the employment pillar, by providing wage coordination, training and job protection to workers at the bottom end of the wage distribution. In addition, through their influence on minimum wages, centralized and coordinated CB systems may not only compress overall wage inequality but also affect poverty rates *before* taxes and transfers by raising the market income of poor households (Garnero et al., 2015). However, higher minimum wages might not be sufficient to lift all vulnerable people out of poverty (Peña-Casas et al., 2019). Many households composed at least partly of unemployed and/or inactive adults will typically benefit less from increased minimum wages. Furthermore, several empirical studies find that raising the minimum wage leads to a large increase in the income of households in the middle of the income distribution but has a modest influence on the bottom quintile since relatively few workers earning a minimum wage live in poor households (Logue & Callan, 2016; Overstreet, 2021; Sabia & Burkhauser, 2010; Sabia, 2014). Nevertheless, turning to a post-tax benefit scenario, the relationship between CB and poverty can also occur through other underlying mechanisms.

The power resource theory (PRT) argues that collective actors are not only involved in the field of industrial relations where they negotiate better wages and employment conditions, but are also mobilized in policies aimed to strengthen the welfare state for the working class and the poor (Brady et al., 2016; Crouch, 2017; Korpi, 2006; Rudra, 2002). In addition, it is argued that trade unions transform members into more political citizens, who are thereby more strongly involved in strikes and protests, and more likely to vote for political parties that promise to implement redistributive policies (Ahlquist, 2017). In this respect, Faniel (2018) states that in most Western European countries, close alliances or political exchanges have been forged between trade unions

and party organizations. Trade unions have also been the main external stakeholders in bringing to the political agenda of European institutions the specificity and the urgency for policies to tackle the issue of the working poor (Peña-Casas et al., 2019). Finally, Swank (2020) also suggests that high levels of trade union density go hand in hand with the incorporation of many outsiders in labour movements, which pushes trade unions to pursue social and labour market policies that meet the needs of outsiders.

Moreover, it has been noted that workers turn to trade unions when they can no longer rely on their government for social security in the event of illness, unemployment or retirement (Ingleson, 2000). Lobbying for legislation that increases social benefits for workers and outsiders has thus become a crucial part of the trade unions' tasks (Sen, 2012). This would also apply (at least in part) to liberal regimes, such as the United States, that offer market-based solutions to social problems (Engeman, 2021).

In the same vein, the social-democratic corporatist model asserts that organized labour units tend to be actively involved in government decisions in order to promote benevolent policies (Janoski & Hicks, 1994). In this respect, Lane and Ersson (2004) state that the pressure to increase social spending on family, disability and unemployment benefits stems from the strength of social partners (i.e. employer organizations and labour representatives, usually trade unions) and their interaction with the states. The role of social partners in a country's welfare state can, therefore, be seen as a key underlying CB mechanism for poverty alleviation. As an illustration, Table 1 provides a general overview of social partners' involvement in the policy-making process of unemployment benefit schemes (a branch of the social security system) in the 24 developed countries covered by our study. We observe that in some European countries and South Korea, social partners are consulted or involved in bi/tripartite bodies or committees to discuss the design and development of unemployment benefit schemes (Eurofound, 2013; European Commission, 2016; Hwang, 2013).<sup>8</sup> In addition, trade unions are involved in the management and control of unemployment insurance (i.e. the so-called Ghent system) in Belgium, Denmark, Iceland, Finland, Sweden and Switzerland.<sup>9</sup> Where appropriate, trade unions are also responsible for collecting contributions to finance unemployment funds.

It should be noted, however, that the role of trade unions in social security systems has been under pressure in northern European countries since the early 2000s. Several governments have introduced institutional changes, such as cross-occupational or independent unemployment funds and higher fees to union-controlled unemployment funds. These actions have diminished the number of workers who affiliate with trade unions in pursuit of better social security benefits, which has consequently waned the influence of trade unions on government social affairs (Høgedahl & Kongshøj, 2017; Kjellberg & Ibsen, 2016). Nevertheless, the active participation of social partners in social security institutions remains, albeit to a lesser extent, an essential component of the European social market economy (Bryson et al., 2011; Schnabel, 2013).

In addition, it is interesting to observe that most countries where trade unions have a strong influence on social security institutions share commonalities in their CB systems. For example, all countries in which the Ghent system has been implemented are characterized by high coverage rates, typically between 80 per cent and 95 per cent (Visser, 2019). This observation is consistent with Pontusson's (2013) assertion that bargaining coverage is an adequate measure of union political strength. His analysis indeed suggests that changes in these two variables have been highly correlated within OECD countries since the 1990s. These variables should, therefore, not be considered in isolation from each other. Moreover, as Schnabel (2020) points out, it should be remembered that the coverage rate is also strongly correlated with the dominant bargaining level (i.e. centralization) in a country. As Table 2 shows, in our sample of 24 developed countries, most

TABLE 1 Social partners' involvement in unemployment benefit schemes

Policy-making process	Type of involvement	Countries
Involvement in policy designs or reforms	Consultation, elaboration and submission of shared proposals (bipartite social dialogue)	BEL, FIN <sup>a</sup> , FRA
	Systematic participation or advisory function in the decision-making process (tripartite social dialogue)	AUT, CHE <sup>b</sup> , DEU, ESP, ISL, NLD
	Information and consultation (tripartite social dialogue)	KOR, LUX, PRT
	Lobbying type role (participation without involvement)	IRL
	No institutional involvement and occasional consultation	DNK <sup>c</sup> , GBR, GRC, ITA, NOR, SWE
Involvement in administration	Direct involvement in setting general rules and managing the unemployment benefits system (i.e. Ghent system). Where applicable, collecting contributions for the funds	BEL <sup>d</sup> , CHE, DNK, FIN, ISL, SWE
	Only advisory or coordination functions and no specific role in the management of programmes	AUT, FRA, DEU, ESP, GRC, ITA, LUX, NLD, PRT,
	No institutional involvement	GBR, KOR, IRL, NOR
Other	No institutional involvement in any policy-making process (occasionally administrative and/or informational support to apply for and receive unemployment benefits)	AUS, CAN <sup>e</sup> , JAP, NZL, USA

<sup>a</sup>Systematic involvement in ad hoc tri/bipartite committees in Finland.

<sup>b</sup>Any reform of the Swiss unemployment insurance legislation requires an amendment to the constitution by a vote of a majority of the Swiss electors and the cantons.

<sup>c</sup>A reform of the Danish unemployment benefits regime took place in 2010, which has excluded social partners of policy designs or reforms.

<sup>d</sup>Belgium has a partial Ghent system, where trade unions continue to play a role despite the introduction of compulsory unemployment insurance.

<sup>e</sup>Canada abolished the Boards of Referees and Umpire System (tripartite decision-making) in 2013 and replaced it with a Social Security Tribunal, which does not have to transmit information to or consult social partners.

Source: Afonso, 2013; Aðalsteinsson and Guðlaugsson, 2019; Eurofound, 2013; European Commission, 2016; Hertel-Fernandez, 2020; Hwang, 2013; Morris and Wilson, 2014; New Zealand Productivity Commission, 2020; OECD, 2017; Schaapman and van het Kaar, 2007; Van Rie et al., 2011; Wood, 2017.

countries with medium or high centralization of bargaining have a coverage rate above 67 per cent.

Ahlquist (2017) furthermore argues that trade unions' organizational attributes and involvement in the content of public policy depend on the institutional environment in which these labour representatives operate. On the one hand, if trade unions only bargain at the firm level (i.e. fully or largely decentralized CB), then each trade union, representing a limited and minor number of workers, would have difficulties not only in embedding the cost of its wage settlement for all workers but also in gathering with other counterparts across sectors to have a prevailing

**TABLE 2** The relationship between bargaining centralization and bargaining coverage in 2015

		Level of bargaining		
		Low centralization (levels 1 and 2)	Medium centralization (level 3)	High centralization (levels 4 and 5)
Bargaining coverage	0–33%	CAN, GBR, GRC, IRL <sup>a</sup> , JPN, KOR, NZL, USA		
	34–66%	AUS <sup>a</sup> , LUX <sup>a</sup>	CHE <sup>a</sup> , DEU	
	67–100%		AUT, DNK, ESP, FRA, ISL, ITA, NLD, PRT, SWE	BEL, FIN, NOR <sup>a</sup>

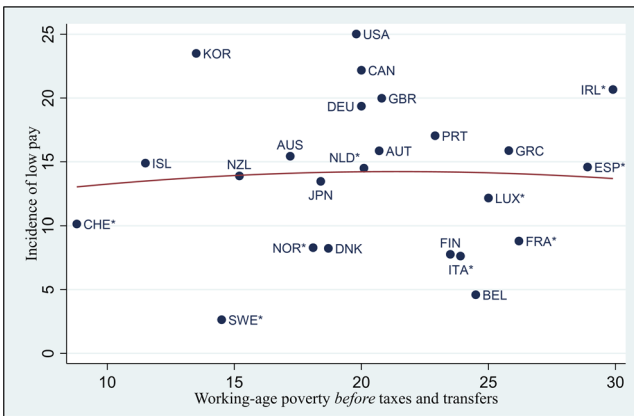
Note: The definitions of bargaining centralization and bargaining coverage are presented in Table 3.

<sup>a</sup>Bargaining coverage in 2015 was not calculated for Australia, Ireland, Luxembourg, Norway and Switzerland. The closest values are, therefore, used.

