Assessing the impact of labour market spendings on unemployment dynamics across demographics in OECD countries

OSAMA SHAIKH, Ph.D.*
SELCEN OZTURK, Ph.D.*

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Osama SHAIKH
Department of Economics, Hacettepe University 35 C, 06800 Çankaya/Ankara, Türkiye
e-mail: osama.shaikh@hacettepe.edu.tr
ORCiD: 0000-0002-9873-8040

Selcen OZTURK
Department of Economics, Hacettepe University 35 C, 06800 Çankaya/Ankara, Türkiye
e-mail: selcen@hacettepe.edu.tr
ORCiD: 0000-0003-2011-2360

PUBLIC SECTOR ECONOMICS
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Abstract

This study investigates the long-run effects of labour market policies on unemployment dynamics in 36 OECD countries from 2004 to 2022. Derived from second-generation panel methods that address cross-sectional dependence and heterogeneity, the results indicate that activation policies without providing employment maintenance incentives are associated with higher unemployment. Institutional and public training expenditures mainly reduce youth unemployment, while minimum income benefits and wages contribute to higher adult and total unemployment, reflecting disincentivising effects and wage rigidities. Rising labour force participation increases measured unemployment by re-engaging marginally attached workers. Robustness checks across sub-periods and welfare-regime clusters reveal heterogeneity, showing that policy effects are context-dependent and time-sensitive rather than uniformly stable. Causality tests confirm two-way interactions between unemployment and labour market policies. These findings underscore the need for nuanced, age-specific strategies that integrate activation measures, targeted training, and carefully calibrated income support to promote inclusive and effective labour markets in advanced economies.

Keywords: active labour market policies (ALMPs), institutional training, minimum income benefits, wages rigidity, unemployment rate, and panel data analysis

1 INTRODUCTION

Unemployment trends in OECD countries, affecting regions and demographic groups differently, remain a major policy challenge (OECD, 2024a). As of early 2024, the overall OECD unemployment rate stood at 4.8%, with significant disparities among member nations. For example, while Spain's total unemployment was 11.8% and adult unemployment near 10%, youth unemployment for the ages 15-24 reached 26.5%. Similarly, Sweden's youth unemployment exceeded 24%, more than triple the adult rate of 6.2%, and above the OECD youth average of 11.1% versus 4.1% for adults and 4.8% overall (OECD, 2024b). These contrasts, illustrated in appendix figure A1, highlight the urgent need to address youth unemployment, as young workers face greater barriers to stable employment, with long-term economic implications.

Projections indicate modest overall employment growth, with slight increases in unemployment amid economic uncertainty, disproportionately affecting young workers (OECD, 2023). Public expenditures on active labour market programs (ALMPs) averaged 1.69% of GDP in 2021, with Austria and Spain allocating over 3% and the United States 0.23%. By 2022, spending declined in many countries, averaging 0.98% of GDP (appendix figure A2; OECD, 2024c), raising concerns about the adequacy of current support.

Prior studies show that job search assistance, targeted training programmes, and public employment schemes can improve labour market outcomes, particularly for young and disadvantaged workers (Caliendo and Schmidl, 2016; Kluve, 2014). Integrating group-specific interventions with broader policies enhances

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

effectiveness (Apostolidou, 2015), while successful implementation requires reliable labour market information and monitoring frameworks (O'Higgins, 2001). Nevertheless, gaps remain; in Germany, one-third of apprenticeships ended prematurely in 2022, reflecting skills mismatches and limited guidance (Hofer, 2025). Youth income volatility during the transition from education to work is widespread, with many facing fluctuating earnings, limited savings, and uneven social protection access (OECD, 2024d). The OECD Youth Policy Toolkit emphasizes the lack in many countries of comprehensive strategies integrating high-quality activation measures, income support, and targeted skills development (OECD, 2024e; 2024f).

These findings underscore the fact that targeted youth employment policies such as apprenticeships, training, and job placement services are vital to reducing labour market vulnerabilities and supporting equitable growth. Against this backdrop, the present study makes a substantive contribution by systematically evaluating the long-run impacts of key labour market policies including activation measures, income transfers, training, wage dynamics, and labour force participation on unemployment across 36 OECD countries between 2004 and 2022. By disaggregating outcomes for youth, adults, and the total workforce, and by accounting for institutional heterogeneity across welfare regime clusters (Nordic, Liberal, Continental, Southern, Eastern, and Mixed) as well as major economic crises (pre- and post-2008 financial crisis, pre-pandemic, and post-COVID), this study provides robust macro-level evidence that complements existing micro-level research. These contributions allow for context-sensitive policy insights, advancing our understanding of how labour market institutions interact with unemployment dynamics under varying macroeconomic and institutional conditions.

The study has three main objectives. First, it assesses the long-run effects of public spending on core labour market programs, such as activation policies, income support, training, wage conditions and labour force participation on unemployment. Second, it examines differential impacts across youth, adult, and total populations. Third, it generates comparative evidence to inform tailored strategies that reduce unemployment, strengthen labour market resilience, and promote inclusive growth.

To achieve these objectives, the study uses novel second-generation panel cointegration techniques, specifically, the common correlated effects mean group (CCEMG) and mean group (MG) estimators, to account for cross-country heterogeneity and interdependencies. Potential limitations related to endogeneity, data quality, and model specification are addressed through fully modified ordinary least squares (FMOLS), and short-run dynamics are examined using the Dumitrescu and Hurlin (2012) panel non-causality test.

In summary, this study is a response to persistent unemployment disparities in OECD countries, particularly high youth joblessness. By systematically analysing the long-run effects of labour market policies, wage dynamics, and labour supply,

PUBLIC SECTOR ECONOMICS
49 (4) 527–562 (2025)

it provides evidence-based insights for policymakers to be able to design effective, context-sensitive strategies. The following sections present a literature review, the theoretical framework, data description, empirical model, methodology, results, and conclusions.

2 LITERATURE REVIEW

This section reviews the determinants of unemployment dynamics, organized into three thematic groups reflecting the empirical model: (i) labour policy instruments, focusing on active labour market policies (ALMPs), institutional training, and public training expenditure; (ii) institutional determinants, particularly minimum income benefits and unemployment insurance; and (iii) macroeconomic conditions, including wage dynamics and labour force participation. Together, these strands of the literature reveal how different mechanisms, policy interventions, institutional frameworks, and structural conditions shape total, youth, and adult unemployment, while also identifying gaps, motivating the empirical strategy of this study.

2.1 LABOUR POLICY INSTRUMENTS: ACTIVE LABOUR MARKET POLICIES, TRAINING, AND PUBLIC EXPENDITURE

Active labour market policies (ALMPs) seek to reduce unemployment and foster labour market integration by enhancing employability, skills, and job search capacity (Kluve, 2010; Card, Kluve and Weber, 2010). Non-employment-maintenance ALMPs, those that do not preserve existing jobs but instead focus on human capital accumulation and activation – are grounded in the human capital theory (Becker, 1964) and the endogenous growth theory (Lucas, 1988; Romer, 1990), which highlight skills, productivity, and knowledge spillovers as drivers of growth and employability.

Institutional training represents a core ALMP tool. General classroom training (GCT) focuses on soft skills such as résumé writing and job search techniques, but its limited signalling value and weak labour market linkages often yield only modest employment outcomes (Card, Kluve and Weber, 2018; Fossati, Liechti and Wilson, 2021). In contrast, occupation-specific training (OCT) better aligns with labour demand and produces stronger results, particularly for workers with prior experience or higher education (Caliendo, Schmidl and Uhlendorff, 2011; Wood, Neels and Vujić, 2025). Nonetheless, temporary "lock-in effects" and weak employer engagement can offset short-term benefits (Lechner and Wunsch, 2009). Heterogeneity is strong: women, educated workers, and residents of developed regions benefit more, while workplace-integrated training models have proven particularly effective in Sweden and Latin America (Escudero et al., 2019; Lebedinski and Pavlović, 2023).

Moreover, public expenditure on training further reflects macro-level investment in workforce development. In Albania, a 1% rise in education spending reduces youth unemployment by more than 10% (Mehmetaj and Xhindi, 2022), while OECD data show vocational training investment substantially reduces long-term

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

unemployment among low-skilled groups (Martins, 2021; Card, Kluve and Weber, 2018). However, diminishing returns are observed beyond certain thresholds (Kluve and Schmidt, 2002), and ineffective targeting or skills mismatches, as in China, reduce impact (Xie, 2016).