Source: OECD/AIAS ICTWSS database.

political voice. On the other hand, if trade unions are well-organized and negotiate at the sector or central level (i.e. organized decentralized or centralized CB), then all of them, representing a substantial share of the workforce, would obtain sufficient political strength to put pressure on the government's decisions regarding the protection and well-being of workers (i.e. labour market policies and social security expenditure). Furthermore, strong CB institutions allow for centralized consultation bodies and social dialogue committees, which are used by trade unions to be involved in governing institutions, especially those with social spending responsibilities (Faniel, 2018; Peña-Casas & Ghailani, 2019). In this respect, a series of articles highlights the existence of a significant and positive cross-national link between unionization rates and redistribution between 1970 and 2010, which is mainly driven by developed countries with predominantly centralized CB systems (e.g. Nordic countries and Belgium) (Bradley et al., 2003; Iversen & Soskice, 2006; Pontusson, 2013). Similarly, using a panel of 21 OECD countries between 1980 and 2013, Engler and Voigt (2022) show that unions have been effective promoters of their members' interests by influencing left-wing political parties to implement more generous labour market-related welfare state programs.

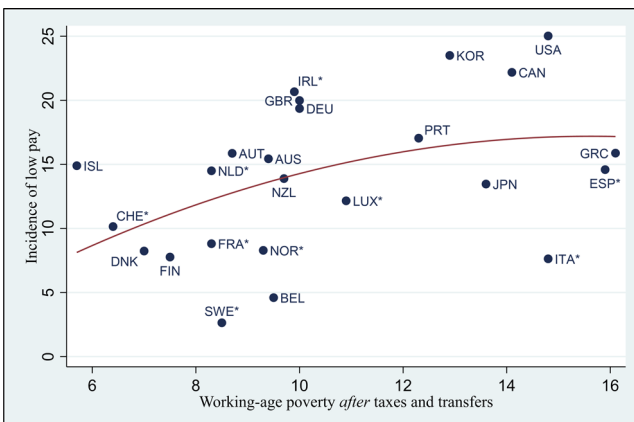
Despite the growing literature on the social consequences of industrial relation systems, the impact of CB systems on poverty rates has been largely overlooked by researchers. This is probably due to the widespread but misleading assumption of a straightforward relationship between earnings inequalities, especially at the bottom end of the distribution, and poverty rates (Marx, 2018; McKnight et al., 2016). First, it should be recalled that unlike gross or net earnings, which are measured at the individual level on an hourly or monthly basis, poverty is calculated annually on the basis of equalized household incomes. Second, while earnings inequalities are always measured on a sample of employed people, poverty rates usually also take into account other groups in the population (e.g. the unemployed and inactive). Third, it is worth noting that while the risk of poverty for low-wage earners is very high, especially for those who are the sole income earner in a household with or without children, low-wage earners are less likely to be considered poor when they live in multi-person households (Logue & Callan, 2016). This is because low-pay earners are spread across the entire household income distribution, and only a portion of them end up being poor. For instance, a young person earning a low wage may not be counted as poor because she lives with her parents who also have financial resources. However, household composition and labour market participation are not the only factors that delineate poverty from earnings inequalities. Indeed, in a post-tax benefit scenario, poverty rates also take into account



**FIGURE 1** Incidence of low pay and working-age poverty *before* taxes and transfers, 2015

[Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

*Notes:* The definitions of the incidence of low pay and working-age poverty *before* taxes and transfers are provided in Table 3. \* Observations in 2014 are used for the incidence of low pay. Source: OECD Social and Welfare Statistics, OECD Employment and Labour Market Statistics and Eurostat Earnings Statistics.



**FIGURE 2** Incidence of low pay and working-age poverty *after* taxes and transfers, 2015

[Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

*Notes:* The definitions of the incidence of low pay and working-age poverty *after* taxes and transfers are provided in Table 3. \* Observations in 2014 are used for the incidence of low pay. Source: OECD Social and Welfare Statistics, OECD Employment and Labour Market Statistics and Eurostat Earnings Statistic

net social transfers (e.g. unemployment and disability benefits, pensions, and family allowances) and incomes from other sources (e.g. real estate revenues) allowing a high share of low-wage workers to escape poverty (Marx & Nolan, 2012; Salverda, 2016)

To further highlight the difference between earnings inequalities and poverty indicators, Figure 1 shows the relationship between the incidence of low pay and working-age poverty *before* taxes and transfers in 2015 in the 24 developed countries covered by our study. As can be seen in Figure 1, the correlation is extremely weak ( $r = 0.02$ ), which illustrates that earnings inequality is a very imperfect proxy for the working-age poverty rate *before* taxes and transfers in developed countries. In contrast, Figure 2 shows a much stronger correlation ( $r = 0.42$ ) between the incidence of low pay and working-age poverty *after* taxes and transfers, reflecting the role of the welfare state in the interaction between these two indicators. Figure 2 also shows that the incidence of low pay is, on average, 3.5 percentage points higher than the working-age poverty rate in a post-tax benefit scenario.<sup>10</sup> As previously mentioned, this implies that many low-wage workers are in fact found in households with incomes above the poverty threshold (i.e. 50 per cent of national median equivalized disposable income). In other words, a significant proportion of those workers escape poverty when taking into account the incomes of other household members, family composition, taxation and social benefits. Therefore, although several empirical papers suggest that CB systems shape earnings inequalities and, in particular, the incidence of low pay, these papers are insufficient for a proper understanding of the impact of CB systems on poverty rates in developed countries.



To our knowledge, only six studies have provided an empirical analysis of the relationship between CB systems and poverty. Using a panel of 19 OECD countries for the years 1980, 1990 and 1994 ( $N = 43$ ) and relying on a pooled OLS estimator with time fixed effects, Plasman and Rycx (2001) point out that centralized bargaining, bargaining coverage and trade union density lower total and working-age poverty rates *after* taxes and transfers because of the positive influence these variables have on government social security spending.<sup>11,12</sup> Similarly, Brady (2003) and Brady (2009) find that bargaining centralization, wage-setting coordination and gross union density combine with the welfare state to alleviate state-mediated poverty and overall headcount poverty using panels of industrialized countries ( $N = 74$  between 1967 and 1997 in Brady [2003] and  $N = 104$  between 1969 and 2002 in Brady [2009]) as well as random effects (RE) estimators.<sup>13</sup> Moreover, Lohmann (2009) uses micro- and macro-data for 20 European countries in 2003 and 2004 and an RE logit estimator to show that bargaining centralization influences in-work poverty and the setup of the welfare state. Finally, two studies, conducted by Brady et al. (2013) and VanHeuvelen and Brady (2022), focus exclusively on the United States. Thanks to unbalanced micro-level panel data for the period 1991–2010 and a fixed effects (FE) logit estimator, Brady et al. (2013) find that unions reduce in-work poverty for both unionized and non-union households by increasing labour income and state transfers in the bottom half of the income distribution. In a complementary study, VanHeuvelen and Brady (2022) use individual-level panel data over the period 1976–2015, in combination with a three-way (person, year and state) FE estimator, to show that: (1) union membership and state union density are significantly and negatively related to relative and anchored in-work and working-age poverty;<sup>14</sup> (2) the interaction between union membership and union state density has an additional poverty-reducing effect; and (3) higher state union density has a spillover effect that reduces poverty among non-unionized households without being detrimental to their jobs.

To sum up, we can conclude that studies on the link between CB systems and poverty are scarce, even more so if we consider only those with a cross-country perspective, and that almost all of those studies focus on rather old, unbalanced data over short periods. Moreover, to our knowledge, no cross-country study has so far accurately controlled for country-level, time-invariant unobserved heterogeneity (i.e. country fixed effects) and potential endogeneity issues (which may result, *inter alia*, from reverse causality).<sup>15</sup> Against this background, our paper draws on data over the period 1990–2015 for 24 developed countries to provide new, more robust econometric evidence (controlling, *inter alia*, for country and year fixed effects and providing sensitivity tests for endogeneity and overlapping samples) on how the main characteristics of CB systems (e.g. bargaining coverage, trade union density, wage coordination and bargaining centralization) shape low pay incidence, working-age poverty rates and public social expenditure from a cross-country perspective.

### 3 | DATA AND DESCRIPTIVE STATISTICS

Our dataset contains macro-level information collected on a yearly basis for 24 developed countries over the period 1990–2015. The aggregated data used in this research come from the OECD, LIS, ILO, Eurostat and OECD/AIAS ICTWSS databases.<sup>16,17,18</sup> The precise definitions and sources of all dependent and explanatory variables used in this cross-country analysis are provided in Table 3, and the summary of descriptive statistics is reported in Table 4.