Overall, evidence on the effectiveness of ALMPs and training instruments is mixed but generally positive. Meta-analyses of over 100 randomized controlled trials (RCTs) indicate that roughly one-third of programmes produce significant improvements in employment outcomes, particularly those emphasizing human capital accumulation, individualized support, and wage subsidies (Card, Kluve and Weber, 2010; 2018; Kluve et al., 2017; 2019; McKenzie, 2017; Yeyati et al., 2025). Importantly, programme success is highly context-dependent: outcomes tend to be strongest in high-growth environments and when interventions are carefully targeted, of adequate duration, and aligned with business cycle conditions. These findings complement the country-specific examples and underscore the importance of institutional design, funding, and policy sequencing in shaping the impact of ALMPs and training expenditures on unemployment dynamics.

2.2 INSTITUTIONAL DETERMINANTS: MINIMUM INCOME BENEFITS AND UNEMPLOYMENT INSURANCE

Minimum income benefits (MIB), especially unemployment insurance (UI), provide essential income support during joblessness while shaping labour market dynamics. Theoretically, UI balances two opposing forces, reducing hardship and improving job matching. However, it can prolong unemployment due to income substitution effects (Mortensen, 1977; Chetty, 2006; Caliendo, Tatsiramos and Uhlendorff, 2009).

Empirical evidence underscores this duality. UI boosts search effort before benefit exhaustion (Marinescu and Skandalis, 2021) and improves job match quality (Wanberg et al., 2020), but higher generosity lengthens unemployment spells. For instance, a 10% increase in replacement rates extends unemployment by about one week (Spiezia, 2000), while each additional UI week adds 0.16-0.20 weeks to unemployment duration (Katz and Meyer, 1990). At the macro level, extended benefits during recessions increase unemployment volatility – raising U.S. unemployment by 0.5 percentage points during the 2008 crisis, for example (Faig, Zhang and Zhang, 2016; Schmieder and von Wachter, 2016).

Generosity effects vary across groups. Youth are disproportionately affected due to weaker labour market attachment and higher exposure to precarious jobs (Escudero and López Mourelo, 2017; Tosun, Treib and De Francesco, 2019; Dube, 2021). Pandemic-era expansions revealed the high youth share among UI recipients, underscoring distinct age-related vulnerabilities (Ganong et al., 2024). Institutional reforms in Sweden and Germany further confirm that increasing UI generosity significantly raises aggregate unemployment but reduces job separations (Hartung, Jung and Kuhn, 2025).

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

Notably, UI interacts with macroeconomic and wage-setting conditions. In tight labour markets, moral hazard effects intensify (Kroft and Notowidigdo, 2016), while higher wage floors may amplify the disincentive to exit unemployment. Conversely, in recessionary periods with falling wages, UI stabilizes consumption and supports demand, indirectly sustaining employment. These linkages indicate that institutional determinants cannot be analysed in isolation from broader macroeconomic structures.

2.3 MACROECONOMIC CONDITIONS: WAGES AND LABOUR FORCE PARTICIPATION

Structural labour market conditions particularly wage dynamics and labour force participation play a decisive role in shaping unemployment. The wage curve hypothesis identifies a stable negative link between wages and unemployment, with long-run elasticity around -0.1 across countries (Blanchflower and Oswald, 1994; 1995; 2005). While some argue this reflects local shocks rather than causality (Card, 1995), evidence from Europe shows wages affect both local and national unemployment (Elhorst, Bilen and Wolf, 2007).

Wage effects are especially pronounced for youth. Minimum wage hikes reduce youth employment by 3-5% (Sen, Rybczynski and Van De Waal, 2011; Gorry, 2013), with comparable effects across Canada, the UK, and Europe (Williams and Mills, 2001; Pereira, 2003; Marimpi and Koning, 2018). Broader structural conditions also matter. For example, in South Africa, monopsony power depresses wage responsiveness and deepens inequality (Bassier, 2023), while in low-income economies, high unemployment interacts with self-employment and institutional frictions to shape outcomes (Poschke, 2025).

Labour force participation further shapes unemployment by influencing the supply side of the labour market. Declining participation in the U.S. is linked to discouraged worker effects and demographic aging (Barnichon and Figura, 2013; Aaronson et al., 2014), while in Africa and Asia, unemployment shocks and participation move closely together (Raifu and Adeboje, 2022; Musa, Audu and Junaidu, 2024; Adianita, Susilowati and Karisma, 2024). Participation shifts often conceal hidden slack: discouraged workers and underemployed individuals are excluded from official statistics (Provenzano, 2017; Kudlyak and Price, 2012). Flow analyses confirm these dynamics, showing how transitions between nonparticipation and unemployment amplify cyclical fluctuations (Dixon, Lim and van Ours, 2015).

In summary, institutional rules and macroeconomic conditions interact in shaping unemployment outcomes. For example, generous unemployment benefits may extend joblessness in regions with low wage responsiveness, while declining labour force participation can mask the effects of minimum wage adjustments. Across labour policy instruments, institutional frameworks, and macroeconomic factors, youth unemployment emerges as particularly sensitive. Training programs and ALMPs often deliver delayed benefits, income support measures can prolong

PUBLIC SECTOR ECONOMICS 49 (4) 527-562 (2025)

unemployment spells among young workers, and wage rigidity coupled with shifts in participation amplifies discouraged worker effects. These dynamics highlight the heightened vulnerability of youth to both policy and economic shocks, providing a key rationale for the study's age-disaggregated analysis.

2.4 THEORETICAL FRAMEWORK

Building on consistent evidence of heightened youth vulnerability in labour markets, this study adopts the structural labour market equilibrium model of Layard et al. (2005), refined by Calmfors (1994) and Calmfors and Lang (1995). In this framework, unemployment arises from the interaction of wage-setting, labour demand, matching efficiency, and labour force participation. Integrating the three thematic strands identified in the literature review, labour policy instruments, institutional determinants and macroeconomic conditions, provides a coherent lens through which to understand unemployment dynamics across total, youth, and adult groups.

Labour market policies such as ALMPs, institutional training, and public training expenditure improve matching efficiency by enhancing skills, employability, and information flows (Pissarides and McMaster, 1990; Calmfors, 1994). Grounded in human capital theory (Becker, 1964) and endogenous growth theory (Lucas, 1988; Romer, 1990), these interventions raise individual productivity and foster macro-level growth. Temporary lock-in effects may delay re-employment, particularly for the young, who are more vulnerable due to weaker labour market attachment (Edin and Holmlund, 1991; Lechner and Wunsch, 2009; Larsson, 2003; Card, Kluve and Weber, 2010).

Institutional determinants such as minimum income benefits (MIB) and unemployment insurance (UI) influence reservation wages and search incentives, shaping both the duration and incidence of unemployment (Mortensen, 1977; Chetty, 2006; Rothstein, 2011). Generosity effects are stronger among youth, who often lack alternative resources and stable labour market experience (Sen, Rybczynski and Van De Waal, 2011; Gorry, 2013). These institutional mechanisms interact with macroeconomic conditions, amplifying or mitigating unemployment effects depending on local wage dynamics and labour demand.

Macroeconomic factors, particularly wage levels and labour force participation, further determine unemployment outcomes. Wage rigidity can increase unemployment risk, especially for youth, consistent with the wage curve and efficiency wage theories (Blanchflower and Oswald, 1994; Campbell and Orszag, 1998; Sen, Rybczynski and Van De Waal, 2011). Labour force participation shapes the measured unemployment rate; increases in participation draw marginally attached and discouraged workers into the labour force, while declines may conceal slack (Apergis and Arisoy, 2017; Barnichon and Figura, 2013). Interactions with institutional rules – such as the generosity of UI – highlight the importance of integrating policy and macroeconomic perspectives in unemployment analysis.