TABLE 3 Definitions of variables

Variable	Description
<b>Dependent variables</b>	
Incidence of low pay	The share of full-time workers earning less than two-thirds of the gross median earnings of all full-time workers (excluding apprentices). Source: OECD Employment and Labour Market Statistics and Eurostat Earnings Statistics.
Working-age poverty rate <i>before</i> taxes and transfers <sup>a</sup>	The ratio of the number of people among the working-age population whose household market income per equivalent household member falls below the poverty line, which is set at 50% of the median equivalized market income of the working-age population. Source: OECD Social and Welfare Statistics and LIS database.
Working-age poverty rate <i>after</i> taxes and transfers <sup>a</sup>	The ratio of the number of people among the working-age population whose household disposable income per equivalent household member falls below the poverty line, which is set at 50% of the median equivalized disposable income of the working-age population. Source: OECD Social and Welfare Statistics and LIS database.
Public social spending as a % of GDP	<p>Social expenditure comprises cash benefits, direct in-kind provision of goods and services, and tax breaks with social purposes. This aggregate is calculated as a percentage of gross domestic product and accounts for nine social branches:</p> <ul style="list-style-type: none"> <li>- Active labour market programmes: employment services, training, employment incentives, integration of the disabled, direct job creation and start-up incentives;</li> <li>- Family: child allowances and credits, childcare support, income support during leave and single-parent payments;</li> <li>- Health: spending on in- and out-patient care, medical goods and prevention;</li> <li>- Housing: housing allowances and rent subsidies;</li> <li>- Incapacity-related benefits: care services, disability benefits, benefits accruing from occupational injury and accident legislation and employee sickness payments;</li> <li>- Old age: early retirement pensions, home-help and residential services for the elderly;</li> <li>- Survivors: pensions and funeral payments;</li> <li>- Unemployment: unemployment compensation, early retirement for labour market reasons and;</li> <li>- Other social policy areas: non-categorical cash benefits to low-income households and/or other social services.</li> </ul> <p>Source: OECD Social and Welfare Statistics.</p>
<b>Components of collective bargaining</b>	
Bargaining centralization	<ul style="list-style-type: none"> <li>• Level 1: bargaining predominantly takes place at the local or company level;</li> <li>• Level 2: intermediate or alternating between sector and company bargaining;</li> <li>• Level 3: bargaining predominantly takes place at the sector or industry level;</li> <li>• Level 4: intermediate or alternating between central and industry bargaining, and;</li> <li>• Level 5: bargaining predominantly takes place at central or cross-industry level negotiated at lower levels.</li> </ul>

(Continues)

TABLE 3 (Continued)

Variable	Description
Wage coordination	<ul style="list-style-type: none"> <li>• Degree 1: fragmented wage bargaining, confined largely to individual firms or plants;</li> <li>• Degree 2: mixed industry and firm-level bargaining, weak government coordination through minimum wage setting or wage indexation;</li> <li>• Degree 3: negotiation guidelines based on centralized bargaining;</li> <li>• Degree 4: wage norms based on centralized bargaining by peak associations with or without government involvement, and;</li> <li>• Degree 5: maximum or minimum wage rates/increases based on centralized bargaining.</li> </ul>
Bargaining coverage	It represents the share of workers covered by valid collective agreements in force (i.e. percentage of people with the right to bargain). What counts as a valid collective agreement in force is defined by international and national legislations and, in some cases, tribunals.
Trade union density	It is the net union membership as a proportion of wage and salary earners in employment.

<sup>a</sup>Data on working-age poverty rates *before* and *after* taxes and transfers were downloaded from the OECD Social and Welfare Statistics. However, for some countries in the early 1990s, these data were supplemented with information from an archival source, Smeeding (1997), who relied on the LIS to make his calculations.

Source: OECD/AIAS ICTWSS database.

### 3.1 | Dependent variables

To explore the relationship between CB systems and poverty rates, and to examine how this relationship differs from that with wage inequality, we selected four indicators as dependent variables. The first indicator is the incidence of low pay. Table 4 shows that, on average, 15.7 per cent of workers earn less than two-thirds of the gross median earnings in our panel of developed countries.<sup>19</sup> The second indicator is the working-age poverty rate *before* taxes and transfers, which shows that 20.2 per cent of the working-age population in our panel of developed countries is, on average, considered poor when focusing on equivalized household market incomes.<sup>20</sup> The third indicator is the working-age poverty rate *after* taxes and transfers.<sup>21</sup> In a post-tax benefit scenario, only 9 per cent of the working-age population, on average, is still considered poor. The welfare state, which includes social protection spending, social security transfers and decommodification, is indeed an important and powerful driver of poverty reduction (Brady, 2009). Based on this observation and in order to better understand through which channel CB systems can shape poverty, our fourth dependent variable is the level of public social expenditure as a percentage of gross domestic product (GDP), which accounts for nine social branches: active labour market programmes (ALMP), family, health, housing, incapacity-related benefits, old age, survivors, unemployment and other social policy areas. This fourth dependent variable can be seen as a proxy for the welfare state of a country, as it mainly includes social expenditure for low-income households and vulnerable groups. On average, public social expenditure represents 20.5 per cent of GDP in our panel.

### 3.2 | Explanatory variables

To assess the heterogeneity of CB systems over time and across countries, we relied on the detailed classification of CB components included in the OECD/AIAS ICTWSS database. This

TABLE 4 Selected descriptive statistics, 1990–2015

		Mean	SD	Min	Max
<b>Dependent variables</b>					
Incidence of low pay		15.7	5.6	1.8	26.0
Working-age poverty rate					
<i>Before</i> taxes and public transfers		20.2	5.1	6.6	37.0
<i>After</i> taxes and public transfers		9.0	3.0	3.5	17.9
Public social spending as a % of GDP <sup>a</sup>		20.5	5.6	2.6	34.2
<b>Explanatory variables<sup>b</sup></b>					
Bargaining coverage		66.0	29.1	12.2	100.0
Trade union density		35.9	22.1	8.5	92.5
<b>Control variables</b>					
Demographics	Educational attainment	39.8	11.5	8.4	61.9
	Youth population	18.1	2.7	12.6	27.2
	Children in unemployed single-parent households	34.3	11.1	7.6	60.1
Labour market characteristics	Unemployment rate	7.2	4.1	1.5	27.5
	Inactivity rate	27.2	6.4	11.6	42.1
	Labour productivity growth	1.6	1.9	-5.8	14
Macro-economic performance	Output gap	-0.6	3.0	-15.5	9.7
	Inflation	2.5	2.3	-4.5	20.4
	Short-run interest rate	4.5	3.8	-0.8	18.3
	Terms of trade	7.4	6.0	-13	27.7

<sup>a</sup>The decomposition of public social spending by social branch as a percentage of GDP is provided in Appendix 3.

<sup>b</sup>The values of the categorical explanatory variables (in 1990 and 2015) used in our study are reported in Appendix 1. The definitions and sources of the control variables are presented in Appendix 2.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases.

classification makes it possible to identify the following four components of CB systems: (1) bargaining centralization, which is measured as the level of bargaining scored from 1 to 5, with 5 being predominantly high centralization; (2) wage coordination, which defines how wages are set and synchronized between the social partners, scored from 1 to 5, with 5 being predominantly high coordination; (3) bargaining coverage, which is the percentage of workers covered by collective agreements, reaching 66 per cent on average; and (4) union density, which is the proportion of unionized wage and salary earners in employment, standing at 35.9 per cent on average.<sup>22</sup>

Furthermore, to bring out more accurate estimates of the association between CB components and the four dependent variables, our database also includes a set of control variables that are consistent with those used in previous studies, namely demographics (i.e. educational attainment, the fraction of youth population and the share of children in unemployed single-parent households), labour market characteristics (i.e. the unemployment rate, the inactivity rate and the labour productivity growth) and macro-economic performance indicators (i.e. the output gap, inflation, the short-run interest rate and the terms of trade).<sup>23</sup> The intuition for the inclusion of these covariates in our model is as follows. Education is recognized as a tool for poverty reduction as it leads to the accumulation of human capital, which is associated with higher earnings (Tilak, 2002). The incidence of poverty varies throughout the life cycle, with childhood and jobless parenthood being

identified as the most vulnerable stages (Aassve et al., 2005). The risk of ending up living in a poor household is higher for the unemployed and inactive people (Martinez et al., 2001). Lower productivity often leads to lower earnings for workers, which potentially contributes to poverty (Vandenberg, 2004). Inflation can expand poverty if the increase of nominal wages is less than that of the price of goods and services consumed by workers (Cardoso, 1992). Finally, the output gap, the short-run interest rate and the terms of trade enable us to account for the influence of the business cycle.

## 4 | EMPIRICAL STRATEGY AND RESULTS

### 4.1 | Collective bargaining components and poverty

Since CB components generally show little variation over time within a country, we first estimated the long-run association between CB characteristics and our four dependent variables using a pooled OLS estimator with year fixed effects and robust standard errors clustered at the country level. This methodology allows us to focus on cross-country and historical variations while controlling for time shocks, heteroscedasticity and serial correlation in the error term. We also added a wide set of control variables (described at the end of Section 3). Our benchmark specification has thus been defined as follows:

$$Y_{c,t} = \beta_0 + \beta_1 CB\ components_{c,t} + \beta_2 X_{c,t} + \delta_t + \varepsilon_{c,t} \quad (1)$$

where  $Y_{c,t}$  represents either the incidence of low pay, working-age poverty *before* taxes and transfers, working-age poverty *after* taxes and transfers or public social spending as a percentage of GDP in country  $c$  at year  $t$ ;  $CB\ components_{c,t}$  are our main explanatory variables, namely the bargaining coverage, the trade union density, the degree of wage coordination and the level of bargaining centralization;  $X_{c,t}$  is a vector of control variables (see description in Section 3),  $\delta_t$  represents 25 time dummies and  $\varepsilon_{c,t}$  is the error term clustered at the country level.<sup>24,25</sup>

Table 5 first reports the results for the relationship between CB components and the incidence of low pay. Estimates show that the incidence of low pay is significantly lower in countries with a higher proportion of workers covered by collective agreements and/or affiliated with a trade union (see column 1). This finding is consistent with previous empirical results on the cross-country relationship between CB systems and wage compression at the lower end of the wage distribution (Busemeyer & Iversen, 2012; Garnero 2021; Garnero et al., 2015; Wallerstein, 1999).

However, it cannot be taken for granted that due to a lower incidence of low pay, countries with widespread bargaining coverage and/or strong trade unions also show lower poverty levels. Indeed, the relationship between CB and earnings inequalities may differ from the relation between CB and poverty for three main reasons: (1) differences of measurement because the incidence of low pay relies on gross median earnings on an hourly or monthly basis, while poverty rates are based on equivalized market or disposable household incomes on a yearly basis, (2) sampling differences, as earnings inequalities are always measured on a sample of employed people, while poverty is usually measured by including other groups of the population, such as the unemployed or inactive and (3) the role of CB (and in particular unions) in shaping poverty (after taxes and transfers) through the welfare state, which can only be observed in a post-taxes and transfers scenario, that is using equivalized disposable household incomes (see Section 2 for a detailed discussion). Column (2) supports the divergence in outcomes for earnings inequalities and poverty

TABLE 5 Pooled OLS estimator: collective bargaining components and poverty

<b>Dependent variable:</b>	<b>The incidence of low pay</b>	<b>Working-age poverty rate before taxes and transfers</b>	<b>Working-age poverty rate after taxes and transfers</b>	<b>Public social spending as a % of GDP</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Bargaining coverage	-0.127*** (0.026)	0.014 (0.023)	-0.049*** (0.015)	0.135*** (0.028)
Trade union density	-0.112*** (0.024)	0.002 (0.023)	-0.031** (0.013)	0.072** (0.030)
Wage coordination	-0.239 (0.667)	0.738 (0.588)	0.060 (0.283)	-0.293 (0.336)
Bargaining centralization	-0.236 (0.716)	-0.318 (0.501)	-0.112 (0.300)	-0.184 (0.454)
Estimator	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS
<b>Control variables<sup>a</sup></b>				
Demographics	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes
Year fixed effects <sup>b</sup>	Yes	Yes	Yes	Yes
Observations	371	487	505	624
Panel of countries	24 <sup>c</sup>	24	24	24
Adjusted R-squared	0.76	0.69	0.70	0.78

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Clustered standard errors at the country level are denoted in parentheses.

<sup>a</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>b</sup>25 year dummies.

<sup>c</sup>The following countries only show three available observations for the incidence of low pay: France, Norway and Sweden.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.

rates as none of the four components of CB is significantly correlated with working-age poverty before taxes and transfers. However, in a post-tax benefit scenario, we find that working-age poverty is significantly and negatively related to both the trade union density and bargaining coverage (see column (3)).

In previous studies, CB and trade unions have been associated with lower poverty rates because of their political role in the development of the welfare state (Brady, 2003; Brady, 2009; Brady et al., 2013; Lohmann, 2009; Plasman & Rycx, 2001; VanHeuvelen & Brady, 2022). Using public social spending, represented as a percentage of GDP, as a proxy for the welfare state, our estimates confirm and extend these earlier results. Specifically, our estimates, presented in column (4), show that public social spending is higher in countries with higher levels of unionization and bargaining coverage.

Since the bargaining coverage rate is highly correlated with the degree of bargaining centralization in our panel of countries ( $r = 0.73$ ) (see also Table 2), we also estimated two slightly

modified versions of Equation (1), each taking one of these CB components on board. Results, presented in Appendix 4, show that regressions coefficients associated with the bargaining coverage remain very similar to those presented in Table 5 when not controlling for bargaining centralization. Regarding coefficients for bargaining centralization, as expected, they are now significant and negative when focusing on the incidence of low pay and working-age poverty *after* taxes. Moreover, when examining public social spending, the association with bargaining centralization becomes significant and positive (as previously found between public social spending and bargaining coverage).

Overall, our estimates suggest that the political influence of trade unions on redistributive policies – and hence their capacity to shape poverty rates – depends positively on both the number of unionized workers and the CB coverage rate. Put differently, our results support the hypothesis that centralized bargaining regimes allow for better coordination of unions at the sectoral and national levels and thus create more opportunities and channels for unions to interact with policymakers and in particular to influence their decisions regarding the level of public social spending.

However, this first conclusion should be taken with caution because, despite the inclusion of a wide range of covariates and time fixed effects, our specifications may not fully capture time-invariant unobserved heterogeneity at the country level. This econometric limitation to the interpretation of our results is common to all studies that have so far examined the relationship between CB and poverty from a cross-country perspective.<sup>26</sup> Nevertheless, we will attempt to go a step further in the following subsection by explicitly taking these country fixed effects into account in order to obtain more robust estimates for CB components with a relevant within-country variation.

## 4.2 | Trade union density and poverty

To test for the presence of time-invariant, unobserved heterogeneity at the country level and to assess whether these country fixed effects are correlated with the regressors, we performed a Chow test and a Hausman test, respectively.<sup>27</sup> The results indicate that the null hypotheses of no country fixed effects and no correlation between these fixed effects and the regressors should both be rejected.<sup>28</sup> We, therefore, decided to opt for a two-way fixed effects estimator (2FE), that is to estimate the following mean-differentiated version of Equation (1) with time fixed effects ( $\delta_t$ ):

$$(Y_{c,t} - \bar{Y}_c) = \lambda_0 + \lambda_1 \left( CB\ components_{c,t} - \overline{CB\ components}_c \right) + \lambda_2 (X_{c,t} - \bar{X}_c) + \delta_t + (\varepsilon_{c,t} - \bar{\varepsilon}_c) \quad (2)$$

where  $\bar{Y}_c$ ,  $\overline{CB\ components}_c$ ,  $\bar{X}_c$  and  $\bar{\varepsilon}_c$  represent the average values of the dependent variable ( $Y$ ), the four components of CB ( $CB\ components$ ),<sup>29</sup> the control variables ( $X$ ) and the error term ( $\varepsilon$ ), respectively, in country  $c$  over all the years studied (i.e. from 1990 to 2015).<sup>30</sup>

Before continuing, it is worth reminding that a 2FE estimator cannot properly assess the effect of regressors that have little within-group variation (Wooldridge, 2010). As CB characteristics generally show little variation over time within countries, we conducted an analysis of variance (ANOVA) for the four components of CB under study to determine which components show sufficient within-country variation for meaningful use of the 2FE estimator. This analysis indicates that trade union density is the only CB component with an acceptable signal-to-noise ratio (i.e. the within-country variation is greater than the residual variation; Swann, 2006) and, therefore,

TABLE 6 Two-way fixed effects estimator: trade union density and poverty

<b>Dependent variable:</b>	<b>The incidence of low pay</b>	<b>Working-age poverty rate before taxes and transfers</b>	<b>Working-age poverty rate after taxes and transfers</b>	<b>Public social spending as a% of GDP</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Trade union density	-0.087** (0.044)	0.066*** (0.025)	-0.062*** (0.015)	0.096*** (0.019)
Estimator	2FE	2FE	2FE	2FE
Other collective bargaining components <sup>a</sup>	Yes	Yes	Yes	Yes
<b>Control variables<sup>b</sup></b>				
Demographics	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects <sup>c</sup>	Yes	Yes	Yes	Yes
Observations	371	487	505	624
Panel of countries	24 <sup>d</sup>	24	24	24
Within R-squared	0.21	0.57	0.68	0.76

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Within standard errors are reported in parentheses.

<sup>a</sup>Collective bargaining components showing little within country-variation (i.e. bargaining centralization, wage coordination and bargaining coverage) have been included as covariates. Corresponding regression coefficients are not reported in this table as their signal-to-noise ratio is too small to enable statistical inference.

<sup>b</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>c</sup>25 year dummies.

<sup>d</sup>The following countries only show three available observations for the incidence of low pay: France, Norway and Sweden.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.

the only CB component for which the use of the 2FE estimator is appropriate.<sup>31</sup> On the basis of these results, we, therefore, decided to estimate Equation (2), including all four components of CB (to avoid an omitted variable bias), but to exclusively focus on and interpret the regression coefficient associated with trade union density. As we saw, in Subsection 4.1, that trade union density appears to be a key variable (along with the bargaining coverage rate and the level of centralization) in explaining the long-run relationship between CB systems and working-age poverty (*after taxes and transfers*), we were thus able to extend our analysis further by testing the robustness of this significant finding with a 2FE estimator.

Our results on the relationship between trade union density and the four variables of interest, while controlling for country-level unobserved heterogeneity, common time shocks among countries and relevant covariates, are presented in Table 6. Our 2FE estimates first show that a 10 percentage point increase in union density is associated with a decrease in the incidence of low pay by 0.87 percentage points on average (see column (1)). Results further show (in column



(2)) that unionization rates are positively correlated with working-age poverty in a pre-tax benefit scenario. More precisely, a 10 percentage points increase in union density is associated with an increase in working-age poverty *before* taxes and transfers of 0.66 percentage points on average. This finding is probably related to the compression of the earnings distribution by trade unions (OECD, 2018), especially at the bottom end of the distribution. In other words, the point is that the lower incidence of low wages resulting from greater unionization (see column (1)) is likely to shift the poverty line upward, resulting in a greater proportion of people with an equivalized market income below this poverty threshold. A related argument is that trade unions, by raising wages above the competitive level, could have a negative impact on employment (Aidt & Tzannatos, 2008; Chang & Hung, 2016) and thus increase the pre-tax and transfer poverty rate. However, caution is needed as the relationship between trade union density and employment is, as Garnero (2021: 1) points out, 'more nuanced than previously suggested'.