PUBLIC SECTOR ECONOMICS
49 (4) 527–562 (2025)

Moreover, concrete OECD examples further illustrate these institutional mechanisms. For instance, Denmark's flexicurity model combines generous unemployment benefits with strict job-search requirements and strong re-employment support, serving as a benchmark for active labour market policies (Andersen and Svarer, 2007). Germany's Hartz reforms in the early 2000s restructured unemployment assistance and expanded subsidised employment and training schemes, significantly reshaping labour market dynamics (Jacobi and Kluve, 2007). Spain introduced youth employment initiatives in the aftermath of the Eurozone crisis, including hiring subsidies and vocational training programs targeted at reducing persistently high youth unemployment (OECD, 2015b). Similarly, the United Kingdom's jobseeker's allowance and associated training provisions have long emphasised rapid re-entry into employment through activation requirements (Clasen and Clegg, 2006; Manning, 2009). These cases highlight how activation, training, and income support policies operate in practice, and how their effectiveness depends on interactions with wages and labour force participation.

By integrating labour policy instruments, institutional determinants, and macroeconomic conditions within a structural equilibrium framework, this study provides a comprehensive lens through which to understand unemployment across age groups in OECD countries. Youth unemployment is particularly sensitive due to the age group's limited experience, weaker bargaining power, and higher exposure to wage rigidity, lock-in effects, and benefit dependency. Building on these theoretical and empirical insights, the following six hypotheses guide the empirical analysis of age-specific unemployment dynamics:

H1: Increased spending on active labour market policies (excluding employment maintenance) reduces total, youth, and adult unemployment rates.
H2: Higher investment in institutional training interventions lowers unemployment across all age groups.
H3: Greater public training expenditure is negatively associated with total and youth unemployment.
H4: More generous minimum income benefits increase unemployment duration and rates, with stronger effects among youth due to their vulnerable labour market position.
H5: Higher average annual wages correlate with higher unemployment, especially among youth, reflecting wage rigidity and weaker labour market attachment.
H6: Higher labour force participation rates correspond to increased measured unemployment by drawing marginally attached and discouraged workers back into the labour force during improvements.

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

3 DATA, MODEL, AND METHODOLOGY

This section outlines the data description, data sources, empirical model, and methodology to analyse unemployment dynamics across OECD countries.

3.1 DATA AND DESCRIPTION

This study employs a balanced panel dataset of 36 OECD countries; Australia, Austria, Belgium, Canada, Chile, Costa Rica, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and the United States, over 2004-2022. The selection of these countries was based on consistent data availability and ensures broad geographic and institutional representation, capturing variations in labour market policies, training investments, minimum income benefits, and labour force participation. Two OECD countries, Colombia and Turkey are not included due to inconsistent or unavailable data over the study period; their exclusion does not materially affect the panel's representativeness, as the remaining countries cover all major welfare regime clusters (Nordic, Liberal, Continental, Southern, Eastern, and Mixed) and diverse labour market structures.

Table 1

Data description

Variable	Type	Description	Combined unit of measure
YUNP	Dependent	Youth unemployment rate	% of youth labour force, aged 15-24
AUNP		Adult unemployment rate	% of adult labour force, aged 25+
UNP		Total unemployment rate	% of total labour force, aged 15+
APWEMI	Independent	Public expenditure on active labour market policies without employment incentives	% of GDP
LNITI		Institutional training investments (logged)	National currency in millions
LNTRI		Public training expenditure (logged)	
LNMIB		Minimum income benefits (logged)	National currency
LNAAW		Average annual wages (logged)	USD, PPP-adjusted, constant 2023 prices
LNLFPR		Labor force participation rate (logged)	Number of economically active persons

Source: OECD, 2024.

The dataset provides sufficient longitudinal and cross-country variation to examine the long-run and dynamic relationships between unemployment and labour market policies. The dependent variables are the youth unemployment rate

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

(YUNP), adult unemployment rate (AUNP), and total unemployment rate (UNP), each expressed as a percentage of the relevant labour force segment. Explanatory variables include public expenditure on active programmes without employment maintenance incentives (APWEMI, % of GDP), institutional and total training investments (LNITI and LNTRI, log-transformed), minimum income benefits for a couple with two children (LNMIB, log-transformed), average annual wages (LNAAW, log-transformed), and the labour force participation rate (LNLFPR, log-transformed). All data are sourced from the OECD database to ensure harmonized definitions and cross-country comparability (table 1), enhancing the robustness and generalizability of the empirical findings.

3.2 EMPIRICAL MODEL

This study analyses the impacts of labour market policies on unemployment rates disaggregated by age groups: UNP, AUNP, and YUNP, capturing heterogeneous effects. Independent variables include APWEMI, LNITI, and LNTRI, representing active labour market interventions aimed at enhancing matching-efficiency and employability. LNMIB captures passive minimum income benefits expected to raise reservation wages and prolong unemployment. LNAAW proxies wage-setting and rigidity per the wage curve, while LNLFPR controls for labour supply variations. Following the (Calmfors and Skedinger, 1995), the general functional forms for the three unemployment categories are specified as follows:

$$YUNP = f\left(APWEMI,\ LNITI,\ LNTRI,\ LNMIB,\ LNAAW,\ LNLFPR\right) \quad (1)$$

$$AUNP = f\left(APWEMI,\ LNITI,\ LNTRI,\ LNMIB,\ LNAAW,\ LNLFPR\right) \quad (2)$$

$$UNP = f\left(APWEMI,\ LNITI,\ LNTRI,\ LNMIB,\ LNAAW,\ LNLFPR\right) \quad (3)$$

Following Sahnoun and Abdennadher (2022) and Martins (2021), who highlight the interpretative challenges of multicollinearity and overestimation bias, this study estimates multiple regressions combining APWEMI with one additional policy measure at a time. This approach clarifies marginal effects and avoids over-parameterization.

Fifteen empirical equations are specified, each pairing APWEMI with another variable for each unemployment category.

$$YUNP = \beta_1 APWEMI + \beta_2 LNITI + \mu_t \quad (E1)$$

$$YUNP = \beta_1 APWEMI + \beta_2 LNTRI + \mu_t \quad (E2)$$

$$YUNP = \beta_1 APWEMI + \beta_2 LNMIB + \mu_t \quad (E3)$$

$$YUNP = \beta_1 APWEMI + \beta_2 LNAAW + \mu_t \quad (E4)$$

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

$$YUNP = \beta_1 APWEMI + \beta_2 LNLFPR + \mu_t \quad \text{(E5)}$$

$$AUNP = \beta_1 APWEMI + \beta_2 LNITI + \mu_t \quad \text{(E6)}$$

$$AUNP = \beta_1 APWEMI + \beta_2 LNTRI + \mu_t \quad \text{(E7)}$$

$$AUNP = \beta_1 APWEMI + \beta_2 LNMIB + \mu_t \quad \text{(E8)}$$

$$AUNP = \beta_1 APWEMI + \beta_2 LNAAW + \mu_t \quad \text{(E9)}$$

$$AUNP = \beta_1 APWEMI + \beta_2 LNLFPR + \mu_t \quad \text{(E10)}$$

$$UNP = \beta_1 APWEMI + \beta_2 LNITI + \mu_t \quad \text{(E11)}$$

$$UNP = \beta_1 APWEMI + \beta_2 LNTRI + \mu_t \quad \text{(E12)}$$

$$UNP = \beta_1 APWEMI + \beta_2 LNMIB + \mu_t \quad \text{(E13)}$$

$$UNP = \beta_1 APWEMI + \beta_2 LNAAW + \mu_t \quad \text{(E14)}$$

$$UNP = \beta_1 APWEMI + \beta_2 LNLFPR + \mu_t \quad \text{(E15)}$$

This modelling strategy mitigates overfitting by excluding highly correlated variables from the same specification, yielding more stable and interpretable estimates. It also enables a nuanced analysis of how various ALMPs, income support, wage dynamics and labour supply influence unemployment across age groups. The inclusion of a time-specific error term (μ_t) controls for unobserved heterogeneity and common macroeconomic shocks, strengthening the robustness of the results.

The subsequent methodology applies second-generation panel estimators; CCEMG, MG, and FMOLS to produce reliable long-run estimates while addressing cross-sectional dependence, parameter heterogeneity, and non-stationarity.

3.3 METHODOLOGY

This study estimates long-run relationships between unemployment rates and labour market variables across OECD countries using second-generation panel estimators, following the empirical strategies of Salahuddin et al. (2020), Ng, Choong and Lau (2020), Malik and Shaikh (2023) and Dogan et al. (2020). Unlike first-generation methods, which assume cross-sectional independence and homogeneous slopes, second-generation estimators account for cross-sectional dependence (CSD), slope heterogeneity, and non-stationarity, improving the reliability of estimates in interdependent OECD economies (Pesaran and Yamagata, 2008).

PUBLIC SECTOR ECONOMICS
49 (4) 527–562 (2025)

The estimation strategy proceeds in several main stages. First, cross-sectional dependence and stationarity are examined using the Pesaran (2004) cross-sectional dependence (CD) test and the cross-sectionally augmented Im, Pesaran and Shin (CIPS) test (Pesaran, 2007), ensuring that subsequent analyses are robust to common shocks and inter-country interdependencies. Second, slope homogeneity is assessed using the Pesaran and Yamagata (2008) test. Evidence of heterogeneous slopes motivates the use of estimators that allow for country-specific coefficients. Third, panel cointegration is examined using the Westerlund (2007) cointegration tests. Fourth, long-run coefficients are estimated using a combination of CCEMG (Pesaran, 2006), MG (Pesaran and Smith, 1995), and FMOLS (Pedroni, 2001), which jointly address CSD, heterogeneity, partially endogeneity, and serial correlation. Fifth, robustness is assessed through a series of tests: temporal robustness, institutional robustness, and the Dumitrescu and Hurlin (2012) panel non-causality test. All technical formulas and statistical details for these tests are provided in appendix (A.1 – A.5).

4 RESULTS

This section presents the empirical analysis, covering pre-tests of the novel second-generation panel methods, the long-run estimation results, and robustness checks across temporal, institutional, and short-run causality dimensions.

4.1 PESARAN (2004) CROSS-SECTIONAL DEPENDENCE TEST

Table 2 reports the results of the Pesaran (2004) CD test and its extensions (CDw, CDw+, and CD*), applied to all variables. The CD statistic tests the null hypothesis of cross-sectional independence. High positive values indicate the presence of cross-sectional dependence, while the alternative statistics provide robustness to unbalanced panels, heteroskedasticity, and serial correlation.

Table 2
Panel CD test statistics

Variable	CD statistic	CDw statistic	CDw+ statistic	CD* statistic
YUNP	37.10*	-0.98	1,085.50*	-0.87
AUNP	31.91*	-0.96	1,043.22*	3.27*
UNP	35.13*	1.48	1,060.59*	3.30*
APWEMI	8.53*	-1.24	957.69*	2.48*
LNMIB	43.26*	-0.50	1,745.27*	-1.40
LNITI	0.62	-2.11*	812.28*	-0.78
LNTRI	2.17**	1.80***	812.12*	0.82
LNAAW	58.41*	-1.32	1,895.72*	-0.96
LNLFPR	52.94*	-1.90*	2,134.33*	-1.00

*Note: *, **, and ***, represents significance at 1%, 5%, and at 10%, respectively.*

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

The results strongly reject the null of cross-sectional independence for most variables, including YUNP, AUNP, UNP, APWEMI, LNMIB, LNTRI, LNAAW, and LNLFPR. These findings confirm substantial cross-sectional dependence, justifying the use of second-generation estimation techniques in subsequent analyses.

4.2 CROSS-SECTIONALLY AUGMENTED IM, PESARAN AND SHIN (CIPS) UNIT ROOT TEST

To assess the stationarity properties of the variables in the presence of cross-sectional dependence, the study employs the cross-sectionally augmented IPS (CIPS) test proposed by Pesaran (2007). This approach augments the standard augmented Dickey-Fuller regression with cross-sectional averages of lagged levels and first differences, making it suitable for macro-panel data with interdependencies.

Table 3

CIPS unit roots test statistics

Variables	Trend	CIPS I(0)	CIPS I(1)
YUNP	Yes	-1.85	-3.21*
AUNP	No	-2.01	-2.74*
UNP		-2.06	-2.65*
APWEMI		-2.02	-3.69*
LNMIB		-1.23	-3.91*
LNITI		-1.47	-3.45*
LNTRI		-1.67	-3.69*
LNAAW		-1.89	-3.45*
LNLFPR		-1.46	-3.47*

*Note: *, **, and ***, represents significance at 1%, 5%, and at 10%, respectively.*

Table 3 reports the CIPS statistics for all variables at both levels (I(0)) and first differences (I(1)). The results reveal that all the variables are non-stationary at levels, they become stationary after first differencing, as indicated by statistically significant CIPS statistics at the 1% level. This confirms that the variables are integrated of order one, I(1), which justifies the use of panel cointegration techniques in subsequent analysis.

4.3 SLOPE HOMOGENEITY TEST

To assess whether slope coefficients are consistent across cross-sectional units, this study employs the slope homogeneity test proposed by Pesaran and Yamagata (2008). This test evaluates the null hypothesis of slope homogeneity against the alternative of heterogeneity, a critical consideration in macro-panel datasets covering structurally diverse OECD economies.

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

TABLE 4
Slope homogeneity test results

Variable	t-statistic	E1	E2	E3	E4	E5
YUNP	Δ	10.84*	8.87*	11.96*	16.53*	14.59*
	Δ_{adj}	12.20*	9.98*	13.46*	18.60*	16.42*
AUNP	Δ	9.93*	7.53*	10.92*	12.59*	13.19*
	Δ_{adj}	11.17*	8.48*	12.29*	14.17*	14.85*
UNP	Δ	11.32*	9.38*	12.84*	16.13*	15.28*
	Δ_{adj}	12.74*	10.56*	14.45*	18.16*	17.19*

*Note: *, **, and ***, represents significance at 1%, 5%, and at 10%, respectively.*

Table 4 reports the Δ and Δadj statistics for the fifteen equations across the youth, adult, and total unemployment models. In the youth unemployment model, both statistics reject slope homogeneity at the 1% significance level for all equations, indicating strong evidence of heterogeneity. The total unemployment model shows a similar pattern. Although the adult unemployment model exhibits somewhat lower values, the null hypothesis is still consistently rejected, confirming heterogeneous slopes.

These results validate the presence of slope heterogeneity and support the application of second-generation panel estimation methods.

4.4 WESTERLUND (2007) PANEL COINTEGRATION TEST

Given the identified cross-sectional dependence, the Westerlund (2007) test is used to assess long-run cointegration between unemployment rates and labour market variables, based on four statistics: $G\tau$, $G\alpha$, $P\tau$, and $P\alpha$.

TABLE 5
Westerlund cointegration test results

Variable	t-statistic	E1	E2	E3	E4	E5
YUNP	Gt	-2.08*	-1.93*	-1.91*	-2.56*	-2.72*
	Ga	-5.00	-4.82	-5.11	-4.51	-4.60
	Pt	-11.33*	-14.26*	-14.00*	-14.20*	-17.00*
	Pa	-4.20*	-4.95*	-5.03*	-3.99*	-5.38*
AUNP	Gt	-1.87*	-1.89*	-1.91*	-2.35*	-2.52*
	Ga	-4.96	-4.58	-5.00	-5.00	-4.59
	Pt	-10.32*	-13.52*	-13.80*	-12.71*	-13.65*
	Pa	-4.06*	-4.95*	-5.16*	-3.92*	-4.52*
UNP	Gt	-2.13*	-1.99*	-1.98*	-2.62*	-2.78*
	Ga	-5.13	-4.81	-5.17	-4.70	-4.75
	Pt	-11.57*	-14.73*	-14.56*	-14.63*	-17.63*
	Pa	-4.31*	-5.10*	-5.18*	-4.20*	-5.65*

*Note: *, **, and ***, represents significance at 1%, 5%, and at 10%, respectively.*

As shown in table 5, the p-values associated with $G\tau$, $G\alpha$, and $P\alpha$ statistics strongly reject the null hypothesis of no cointegration across all fifteen empirical equations, covering youth, adult, and total unemployment models. Although the $G\alpha$ statistic does not consistently reach conventional significance levels, the consistent significance of the other three statistics provides robust evidence of the existence of long-run cointegrating relationships.

These results confirm stable long-run associations among the variables, justifying the estimation of long-run coefficients using second-generation panel techniques.