Our results, in a post-tax and benefit scenario, are radically different. Indeed, the 2FE estimates presented in column (3) show that working-age poverty *after* taxes and transfers decreases on average by 0.62 percentage points when trade union density increases by 10 percentage points. The reversal of our findings *before* and *after* taxes and transfers is best understood by examining the estimation results presented in column (4). Indeed, they show that public social expenditure increases on average by 0.96 percentage points when trade union density increases by 10 percentage points.

So far, a positive relationship has been established between union density and the size of the welfare state. However, since our welfare state indicator is the sum of expenditures associated with nine social branches (Table 3), in order to obtain more precise results on the channels through which unions are able to influence the poverty rate of the working-age population *after* taxes and transfers, Equation (2) has been re-estimated using each type of social expenditure separately as a dependent variable. The corresponding 2FE estimates, presented in Table 7, show that unionization is significantly and positively associated with seven out of the nine social expenditure branches (i.e. ALMP, health, housing, incapacity-related benefits, survivors, unemployment and other social policy areas). On average, these seven categories account for 39.4 per cent of total public social spending and 8.1 per cent of GDP in the countries covered by our panel (see Appendix 3).

In Section 2, we documented the significant participation of unions in the policy-making process of social security systems, and even their involvement in the management of unemployment funds in some countries (i.e. the Ghent system). Our results back up these observations. More precisely, in line with earlier studies (Engler & Voigt, 2022; Jensen, 2012; Rueda, 2006), they provide empirical support for the existence of a positive relationship between union density and labour market-related welfare programs (i.e. ALMP, disability benefits and unemployment). Regarding other types of social expenditures (health, housing, survivors and other social policy areas), our results also suggest that unions play a significant role. This could notably be explained by unions' political strength in mobilizing workers to vote for political parties with a benevolent social agenda (Brady et al., 2016; Crouch, 2017; Korpi, 2006; Rudra, 2002; Sen, 2012).

The results presented so far, based on a 2FE estimator with a wide range of covariates, provide fairly consistent estimates of the relationship between union density, social spending and working-age poverty rates before and after taxes and transfers. However, caution is required as the quality of our estimates may still be affected by potential endogeneity issues and problems related to heterogeneous sample sizes. Therefore, in the next subsection, we provide two sensitivity analyses to test the robustness of our 2FE estimates.

TABLE 7 Two-way fixed effects estimator: trade union density and different components of public social spending

Dependent variable: public social spending as a % of GDP on	ALMP (1)	Family (2)	Health (3)	Housing (4)	Incapacity-related benefits (5)	Old age (6)	Survivors (7)	Unemployment (8)	Other social policy areas (9)
Trade union density	0.019*** (0.003)	-0.004 (0.009)	0.013** (0.005)	0.019*** (0.004)	0.005** (0.002)	-0.003 (0.010)	0.016*** (0.003)	0.024*** (0.004)	0.007*** (0.002)
Estimator	2FE	2FE	2FE	2FE	2FE	2FE	2FE	2FE	2FE
Other collective bargaining components <sup>a1</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables <sup>b</sup>									
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects <sup>c</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	624	624	624	624	589	624	624	618	624
Panel of countries	24	24	24	24	24	24	24	24	24
Within R-squared	0.33	0.58	0.24	0.54	0.32	0.66	0.50	0.64	0.26

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Within standard errors are reported in parentheses. The definitions of the nine social branches are presented in Table 3. The decomposition of public social spending by social branch as a percentage of GDP is provided in Appendix 3.

<sup>a</sup>Collective bargaining components showing little within country-variation (i.e. bargaining centralization, wage coordination and bargaining coverage) have been included as covariates. Corresponding regression coefficients are not reported in this table as their signal-to-noise ratio is too small to enable statistical inference.

<sup>b</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>c</sup>25 year dummies.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.

### 4.3 | Sensitivity analysis

Endogeneity may notably arise because of reverse causality, that is the fact that the incidence of low pay, working-age poverty rates and public social spending may themselves influence trade union density. To address this issue, we applied a 2FE-2SLS estimator. In order to find appropriate instruments, that is variables that are correlated with trade union density but not with our four dependent variables, we drew on existing studies. Following common practice (e.g. Piton & Rycx, 2019; Reed, 2015), our first instrument is simply the lagged value of trade union density. Our second instrument, inspired by Giuliano et al. (2013),<sup>32</sup> is the lagged value of average trade union density in neighbouring countries.<sup>33</sup> The assumption underlying the choice of our second instrument is that the average lagged level of trade union density in neighbouring countries is likely to have a significant impact on the contemporaneous value of trade union density in the country in question but not on its current level of low pay, working-age poverty and public social spending.

To assess the soundness of our 2FE-2SLS approach, we performed an array of diagnostic tests. The results of these tests are reported at the bottom of Table 8 (see also Appendix 5 for first-stage estimates). The Cragg–Donald–Wald  $F$  statistics suggest that our IVs are not weak, which is also supported by first-stage estimates.<sup>34</sup> As regards the Durbin–Wu–Hausman endogeneity test,<sup>35</sup> the  $p$ -values associated with the Chi-squared statistics are equal to 0.14, 0.88, 0.00 and 0.00 in columns (1) to (4), respectively. These results suggest that the null hypothesis of no endogeneity should be rejected in columns (3) and (4) but not in columns (1) and (2). In other words, they suggest that our main explanatory variable, that is trade union density, is not endogenous when looking at the impact on low pay incidence and working-age poverty *before* taxes and transfers. Consequently, 2FE estimates (reported in Table 6) should be preferred to those obtained by 2FE-2SLS in these cases.<sup>36</sup> Therefore, our findings remain unchanged from those discussed in the previous subsection, namely that the unionization rate is significantly and negatively (positively) correlated with the incidence of low-wage employment (the working-age poverty rate *before* taxes and transfers).

In contrast, the results of the Durbin–Wu–Hausman test indicate that trade union density is endogenous when using either working-age poverty *after* taxes and transfers or public social spending as the dependent variable. In these two cases, our instrumentation strategy is thus warranted, so that 2FE-2SLS estimates should be preferred to those obtained by 2FE. Concerning the quality of our instruments, we further find that the  $p$ -values associated with the Sargan–Hansen's  $J$  overidentification test are equal to 0.88 and 0.52, respectively, in the regressions using working-age poverty *after* taxes and transfers and social spending as dependent variables (see columns (3) and (4) of Table 8). This suggests that our instruments are valid. Regarding the regression coefficients themselves, they show that working-age poverty *after* taxes and transfers decreases on average by 0.49 percentage points when trade union density increases by 10 percentage points. The inversion of our results *before* and *after* taxes and transfers can again be understood by the relationship between unions and the welfare state. The 2FE-2SLS estimates, presented in column (4) of Table 8, suggest indeed that a 10 percentage point increase in union density is associated on average with a 0.77 percentage point increase in public social spending.

Overall, this first robustness test corroborates our benchmark estimates. However, 2FE-2SLS estimates should be interpreted with caution. Indeed, it remains very difficult to find valid instruments, namely variables that are both relevant (i.e. goods predictors of the trade union density) and exogenous (i.e. uncorrelated with the dependent variables). Accordingly, while 2FE-2SLS estimates presented in this subsection strongly support the existence of a significant influence of trade union density on social spending and working-age poverty *after* taxes and transfers, they should not be interpreted as causal.

TABLE 8 Sensitivity analysis: two-way fixed effects with instrumental variables

<b>Dependent variable:</b>	<b>The incidence of low pay</b>	<b>Working-age poverty rate before taxes and transfers</b>	<b>Working-age poverty rate after taxes and transfers</b>	<b>Public social spending as a % of GDP</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Trade union density	−0.077 (0.057)	0.051 (0.034)	−0.049** (0.020)	0.077*** (0.024)
Estimator	2FE-2SLS	2FE-2SLS	2FE-2SLS	2FE-2SLS
Other collective bargaining components <sup>a</sup>	Yes	Yes	Yes	Yes
<b>Control variables<sup>b</sup></b>				
Demographics	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects <sup>c</sup>	Yes	Yes	Yes	Yes
Observations	367	477	495	600
Panel of countries	24 <sup>d</sup>	24	24	24
Within R-squared	0.21	0.57	0.67	0.75
<b>Diagnosis tests</b>				
Weak identification test <sup>e</sup> : <i>Cragg–Donald–Wald F statistic</i>	1125.02	1667.38	1711.28	2391.29
Overidentification test <sup>f</sup> : <i>p-value of Sargan–Hansen J statistic</i>	0.00	0.00	0.88	0.52
Endogeneity test <sup>g</sup> : <i>p-value associated with Chi-squared statistic</i>	0.14	0.88	0.00	0.00

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Within standard errors, calculated by creating 1000 bootstrap samples, are reported in parentheses.

<sup>a</sup>Collective bargaining components showing little within country-variation (i.e. bargaining centralization, wage coordination and bargaining coverage) have been included as covariates. Corresponding regression coefficients are not reported in this table as their signal-to-noise ratio is too small to enable statistical inference.

<sup>b</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>c</sup>25 year dummies.

<sup>d</sup>The following countries only show three available observations for the incidence of low pay: France, Norway and Sweden.