4.5 LONG-RUN ESTIMATES OF UNEMPLOYMENT USING CCEMG, MG, AND FMOLS

This section presents the core empirical findings examining the long-run relationships between labour market policy instruments and unemployment, disaggregated by age groups (youth, adults, total working-age population). Table 6 reports coefficient estimates from three panel estimators, CCEMG, MG, and FMOLS which address CSD, slope heterogeneity, non-stationarity, and, partially, endogeneity making them well-suited for macro-panel data analysis across OECD countries (Pesaran, 2006; Eberhardt and Teal, 2010).

Table 6

Long-run estimates of unemployment rates by age group

Eq. No.	Dependent variable	Independent variable	CCEMG	MG	FMOLS
E1	YUNP	APWEMI	117.38	18.81***	9.64*
		LNITI	-26.17**	-1.20	-0.37*
E2		APWEMI	18.69	29.97***	8.98*
		LNTRI	-2.17	-1.95	-0.08*
E3		APWEMI	12.15**	12.90*	6.18*
		LNMIB	1.45	0.70	1.19*
E4		APWEMI	74.34***	14.37*	1.28*
		LNAAW	2.54	2.35	1.51*
E5		APWEMI	4.47	7.80**	3.27*
		LNLFPR	24.53***	16.83*	1.85*
E6	AUNP	APWEMI	7.79***	6.93**	5.13*
		LNITI	-0.93	-0.21	-0.19*
E7		APWEMI	6.37	8.26	4.81*
		LNTRI	-0.85	-0.18	-0.06*
E8		APWEMI	5.16**	6.16*	2.09*
		LNMIB	1.00***	0.54	0.44*
E9		APWEMI	1.04	2.13	0.41*
		LNAAW	8.24**	2.72**	0.55*
E10		APWEMI	0.19	1.72	1.18*
		LNLFPR	14.91**	8.24*	0.63*

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

Eq. No.	Dependent variable	Independent variable	CCEMG	MG	FMOLS
E11	UNP	APWEMI	9.39***	12.76**	6.37*
		LNITI	-1.14	-0.83	-0.32*
E12		APWEMI	2.04	11.08**	5.68*
		LNTRI	-9.66***	-0.54	-0.08*
E13		APWEMI	6.16**	7.17*	2.61*
		LNMIB	1.43**	0.55*	0.51*
E14		APWEMI	1.37	6.19**	0.58*
		LNAAW	9.31**	2.24	0.66*
E15		APWEMI	2.01	2.11	1.45*
		LNLFPR	16.46**	9.38*	0.75*

*Note: *, **, and ***, represents significance at 1%, 5%, and at 10%, respectively.*

The long-run coefficients on APWEMI are positive and statistically significant across all unemployment groups, indicating that activation policies tend to increase measured unemployment. The effect is most pronounced for youth unemployment, with notably large CCEMG coefficients (e.g., 117.38 in E1, 74.34*** in E4), reflecting heightened youth sensitivity to activation measures (O'Higgins and Brockie, 2024). This supports the "activation effect", where increased labour force participation among previously inactive youth temporarily raises unemployment due to delayed job matches (Bell and Blanchflower, 2010; Kluve, 2010). For adults, APWEMI coefficients remain positive but smaller (e.g., 7.79*** in E6), likely reflecting stronger labour market attachment and higher opportunity costs that reduce responsiveness (Bell and Blanchflower, 2010; Calmfors, Forslund and Hemström, 2002). Total unemployment also exhibits a positive association (e.g., 9.39*** in E11), consistent with these dynamics.

However, both institutional training (LNITI) and public training expenditures (LNTRI) consistently yield negative coefficients across youth, adult, and total unemployment models, corroborating extensive literature highlighting skill-building's role in enhancing employability and reducing unemployment in the medium to long term (Card, Kluve and Weber, 2010; Martin and Grubb, 2001). The significantly negative LNITI coefficient for youth unemployment (-26.17** in E1, CCEMG) underscores training's considerable effectiveness in youth labour market integration, aligning with findings emphasizing the importance of occupation-specific and well-targeted training for durable employment gains (Card, Kluve and Weber, 2018; Forslund, Fredriksson and Vikström, 2011). Conversely, training effects on adult unemployment are negative but mostly insignificant, reflecting prior evidence of insufficient intensity, targeting, or longer lag times needed to detect impacts among adults (Betcherman, Dar and Olivas, 2004; Lebedinski and Pavlović, 2023; Larsson, 2003). For total unemployment, negative coefficients – though with varied significance – support meta-analytical conclusions that public training investments reduce aggregate unemployment, particularly during downturns or periods of skill shortages (Card, Kluve and Weber, 2010; Martins, 2021).

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

Moreover, positive and statistically significant coefficients on LNMIB for adult and total unemployment (e.g., 1.43** in E13 and 1.00*** in E8, CCEMG) align with literature documenting the disincentive effects of passive income supports on labour market re-entry (Moffitt, 1985; Immervoll and Pearson, 2009; van Ours, 2007). These findings reinforce theoretical and empirical evidence that more generous benefits reduce job search intensity and prolong unemployment duration via income substitution effects (Chetty, 2006; Reale, Banning and Roos, 2024). The weaker or insignificant effects on youth unemployment reflect heterogeneity in labour market responsiveness, with youth facing distinct challenges such as weaker attachment, less stable work histories, and differing benefit eligibilities or uptake patterns (Escudero and López Mourelo, 2015; Tosun, Hörisch and Marques, 2019; Bell et al., 2024).

Furthermore, positive and significant coefficients for LNAAW across youth (2.54, E4), adult (8.24**, E9), and total unemployment (9.31**, E14) suggest that higher wages correlate with increased unemployment rates, particularly for adults. This contrasts with the traditional negative wage curve hypothesis (Blanchflower and Oswald, 1994; 2005) but aligns with more nuanced perspectives emphasizing labour market frictions and institutional constraints (Card, 1995; Poschke, 2025). The disproportionate effect on youth mirrors minimum wage literature, where wage increases can adversely affect youth employment due to their vulnerability to wage rigidities and weaker market attachment (Sen, Rybczynski and Van De Waal, 2011; Gorry, 2013).

Additionally, significant and positive coefficients for LNLFPR in youth (24.53***, E5), adult (14.91**, E10), and total unemployment (16.46**, E15) indicate that rising labour force participation – without corresponding employment growth – raises measured unemployment. This is especially evident among youth, reflecting their greater susceptibility to labour market slack and weaker attachment (Blanchard and Wolfers, 2000). The results align with empirical evidence on participation's role in amplifying unemployment during cyclical and demographic shifts (Barnichon and Figura, 2013; Aaronson et al., 2014; Rios-Avila, 2015) and structural labour market dynamics involving employment-unemployment-nonparticipation transitions (Kudlyak and Price, 2012; Dixon, Lim and van Ours, 2015). These findings emphasize the critical importance of accounting for participation dynamics to accurately assess labour market slack and the unemployment burden (Raifu and Adeboje, 2022; Paternesi Meloni, 2024; Musa, Audu and Junaidu, 2024).

While the results section presents long-run coefficients, prior studies suggest that these policy effects typically materialize over 1-3 years, reflecting the structural and behavioural adjustments required for skill acquisition, job search, and labour supply responses (Bell and Blanchflower, 2010; Card, Kluve and Weber, 2010).

The empirical results reveal that activation policies increase measured unemployment – especially among youth – while skill-building training reduces unemployment predominantly for younger workers. Generous minimum income benefits

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

are associated with higher adult and total unemployment, reflecting disincentive effects, whereas higher wages and rising labour force participation correlate with increased unemployment, highlighting labour market frictions and slack, particularly for vulnerable youth populations.

4.6 ROBUSTNESS TESTS

To assess the robustness of our main long-run estimates, we perform three complementary analyses: (i) temporal robustness across sub-periods reflecting major structural breaks in OECD labour markets, (ii) institutional robustness across welfare regime clusters, and (iii) panel non-causality checks using the Dumitrescu and Hurlin (2012) test. These analyses allow us to verify whether the effects of labour market policies are stable over time, whether they vary systematically with institutional context, and whether the identified associations generally reflect the hypothesized direction of influence from policies to unemployment outcomes.