<sup>e</sup>The Cragg–Donald–Wald *F*-statistic for weak identification is a Wald *F* statistic testing whether the excluded instruments are sufficiently correlated with the endogenous regressor. The null hypothesis is that the instruments are weak. According to the standard ‘rule of thumb’, weak identification is problematic for *F* statistics smaller than 10 (as suggested by van Ours and Stoeldraijer [2011]).

<sup>f</sup>The Sargan–Hansen *J* statistic tests the null hypothesis that the instruments are valid, that is uncorrelated with the error term. Under the null hypothesis, the instruments are considered to be valid.

<sup>g</sup>The Durbin–Wu–Hausman endogeneity test is based on the difference of two Sargan–Hansen statistics: one for the equation in which trade union density is treated as endogenous, and one in which it is treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary, that is union density can actually be considered as exogenous.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.

TABLE 9 Sensitivity analysis: two-way fixed effects with overlapping samples

	Working-age poverty rate <i>before</i> taxes and transfers	Working-age poverty rate <i>after</i> taxes and transfers	Public social spending as a % of GDP
Dependent variable:	(1)	(2)	(3)
Trade union density	0.066*** (0.025)	-0.061*** (0.015)	0.182*** (0.022)
Estimator	2FE	2FE	2FE
Other collective bargaining components <sup>a</sup>	Yes	Yes	Yes
<b>Control variables<sup>b</sup></b>			
Demographics	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Year fixed effects <sup>c</sup>	Yes	Yes	Yes
Observations	487	487	487
Panel of countries	24	24	24
Within R-squared	0.57	0.66	0.73

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Within standard errors are reported in parentheses.

<sup>a</sup>Collective bargaining components showing little within country-variation (i.e. bargaining centralization, wage coordination and bargaining coverage) have been included as covariates. Corresponding regression coefficients are not reported in this table as their signal-to-noise ratio is too small to enable statistical inference.

<sup>b</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>c</sup>25 year dummies.

Source: OECD, ILO, LIS and OECD/AIAS ICTWSS databases, 1990–2015.

Beyond endogeneity issues, sample size effects might also drive our 2FE estimates since the number of observations in our panel varies according to the dependent variable that is considered. In order to evaluate these sampling concerns, we re-estimated Equation (2) using a perfectly overlapping sample (i.e. the same sample for all regressions).<sup>37</sup> Table 9 presents corresponding 2FE estimates. The number of observations in our overlapping sample corresponds to the one we had so far when using as a dependent variable the working-age poverty rate before taxes and transfers. Accordingly, estimates in column (1) of Table 9 are the same as those reported in column (2) of Table 6. They thus show a significantly positive association between trade union density and poverty *before* taxes and transfers. As regards the relation between trade union density and poverty *after* taxes and transfers, we find very little difference with respect to our benchmark specification. Indeed, the coefficient of union density is statistically significant and equal to -0.061 (instead of -0.062 in column (3) of Table 6). Finally, concerning the nexus between trade union density and social expenditure, our robustness test also corroborates previous results. The regression coefficient associated with trade union density (see column (3) of Table 9) is still significantly positive and even bigger.<sup>38</sup>

Overall, estimates based on overlapping samples thus tend to back up our main conclusions. On the one hand, they do not support the hypothesis that trade unions reduce working-age poverty *before* taxes and transfers through a direct effect on the earnings distribution. On the other hand, they do suggest that higher trade union density leads to a lower working-age poverty rate *after* taxes and transfers and that this impact stems from the influence of unions on public social spending.

## 5 | CONCLUSION

Over the past four decades, inequality and poverty have soared throughout the developed world (Atkinson & Piketty, 2007; OECD, 2015; Piketty, 2013). At the same time, CB systems have undergone a continuous process of dismantling and weakening, particularly in English-speaking and Southern European countries (Dustmann et al., 2014; Gray, 2009; OECD, 2017; OECD, 2018; Payá Castiblanque, 2020; Visser, 2016). Although the influence of CB systems on wage inequality has been widely studied, to our knowledge, only six studies have examined the impact of these systems on poverty, and only four of these from a cross-country perspective (Brady, 2003; Brady, 2009; Brady et al., 2013; Lohmann, 2009; Plasman & Rycx, 2001; VanHeuvelen & Brady, 2022). Yet, it would be a mistake to believe that the relationship between CB systems and poverty necessarily matches the one estimated with wage inequality. Indeed, whereas wage inequality is measured at the individual level, poverty *before* (*after*) taxes and transfers is calculated at the household level using equivalized market (disposable) incomes (Marx, 2018; McKnight et al., 2016). In addition, CB systems can provide an institutional environment conducive to political action by trade unions and, in particular, to their influence on public social spending (Ahlquist, 2017; Engler & Voigt, 2022; Faniel, 2018; Peña-Casas & Ghailani, 2019; Pontusson, 2013) and, therefore, also on poverty rates *after* taxes and transfers.

Further research is, therefore, much needed to better understand the relationship between CB systems and poverty. This is especially true as all cross-national studies on this issue rely on rather old, often unbalanced datasets over short periods. Moreover, to our knowledge, no cross-national study has so far accurately controlled for country-level, time-invariant unobserved heterogeneity (i.e. country fixed effects) and potential endogeneity issues (which may notably result from reverse causality). Our paper, therefore, makes a significant contribution to this literature by drawing on macro-level data over the period 1990–2015 for 24 developed countries to provide new, more robust econometric evidence (controlling, *inter alia*, for country and year fixed effects and providing sensitivity tests for endogeneity and overlapping samples) on how the main characteristics of CB systems (e.g. bargaining coverage, trade union density, wage coordination and bargaining centralization) shape low pay incidence, working-age poverty rates and public social expenditure from a cross-country perspective.

Using a pooled OLS estimator with time fixed effects and a wide range of covariates, we first find that countries with a higher bargaining coverage (i.e. a more centralized bargaining system) or trade union density have a significantly lower incidence of low pay. Nonetheless, this wage compression effect is not mirrored in the bottom part of the market income household distribution. Indeed, none of the four CB components under investigation is found to be significantly and negatively correlated with working-age poverty *before* taxes and transfers. This result is consistent with studies showing that increases in the minimum wage (a key feature of CB systems in many countries) lead to little improvement in the incomes of the bottom quintile, since most low-wage workers are in households with incomes around the middle quintile (Logue & Callan,

2016; Overstreet, 2021; Sabia & Burkhauser, 2010; Sabia, 2014). It should be noted, however, that a pre-tax benefit scenario represents a 'simulation' (i.e. an artificial situation), as no one lives in such a world. Moreover, it is based on the strong assumption that the labour supply would not be responsive to taxes and transfers. In a post-tax benefit scenario, our results are quite different. Indeed, working-age poverty rates *after* taxes and transfers are found to be significantly lower in countries with a higher proportion of workers covered by collective agreements (i.e. a more centralized bargaining system) or affiliated with a trade union. These results are consistent with previous cross-country studies on this issue (Brady, 2003; Brady, 2009; Lohmann, 2009; Plasman & Rycx, 2001).

Next, turning to within-country variations (i.e. short-run dynamics), our 2FE estimates suggest that the negative cross-country relationship between CB components and poverty *after* taxes and transfers stems from the political strength of trade unions in promoting public social spending (e.g. active labour market policies, health, housing, incapacity-related benefits and unemployment) rather than from any direct effect on earnings inequalities. It should be noted that our analysis of the association between trade union density, working-age poverty rates and public social spending is econometrically robust to different sensitivity tests, such as 2FE-2SLS regressions and estimations using overlapping samples. Moreover, our 2FE estimates confirm earlier cross-country studies that empirically link trade unions to redistribution (Bradley et al., 2003; Iversen & Soskice, 2006; Plasman & Rycx, 2001; Pontusson, 2013; Swank, 2020).

From a theoretical perspective, our findings are in line with the power resource approach, which explains that unions are not only involved in negotiating better wages and working conditions but that they can also be driving political forces in the success of welfare states. In other words, they seem compatible with the argument that unions mobilize workers to vote for political parties that, in turn, implement redistributive policies and lobby for legislation that increases social benefits, especially for the working class and the poor (Brady et al., 2016; Crouch, 2017; Engeman, 2021; Korpi, 2006; Rudra, 2002; Sen, 2012). Our results are also consistent with the social-democratic corporatist model, which emphasizes union involvement in governance bodies (e.g. social security institutions) to promote social spending and redistributive policies (Afonso, 2013; Janoski & Hicks, 1994; Lane & Ersson, 2004). In this regard, it is worth noting that in order to demonstrate significant political power, unions appear to need a relatively centralized CB system (i.e. broad bargaining coverage) and/or to have a sufficiently large membership, which, in turn, allows the presence of a complex institutional environment with consultation systems and social dialogue bodies (Ahlquist, 2017; Faniel, 2018; Peña-Casas & Ghailani, 2019; Pontusson, 2013). Our results suggest indeed that these features of CB systems go hand in hand with an elaborate institutional and policy framework that strengthens social policies for groups most at risk of poverty.

To sum up, our study provides robust and up-to-date empirical evidence on the social impact of CB systems across 24 developed countries, highlighting the role of trade unions in reducing poverty among the working-age population through the welfare state (i.e. by pushing governments to spend more on social security) rather than through a direct effect on wage formation. These results appear consistent with the conclusion of Brady et al. (2010) that the role of the welfare state in reducing poverty is at least as important as labour market policies or reforms aimed at achieving this goal.

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## DATA AVAILABILITY STATEMENT

Data and STATA do-files that support the empirical findings of this paper are available upon request.

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## ENDNOTES

<sup>1</sup>'Excess' bargaining coverage has been defined as the difference between the proportion of workers covered by collective agreements and the proportion of workers who are members of a trade union (Bouis et al., 2012).

<sup>2</sup>The argument is thus similar to that developed earlier by Calmfors and Driffill (1988) for intermediate systems (i.e. sectoral-level bargaining) as opposed to centralized and decentralized systems. It should, however, be recalled that empirical studies have not provided much support for Calmfors and Driffill's hypothesis and have led to a reconsideration of the OECD stance on sectoral bargaining in the 2006 (OECD 2006) and, even more so, in the 2018 Jobs Strategy. The empirical evidence on the employment consequences of 'excess' bargaining coverage is also not that robust (Jaumotte & Osorio 2015). For a review of the literature on the interaction between CB systems and employment performance, see, for example Garnero (2021).

<sup>3</sup>The equalized market (disposable) income refers to the total income of a household *before (after)* transfers and taxes that is available for spending or saving, divided by the number of household members converted into equalized adults. Household members are equalized or made equivalent by weighting each according to their age, using the so-called 'modified OECD equivalence scale' (Eurostat 2021).

<sup>4</sup>The Belgian National Labour Council is an advisory body, which provides advice to a minister or to both houses of the legislature (either when consulted or on its own initiative) on general economic and social issues (e.g. public assistance and social legislation). The Central Economic Council has the task of submitting to the government and/or Parliament, at their request or on its own initiative, formal opinions on matters relating to the national economy. The European Semester is a well-established forum for discussing and integrating the monitoring and coordination of economic, employment and fiscal policies in the European Union (Eurofound 2021).

<sup>5</sup>This is understandable as the data available at the international level were more limited in the early 2000s.

<sup>6</sup>The working-age population includes all individuals aged 18–64, either employed, self-employed, unemployed or not in the labour force. The countries covered in our study are the following: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, South Korea, Spain, Sweden, Switzerland, the United Kingdom and the United States. Our analysis focuses only on those economies that show similarities in their labour market structure and business cycles over the study period, in order to facilitate cross-country comparison.

<sup>7</sup>The in-work poverty rate refers to the share of people who are at work and have an equalized disposable income below the 'risk-of-poverty' threshold, which is set at 50 per cent of the national median equalized disposable income (*after* net social transfers).

<sup>8</sup>In some European countries, this involvement of social partners also applies to active labour market policies (e.g. education and training).



- <sup>9</sup>The Ghent system refers to arrangements in which trade unions, on behalf of the government, oversee the payment of unemployment benefits, rather than government agencies. This system is named after the Belgian city of Ghent, where it was first implemented.
- <sup>10</sup>There are three countries in Figure 2, where working-age poverty *after* taxes and transfers is significantly higher than the incidence of low pay: Belgium, Italy and Sweden. There are two possible, non-exclusive explanations for this observation. The first is that a large proportion of workers at the bottom end of the wage distribution are single parents with dependent children or share a household with a part-time worker or an unemployed person, which increases the probability of being poor (Buffel & Nicaise 2017). The second is that the unemployed and inactive represent the majority of the poor working-age population in these countries.
- <sup>11</sup> $N$  indicates sample size, that is the total number of observations on which the study in question is based.
- <sup>12</sup>In this study, the poverty rate is defined as 50 per cent of median equivalized income *after* net social security transfers.
- <sup>13</sup>State-mediated poverty is also referred to as poverty *after* taxes and transfers (see definition in Table 3). Overall headcount poverty is the percentage of the population concerned with less than 50 per cent of the median income of the whole population.
- <sup>14</sup>Relative and anchored in-work poverty are defined as < 50 per cent of median equivalized disposable income in the current year and in 1976, respectively. Working-age poverty is the poverty rate among households headed by people aged 18–64.
- <sup>15</sup>Some cross-country studies use an RE estimator because the greatest variation in their dependent variable is between countries. However, this econometric method probably does not adequately control for country fixed effects. Indeed, it is not so obvious to assume that all the explanatory variables are uncorrelated with the country fixed effects and that the latter follow a homogenous empirical distribution, two of the main conditions of the RE model to provide efficient and consistent estimates.
- <sup>16</sup>OECD: Organisation for Economic Co-operation and Development; LIS: Luxembourg Income Study; ILO: International Labour Organisation; AIAS: Amsterdam Institute for Advanced labour Studies; ICTWSS: Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts.
- <sup>17</sup>To merge observations over time from different sources, we notably relied on the Standardized World Income Inequality (Solt 2019) and Comparative Welfare States (Brady et al. 2014) datasets.
- <sup>18</sup>In 2021, the ICTWSS database has been rebranded as the OECD/AIAS ICTWSS database. This new name reflects the effort of the OECD and AIAS-HIS to develop and consolidate earlier versions of the ICTWSS database with the aim of ensuring the continuation of Jelle Visser's work after his retirement.
- <sup>19</sup>The following countries have only three observations available before 2015 for the incidence of low pay: France, Norway and Sweden.
- <sup>20</sup>Other poverty indicators have also been considered as dependent variables (e.g. in-work poverty, at-risk-of-poverty, headcount poverty and poverty intensity). However, these indicators were unavailable for some developed countries or only available for a limited number of years, which could lead to biased and/or inconsistent estimates. For these reasons, we decided to focus exclusively on working-age poverty rather than on these other indicators.
- <sup>21</sup>Working-age poverty also has a comparative advantage over other poverty indicators when estimating the social consequences of CB in a post-tax benefit scenario. Indeed, working-age poverty takes into account not only full-time workers, but also part-time workers, the unemployed and people of working age out of the labour force, who are more likely to receive social benefits.
- <sup>22</sup>The OECD/AIAS ICTWSS database also provides information on two other features of CB systems, namely flexibility and favourability (Visser, 2019). Flexibility specifies whether it is possible to derogate from terms established by law (and offer less favourable conditions) by means of collective agreement. Favourability delineates the hierarchy between agreement levels. These two features of CB systems are not considered in our study since there is no clear theoretical explanation or economic mechanism describing their relationship with working-age poverty rates and public social spending.

Moreover, it should be noted that their inclusion in our econometric models does not affect our conclusions (i.e. it does not change the statistical significance or sign of our estimates, and the size of our estimates remains largely unchanged). In addition, the adjusted  $R$ -squared of all our specifications hardly increases after the inclusion of the flexibility and favourability variables among the covariates.

- <sup>23</sup>The definitions and sources of the control variables are presented in Appendix 2.

- <sup>24</sup> For a detailed description of the four components of CB, see Table 3.
- <sup>25</sup> To avoid a reduction in the sample size, we applied an interpolation technique to our control variables and included dummies for missing observations.
- <sup>26</sup> It is mainly due to the fact that institutions vary little over time, which makes the use of panel estimation techniques difficult.
- <sup>27</sup> The null hypothesis of a Chow test for country-level time invariant, unobserved heterogeneity is that the fixed effects (i.e. the intercepts) are identical across countries. The rejection of this null hypothesis implies that panel data estimations methods, controlling for these country-fixed effects, should be preferred to the pooled OLS estimator. The null hypothesis of a Hausman test is that there is no correlation between the country-level fixed effects and the regressors. The rejection of this null hypothesis implies that the fixed effects (FE) estimator should be preferred to the random effects (RE) estimator.
- <sup>28</sup> The results of the Chow and Hausman tests are available on request.
- <sup>29</sup> As highlighted in Subsection 4.1, the four CB components are the following: bargaining coverage, trade union density, wage coordination and bargaining centralization.
- <sup>30</sup> A detailed description of the variables included in Equation (2) is provided in Subsections 3.1 and 3.2.
- <sup>31</sup> The detailed results of the ANOVA analyses and corresponding signal-to-noise ratios are available on request.
- <sup>32</sup> Giuliano et al. (2013) use the average level of democracy in neighbouring countries as an instrument to tackle the reverse causality between economic reforms and democracy.
- <sup>33</sup> We define neighbouring countries as those countries (excluding overseas territories) that share a common land or maritime border. To identify maritime borders, we used the United Nations Convention on the Law of the Sea.
- <sup>34</sup> As suggested by van Ours and Stoeldraijer (2011), we rely on the standard 'rule of thumb' that weak identification is problematic for  $F$  statistics smaller than 10.
- <sup>35</sup> The Durbin–Wu–Hausman test is based on the difference of two Sargan–Hansen statistics: one for the equation in which trade union density is treated as endogenous, and one for the equation in which it is treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary, which implies that 2FE estimates should be preferred to those obtained with the 2FE-2SLS estimator.
- <sup>36</sup> 2FE-2SLS standard errors may not be correctly measured as their corresponding estimates in the second stage are obtained from estimated regressors. Therefore, we generated 1000 bootstrap samples to increase the inference power of our 2FE-2SLS estimates without making strong distributional assumptions (Wilcox 2010). Bootstrapped standard errors are reported between parentheses in Table 8.
- <sup>37</sup> It should be noted that in this robustness check, the specification for the incidence of low pay has not been considered given that this outcome only contains three observations for France, Norway and Sweden before 2015, as well as very unbalanced data for other countries (e.g. Ireland, Iceland, the Netherlands, Spain and Switzerland). However, as our main objective is to test the robustness of the association between trade union density, poverty and social expenditures, this is unlikely to affect our conclusions.
- <sup>38</sup> This is likely due to the fact that observations that have been excluded for this robustness test mainly belong to countries (such as Australia, Austria, Korea or Portugal) in which social spending and union density did not follow the same pattern over the observation period.