4.6.1 Temporal robustness

To assess the temporal variation in the long-run relationships identified in section 4.5, we estimate fixed-effects regressions across four sub-periods capturing major structural breaks in OECD labour markets: pre-crisis (2004-2007), post-2008 financial crisis (2008-2012), pre-pandemic (2013-2019), and post-COVID (2020-2022). Results are reported in table A1 (appendix).

The sub-period results reveal the heterogeneous, context-dependent effects of labour market policies. For example, APWEMI generally increase youth unemployment, but the magnitude and significance vary over time. Post-crisis (2008-2012) and pre-pandemic (2013-2019) coefficients are positive and significant (YUNP: 14.13* post-crisis, 15.91** pre-pandemic; AUNP: 6.32* post-crisis, 7.04** pre-pandemic), reflecting temporary "activation effects" where previously inactive individuals entering the labour market increase measured unemployment. In contrast, pre-crisis (2004-2007) and post-COVID (2020-2022) effects are smaller and less precise (YUNP: -0.38 pre-crisis, 9.25* post-COVID; AUNP: 0.93 pre-crisis, 2.54 post-COVID), indicating more stable labour market conditions or short-term pandemic-related disruptions.

Training measures (LNITI, LNTRI) reduce youth unemployment most effectively during the pre-crisis and post-crisis periods. LNITI lowers youth unemployment pre-crisis (-0.12*, 10% significance) and post-crisis (-1.26, ns), while LNTRI is significantly negative pre-crisis (-0.17**, 5%) but loses significance subsequently. Adult and total unemployment respond weakly, with mostly negative but insignificant coefficients, suggesting that adjustment periods or targeted interventions may be needed for mature workers.

LNMIB effects are period-specific. Pre-crisis and immediate post-crisis coefficients are small and insignificant, whereas pre-pandemic (2013-2019) and post-COVID (2020-2022) estimates show strong unemployment-reducing effects

across all groups (YUNP: -11.38*, -14.02*; AUNP: -4.62*, -4.86*; UNP: -5.27**, -5.53*), likely reflecting emergency measures such as wage subsidies and short-time work schemes. Long-run estimates, however, indicate positive associations for adults and total unemployment, consistent with classical disincentive effects.

LNAAW and LNLFPR show horizon-dependent dynamics. Sub-period estimates suggest that higher wages reduce youth unemployment in all periods (pre-crisis: -32.29*; post-crisis: -31.00**; pre-pandemic: -33.84*; post-COVID: -56.56*), while effects for adults and total unemployment are smaller. These short-term reductions contrast with long-run positive DCCE coefficients, illustrating that temporary absorption, strong demand, and supportive policies can offset structural wage frictions. Similarly, rising labour force participation lowers youth unemployment in the sub-period analysis (pre-crisis: -17.79***; post-crisis: -26.78**; pre-pandemic: -27.47*; post-COVID: -67.11*), whereas long-run DCCE results show a positive relationship, reflecting limits to labour absorption over extended horizons.

In summary, temporal robustness checks indicate that policy effects are not uniform over time. Activation policies, training measures, passive income benefits, wages, and labour force participation exhibit context-dependent and horizon-specific dynamics. Insignificant coefficients are described without substantive conclusions being drawn, highlighting areas where evidence is limited. Integrating short-term and long-term perspectives provides nuanced insights into the timing and effectiveness of labour market interventions.

4.6.2 Institutional robustness

To examine heterogeneity across institutional contexts, we estimate long-run CCEMG models for six welfare regime clusters: Nordic (Denmark, Finland, Iceland, Norway, Sweden), Liberal (Australia, Canada, Ireland, New Zealand, United Kingdom, United States), Continental (Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland), Southern (Greece, Italy, Portugal, Spain), Eastern (Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia), and Mixed (Chile, Costa Rica, Israel, Japan, Korea, Mexico). Countries are classified according to established welfare regime typologies (Esping-Andersen, 1990; Bonoli, 2005), reflecting similarities in social protection systems, labour market institutions, and policy frameworks. Results are reported in table A2 (appendix).

The results show substantial regime-specific heterogeneity. APWEMI generate the largest increases in youth unemployment in Continental (135.90, Eq. E1) and Nordic regimes (49.48*, Eq. E1), whereas Southern and Eastern clusters display smaller or occasionally negative effects. Coefficients that are not statistically significant (e.g., Eastern cluster) are reported descriptively, without firm conclusions being drawn. For adult unemployment, APWEMI effects are generally positive in Nordic regimes (AUNP: 11.33**, Eq. E6), while coefficients in other clusters are small or insignificant, highlighting context-dependent responses rather than uniform effects.

PUBLIC SECTOR ECONOMICS
49 (4) 527–562 (2025)

Training measures (LNITI, LNTRI) reduce youth unemployment most effectively in Nordic and Continental regimes (LNITI: -21.66**, Eq. E1; LNTRI: -26.42**, Eq. E2). Effects in Southern, Eastern, and Mixed clusters are weaker or statistically insignificant, indicating limited or context-specific evidence. Adult unemployment coefficients are generally small and insignificant.

LNMIB effects are heterogeneous. In Nordic regimes, LNMIB are slightly positive for youth (14.01, Eq. E3) and significantly positive for adult unemployment (37.54**, Eq. E8), reflecting classical disincentive mechanisms for adults. Southern and Eastern clusters show smaller or negative, mostly insignificant coefficients, indicating context-dependent and limited effects.

LNAAW and LNLFPR effects also vary by regime. For instance, LNAAW reduces youth unemployment in Nordic regimes (-2.70, Eq. E4), but the coefficient is not statistically significant. In Liberal (20.24**, Eq. E4) and Eastern clusters (14.63, Eq. E4), coefficients are positive, but where significance is lacking, no definitive inference is drawn. LNLFPR coefficients are strongly positive in Nordic and Eastern regimes (62.37***, 59.04**, Eq. E5) but negative in Liberal and Southern clusters, illustrating heterogeneous institutional mediation of policy impacts.

In summary, the institutional robustness checks reveal considerable heterogeneity across welfare regimes. While some significant coefficients corroborate the long-run patterns observed in the main analysis, many clusters display insignificant or mixed effects, highlighting conditional and context-specific policy dynamics rather than uniform stability. This nuanced interpretation emphasizes where evidence is robust and where it is limited, in line with empirical results.

4.6.3 Dumitrescu and Hurlin panel non-causality test

As an additional robustness check, we implement the Dumitrescu and Hurlin (2012) panel Granger non-causality test. Results are presented in table A3 (appendix). The findings indicate significant bidirectional causality between unemployment rates (YUNP, AUNP, UNP) and all six labour market policy indicators (APWEMI, LNITI, LNTRI, LNMIB, LNAAW, LNLFPR). These results highlight the endogenous and adaptive nature of labour market dynamics, where unemployment fluctuations both drive and are shaped by policy responses.

The reciprocal causality between unemployment and APWEMI and training variables underscores the dual role of ALMPs as reactive safety nets and proactive tools to boost labour supply and employability (Kluve, 2010; Card, Kluve and Weber, 2018). Bidirectional linkages are especially pronounced for youth unemployment, aligning with evidence that young workers are more sensitive to policy interventions due to higher turnover, weaker labor market attachment, and prevalent skill mismatches (Bell and Blanchflower, 2010; Escudero and López Mourelo, 2017).

Similarly, the reciprocal causality between unemployment, minimum income benefits, and wage levels illustrates how income support systems and wage-setting

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

mechanisms both respond to and shape labour market slack, primarily via job search incentives and labour cost channels (Nickell and Layard, 1999). Finally, the significant bidirectional relationships with labour force participation confirm their co-determination: rising unemployment can discourage participation, while shifts in participation directly influence measured unemployment (Blanchard, 2018; Canton, 2021).

Overall, these findings support a view of labour market policies and institutions as endogenous components of unemployment dynamics.

5 CONCLUSION AND DISCUSSION

This study empirically examines the long-run and dynamic relationships between key labour market policies and unemployment rates among youth, adults, and the total labour force in 36 OECD countries from 2004 to 2022. The analysis is motivated by the persistent rise in unemployment, particularly among youth, alongside variations in public expenditure on labour market programs. The objectives were to assess the long-run effects of public spending on activation policies, income support, training, wages, and labour force participation on unemployment, and to examine how these effects vary across demographic groups, highlighting differences in policy effectiveness.

The empirical analysis revealed nuanced and sometimes counterintuitive findings that challenge conventional views on labour market interventions and unemployment dynamics. Contrary to H1, activation policies unaccompanied by employment maintenance components (APWEMI) were consistently associated with increased unemployment across all groups, especially youth. This "activation effect" likely reflects increased labour market participation by previously inactive individuals and transitional unemployment during job search periods.

In contrast, investments in institutional training (H2) and public training expenditures (H3) demonstrated robust negative associations with youth unemployment, underscoring the critical role of skill development in facilitating labour market integration among younger cohorts. Effects on adult unemployment were weaker and generally statistically insignificant, suggesting a need for more targeted or intensive interventions for mature workers.

The study also confirmed that greater generosity in minimum income benefits (H4) is linked to higher adult and overall unemployment rates, consistent with disincentive effects documented in the literature, though the anticipated stronger impact on youth unemployment was not empirically supported. Higher average annual wages (H5) were positively correlated with unemployment rates across all groups, particularly youth, indicating potential wage rigidity and labour market frictions. Rising labour force participation (H6) increased measured unemployment, reflecting the re-entry of marginally attached and discouraged workers, with the effect most pronounced among youth.

PUBLIC SECTOR ECONOMICS
49 (4) 527–562 (2025)

Furthermore, robustness checks across key sub-periods reflecting major crises (pre- and post-2008 financial crisis, pre-pandemic, and post-COVID) and across welfare regime clusters (Nordic, Liberal, Continental, Southern, Eastern, and Mixed) confirm the stability and consistency of the long-run estimates while accounting for potential structural breaks and cross-country heterogeneity, enhancing confidence in the empirical findings. At the same time, these robustness exercises reveal that policy effects are conditional and context-dependent rather than uniformly stable across regimes or time, indicating that institutional structures and macroeconomic phases critically mediate policy effectiveness. Complementing these results, Dumitrescu and Hurlin panel causality tests reveal strong bidirectional relationships between unemployment and all six labour market policy indicators, confirming the endogenous and adaptive nature of labour market institutions within broader unemployment dynamics.

These insights carry important policy implications. Policymakers should prioritize well-targeted and adequately resourced training programs – especially for youth – to promote employability and smoother school-to-work transitions. Activation measures must be carefully designed and sequenced with sufficient job-matching support to mitigate short-term unemployment inflation and maximize sustainable employment gains. Income support schemes need careful calibration to balance income security with work incentives. Wage policies and labour force participation dynamics should also be monitored closely to understand their nuanced impacts on unemployment.

While this study applies rigorous methods to a comprehensive OECD panel, limitations remain. Potential endogeneity is partially addressed using FMOLS and panel econometric techniques, though classical endogeneity concerns cannot be fully ruled out. Nevertheless, the analysis cannot fully capture cyclical asymmetries, micro-level heterogeneity, other unobserved factors, or specific OECD-level policy shifts within the sample period, which may influence country-level unemployment dynamics beyond the broad macroeconomic and institutional controls considered. Future research should build on this framework using micro-level or regional data to account for individual heterogeneity and evolving dynamics and examine additional institutional factors such as collective bargaining and labour market segmentation.

In conclusion, the findings provide robust macro-level evidence on the long-run effects of activation measures, income support, training initiatives, and wage-setting dynamics across age groups in OECD countries. The results highlight the critical role of demographic context in shaping policy effectiveness and underscore the need for nuanced, cohort-specific strategies that balance activation with targeted skill development while carefully calibrating income support and wage policies to avoid unintended distortions. Tailored approaches are essential to address persistent unemployment – especially among youth – and to build resilient, inclusive labour markets.

Disclosure statement

The authors have no conflicts of interest to declare.

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PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

APPENDIX

TEMPORAL ROBUSTNESS

Table A1

Fixed-effects regressions by sub-periods (pre-crisis: 2004-2007, post-crisis: 2008-2012, pre-pandemic: 2013-2019, post-pandemic: 2020-2022)

Eq. no.	Dependent variable	Independent variable	Pre-crisis	Post-crisis	Pre-pandemic	Post-covid
E1	YUNP	APWEMI	-0.38	14.13*	15.91**	9.25*
		LNITI	-0.12*	-1.26	0.05	-1.18
E2		APWEMI	-0.16	14.09*	16.97**	7.77*
		LNTRI	-0.17**	-1.25	-0.52	-0.24
E3		APWEMI	-1.27	11.40**	13.18**	5.16**
		LNMIB	0.50	-0.97	-11.38*	-14.02*
E4		APWEMI	-2.81	12.19*	12.24**	5.33**
		LNAAW	-32.29*	-31.00**	-33.84*	-56.56*
E5		APWEMI	-2.64	11.14**	14.22**	-0.88
		LNLFPR	-17.79***	-26.78**	-27.47*	-67.11*
E6	AUNP	APWEMI	0.93	6.32*	7.04**	2.54
		LNITI	-0.15*	-0.14	-0.12	-0.20
E7		APWEMI	1.05	6.40*	7.18**	2.52***
		LNTRI	-0.17*	-0.18	-0.20	-0.17
E8		APWEMI	0.32	6.02*	5.71**	1.54
		LNMIB	-0.06	-0.01	-4.62**	-4.86*
E9		APWEMI	-0.61	6.36*	5.22***	1.62
		LNAAW	-15.53*	-14.49***	-14.36*	-16.66*
E10		APWEMI	-0.76	5.87*	6.11***	-0.68
		LNLFPR	-11.00***	-12.34***	-10.97**	-23.57*
E11	UNP	APWEMI	2.00	7.13*	8.11**	3.19**
		LNITI	-0.18*	-0.22	-0.10	-0.25
E12		APWEMI	2.13	7.19*	8.32**	2.90**
		LNTRI	-0.20*	-0.25	-0.22	-0.06
E13		APWEMI	1.23	6.66*	6.64**	2.00
		LNMIB	0.01	-0.06	-5.27**	-5.53*
E14		APWEMI	0.23	7.04*	6.09***	2.07
		LNAAW	-17.30*	-16.12***	-16.45*	-20.11*
E15		APWEMI	0.05	6.50*	7.05**	-0.81
		LNLFPR	-12.46**	-13.42***	-13.35*	-29.33*

INSTITUTIONAL ROBUSTNESS

Table A2
CCEMG estimates across welfare regimes

Eq. no.	Dependent variable	Independent variable	Nordic	Liberal	Continental	Southern	Eastern	Other
E1	YUNP	APWEMI	49.48*	21.63**	135.90	-24.80*	0.20	68.09
		LNITI	-21.66**	-1.58	-24.92	-3.46	-0.76	-6.52
E2		APWEMI	55.41*	16.83	69.87**	-6.27*	-11.97*	94.37
		LNTRI	-26.42**	-0.95	-23.75	1.39	2.10*	-8.33
E3		APWEMI	10.38*	39.28**	7.09	-5.98*	8.25	-8.56*
		LNMIB	14.01	6.16	23.20	-0.60	6.38*	-1.62
E4		APWEMI	10.40*	13.79	2.59	-9.76**	15.34	-73.79**
		LNAAW	-2.70	20.24**	-1.56	8.84	14.63	-22.50*
E5		APWEMI	14.14*	27.97	4.96	-10.12**	-3.07	-20.82***
		LNLFPR	62.37***	-54.32	13.02	-4.84	59.04**	-4.45
E6	AUNP	APWEMI	2.62	11.33**	0.70	-0.04	-0.13	-11.06
		LNITI	-3.24*	-0.90	0.89	-0.10	-0.75***	-0.24
E7		APWEMI	2.16	10.81	0.32	-2.27*	-37.65***	37.04
		LNTRI	-3.65**	-0.66	0.45	2.43	5.51**	-4.27
E8		APWEMI	-5.60	6.59*	1.57	0.61	5.45	-2.06*
		LNMIB	37.54**	-1.86	4.00	-1.13*	2.12**	-0.70
E9		APWEMI	1.59	1.52	-2.63	0.40	-7.66	-24.99***
		LNAAW	4.17	10.71*	-32.55***	10.22**	-57.24***	-13.16
E10		APWEMI	1.91	16.59	1.99***	-1.30	-1.84	-16.74**
		LNLFPR	16.59*	1.11	4.95	7.57*	30.37*	2.42