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## APPENDIX 1 COLLECTIVE BARGAINING COMPONENTS ACROSS DEVELOPED COUNTRIES IN 1990 AND 2015

	Bargaining centralization		Wage coordination		Bargaining coverage (%)		Trade union density (%)	
	1990	2015	1990	2015	1990	2015	1990	2015
Australia	4	2	4	2	77.3	62 <sup>a</sup>	41.3	14.6
Austria	3	3	4	4	98	98	46.8	27.4
Belgium	5	4	4	5	96	96	54	54.2
Canada	1	1	1	1	38	30.6	33.6	26.5
Denmark	3	3	4	4	82.8	83.1	73.9	67.1
Finland	5	4	4	4	85 <sup>a</sup>	89.3	72.6	66.5
France	3	3	2	2	94.6	98	10.7	9
Germany	3	3	4	4	85	56.8	31.2	17.6
Greece	5	2	3	1	100	21.3	35.2 <sup>a</sup>	20.2
Iceland	3	3	4	4	93.8 <sup>a</sup>	90	87.9 <sup>a</sup>	90
Ireland	5	3	5	4	62.8	32.5 <sup>a</sup>	51.1	25.5
Italy	3	3	1	3	100	80	39	35.7
Japan	1	1	5	4	25.3	17.5	25.4	17.5
Luxembourg	2	2	2	2	60	56.8 <sup>a</sup>	46.1	32.3
Netherlands	3	3	3	4	81.5	79.4	24.6	17.7
New Zealand	3	1	2	1	60	15.9	49.7	17.9
Norway	5	5	4	4	75	72 <sup>a</sup>	58.5	52.1
Portugal	4	3	4	2	78	73.7	29.3	16.1
South Korea	1	1	2	2	20.4	12.7	17.4	10
Spain	3	3	2	3	90.2	79.6	14.1	15.2
Sweden	3	3	3	4	91	88.7	81.5	61.8
Switzerland	3	3	4	3	49.2	44.6 <sup>a</sup>	23	15.7
United Kingdom	2	1	1	1	58	27.9	39.6	24.2
United States	1	1	1	1	18.2	12.3	15.5	10.6

<sup>a</sup>Missing values for bargaining coverage or trade union density in 1990 or 2015. The closest values are, therefore, used.

Source: OECD/AIAS ICTWSS database.

## APPENDIX 2 DEFINITIONS AND SOURCES OF CONTROL VARIABLES

- *Educational attainment* represents the percentage of people, aged 25–64, having an upper secondary or post-secondary non-tertiary education. Source: OECD Education Statistics.
- *Youth population* is defined as those people aged less than 15. This indicator is measured as a percentage of the total population. Source: OECD Employment and Labour Statistics.
- *Children in unemployed single-parent households* measures the percentage of children, aged 0–14, who live in households where the sole adult is not in employment with respect to all

single-parent households. In most cases, the one adult is one of the child's parents, but may also be another relative (e.g. an older sibling or grandparent) or non-relative guardian. Source: OECD Family database.

- *Unemployment rate* is calculated by expressing the number of unemployed persons as a percentage of the total number of persons aged between 15 and 64 in the labour force. The labour force (formerly known as the economically active population) is the sum of the number of persons employed and the number of persons unemployed. Source: ILO database.
- *Inactivity rate* is the proportion of the working-age population that is not in the labour force (i.e. jobless, not available and/or not looking for a job). Source: ILO database.
- *Labour productivity growth* is the percentage change from a previous year in terms of labour productivity, which is defined as GDP per hour worked. Source: OECD Productivity Statistics.
- *Output gap* is the difference between actual GDP and potential GDP as a per cent of potential GDP. Potential GDP is the level of output that an economy can produce at a constant inflation rate. Source: OECD National Accounts Statistics.
- *Inflation or consumer price index (CPI)* is defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households. Source: OECD Main Economic Indicators database.
- *Short-term interest rate* (also called 'money market rate' and 'treasury bill rate') is the rate at which short-term borrowings are effected between financial institutions or the rate at which short-term government paper is issued or traded in the market. Source: OECD Main Economic Indicators database.
- *Terms of trade* is defined as the ratio between the index of export prices and the index of import prices. If the export prices increase more than the import prices, a country has a positive terms of trade, as for the same amount of exports, it can purchase more imports. Source: OECD National Accounts Statistics.

### APPENDIX 3

#### DECOMPOSITION OF PUBLIC SOCIAL SPENDING BY SOCIAL BRANCH, 1990–2015

Social branch	Mean (as a % of GDP)	Mean (as a % of public social spending)
Active labour market programmes (ALMP)	0.64	3.12
Family	5.60	27.26
Health	2.43	11.83
Housing	2.06	10.03
Incapacity-related benefits	0.37	1.80
Old age	6.85	33.35
Survivors	0.98	4.77
Unemployment	1.09	5.31
Other social policy areas	0.51	2.48
Total	20.54	100.00

Note: The definitions of public social spending and its corresponding social branches are presented in Table 3.

Source: OECD Social and Welfare Statistics.



## APPENDIX 4

### POOLED OLS ESTIMATOR: BARGAINING COVERAGE AND BARGAINING CENTRALIZATION

Dependent variable:	The incidence of low pay		Working-age poverty rate before taxes and transfers		Working-age poverty rate after taxes and transfers		Public social spending as a % of GDP	
	(1)	(2)	(2)	(2)	(3)	(3)	(4)	(4)
Bargaining coverage	-0.131*** (0.026)		0.008 (0.021)		-0.051*** (0.014)		0.132*** (0.028)	
Trade union density	-0.111*** (0.026)	-0.167*** (0.037)	0.003 (0.023)	0.005 (0.021)	-0.030** (0.013)	-0.042** (0.018)	0.073** (0.031)	0.124*** (0.043)
Wage coordination	-0.374 (0.543)	-0.375 (0.778)	0.556 (0.437)	0.761 (0.566)	0.000 (0.219)	0.016 (0.358)	-0.392 (0.246)	-0.562 (0.610)
Bargaining centralization		-1.762** (0.780)		-0.156 (0.483)		-0.716* (0.404)		1.499* (0.850)
Estimator	Pooled OLS		Pooled OLS		Pooled OLS		Pooled OLS	
<u>Control variables<sup>a</sup></u>								
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects <sup>b</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	371	371	487	487	505	505	624	624
Panel of countries	24 <sup>c</sup>		24		24		24	
Adjusted R-squared	0.76	0.66	0.69	0.69	0.70	0.63	0.78	0.63

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Clustered standard errors at the country level are denoted in parentheses.

<sup>a</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>b</sup>25 year dummies.

<sup>c</sup>The following countries only show three available observations for the incidence of low pay: France, Norway and Sweden.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.

## APPENDIX 5

### FIRST-STAGE RESULTS OF 2FE-2SLS SPECIFICATIONS

Dependent variable (first-stage): Dependent variable (second-stage):	Trade union density			
	The incidence of low pay	Working-age poverty rate before taxes and transfers	Working-age poverty rate after taxes and transfers	Public social spending as a % of GDP
	(1)	(2)	(3)	(4)
Lagged trade union density	0.913*** (0.025)	0.902*** (0.023)	0.895*** (0.024)	0.904*** (0.020)
Average lagged trade union density in neighbouring countries	0.022 (0.025)	-0.043* (0.022)	-0.043* (0.022)	-0.006 (0.248)
Estimator	2FE-2SLS	2FE-2SLS	2FE-2SLS	2FE-2SLS
Other collective bargaining components <sup>a</sup>	Yes	Yes	Yes	Yes
Control variables <sup>b</sup>				
Demographics	Yes	Yes	Yes	Yes
Labour market characteristics	Yes	Yes	Yes	Yes
Macro-economic performance	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects <sup>c</sup>	Yes	Yes	Yes	Yes
Observations	361	477	495	600
Panel of countries	24 <sup>d</sup>	24	24	24
Within R-squared	0.97	0.96	0.96	0.97
Shea Partial R-squared <sup>e</sup>	0.88	0.89	0.89	0.90

Notes: \*\*\*/\*\*/\* significant at the 1%, 5% and 10% level. Within standard errors, calculated by creating 1000 bootstrap samples, are reported in parentheses.

<sup>a</sup>Collective bargaining components showing little within country-variation (i.e. bargaining centralization, wage coordination and bargaining coverage) have been included as covariates. Corresponding regression coefficients are not reported in this table as their signal-to-noise ratio is too small to enable statistical inference.

<sup>b</sup>Demographics: educational attainment, youth population and children in households, where the sole parent is not in employment. Labour market characteristics: inactivity rate, labour productivity growth and unemployment rate. Macro-economic indicators: inflation, output gap, short-run interest rate and terms of trade.

<sup>c</sup>25 year dummies.

<sup>d</sup>The following countries only show three available observations for the incidence of low pay: France, Norway and Sweden.

<sup>e</sup>The Shea Partial R-squared measures the instrument relevance by taking into account the intercorrelations between the excluded instruments and the endogenous regressor in question.

Source: OECD, ILO, LIS, Eurostat and OECD/AIAS ICTWSS databases, 1990–2015.