Eq. no.	Dependent variable	Independent variable	Nordic	Liberal	Continental	Southern	Eastern	Other
E11	UNP	APWEMI	4.32**	12.29**	0.66	0.64	-0.012	225.75
		LNITI	-3.53**	-1.03	0.88	-0.75	-0.728***	-13.39**
E12		APWEMI	4.01***	11.58	0.30	-2.85*	-5.347*	38.86
		LNTRI	-4.07**	-0.80	1.22	2.75	0.002	-5.02
E13		APWEMI	1.57	8.63*	3.51**	0.53	5.987	-2.74*
		LNMIB	5.43	-0.58	3.78	-1.04**	2.597**	-0.78**
E14		APWEMI	2.54**	6.76	-2.84	-2.76	6.229***	-11.89
		LNAAW	3.94	23.25*	-26.24**	8.43	6.559	-7.05
E15		APWEMI	4.16	15.18	3.13**	-1.94	-1.954	-18.47**
		LNLFPR	16.09***	-27.85	2.98	7.58*	35.012*	-1.21

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

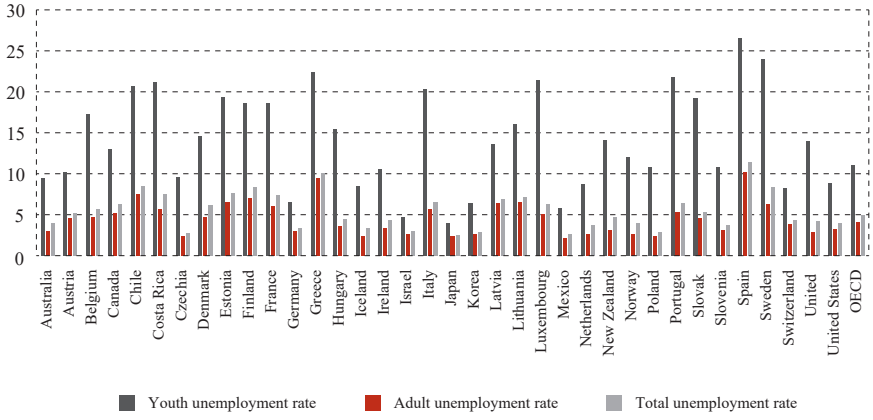
TABLE A3

Panel Granger causality test results (Dumitrescu and Hurlin, 2012)

Dependent variable	Independent variable	Lag (AIC)	Z-bar	Z-bar tilde	Direction of causality
YUNP	APWEMI	2	5.50*	2.92*	YUNP ⇔ APWEMI
	LNITI	2	8.07*	4.70*	YUNP ⇔ LNITI
	LNTRI	2	7.03*	3.99*	YUNP ⇔ LNTRI
	LNMIB	1	3.32*	2.06*	YUNP ⇔ LNMIB
	LNAAW	2	5.47*	2.91	YUNP ⇔ LNAAW
	LNLFPR	1	5.46*	3.69*	YUNP ⇔ LNLFPR
AUNP	APWEMI	2	30.02*	19.61*	AUNP ⇔ APWEMI
	LNITI	2	21.38*	13.75*	AUNP ⇔ LNITI
	LNTRI	2	24.15*	15.64*	AUNP ⇔ LNTRI
	LNMIB	2	5.11*	2.68*	AUNP ⇔ LNMIB
	LNAAW	2	11.66*	7.12*	AUNP ⇔ LNAAW
	LNLFPR	2	3.97*	1.88*	AUNP ⇔ LNLFPR
UNP	APWEMI	2	25.50*	16.53*	UNP ⇔ APWEMI
	LNITI	2	25.79*	16.75*	UNP ⇔ LNITI
	LNTRI	2	25.79*	16.75*	UNP ⇔ LNTRI
	LNMIB	2	4.64*	2.36*	UNP ⇔ LNMIB
	LNAAW	2	10.57*	6.37*	UNP ⇔ LNAAW
	LNLFPR	1	5.84*	3.98*	UNP ⇔ LNLFPR

FIGURE A1

Variation in unemployment rates by age group across OECD countries in 2024 (% of labour force)

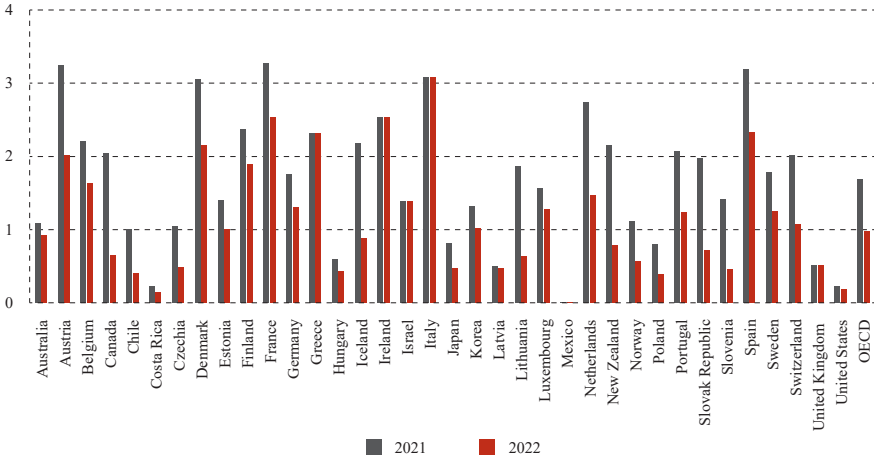


Source: OECD, 2024b; authors' calculation.

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

FIGURE A2

Public spending on labour market programs across OECD countries (% of GDP)



Source: OECD, 2024c; authors' calculation.

METHODOLOGICAL FORMULAS AND DETAILS

This part presents the technical formulas and details for the estimation strategy described in section 3.3.

A.1 Pesaran CD test (2004)

The CD test evaluates cross-sectional dependence (CSD) among residuals:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(H-m)P_{ij}^{\wedge 2} - E\left[(H-m)P_{ij}^{\wedge 2}\right]}{var\left[(H-m)P_{ij}^{\wedge 2}\right]}$$

Where:

- T = number of time periods
- N = number of cross-sectional units
- $P_{ij}^{\wedge}$ = pairwise correlation of residuals between units *iii* and *jjj*.

Significant CD indicates the presence of common shocks affecting multiple units.

A.2 CIPS unit root test (Pesaran, 2007)

The cross-sectionally augmented IPS (CIPS) test evaluates stationarity under CSD:

$$CIPS = N^{-1} \sum_{i=1}^{n} t(N,T)$$

Where, $t(N, T)$ is the CADF t-statistic for unit i.

PUBLIC SECTOR ECONOMICS
49 (4) 527-562 (2025)

A.3 Slope homogeneity test (Pesaran and Yamagata, 2008)

The slope homogeneity test checks whether slope coefficients are identical across countries:

$$\widehat{\Delta} = \sqrt{N}\frac{N^{-1}\widehat{N} - K}{\sqrt{2k}},\ \widehat{\Delta_{adj}} = \sqrt{N}\frac{N^{-1}\widehat{N} - K}{\sqrt{var(T,K)}}$$

Where:

- K = number of regressors
- $Var(T, K)$ = variance adjustment factor.

Rejection of the null indicates heterogeneous slopes.

A.4 Westerlund panel cointegration test (2007)

The error-correction model:

$$\Delta y_{it} = \delta_i' d_t + \alpha_i y_{i,t-1}, -\beta_i' x_{i,t-1} + \sum_{j=1}^{pi} \alpha_{ij} \Delta y_{i,t-j} + \sum_{-qi}^{pi} \gamma_{ij} \Delta x_{i,t-j} + \mu it$$

- Null hypothesis: H_0: $\alpha_i = 0$ (no cointegration)
- Westerlund proposes four test statistics: group-mean G_τ, G_α and panel P_τ, P_α.

A.5 Dumitrescu and Hurlin panel non-causality test (2012)

The panel causality model:

$$Y_{it} = \pi_i + \sum_{\rho=1}^{P} \theta_{i,\rho} Y_{i,t-p} + \sum_{\rho=1}^{P} \delta_{i,\rho} X_{i,t-p} + e_{i,t}$$

The null hypothesis H_0:$\delta i = 0$ implies no causality.

The standardized statistics are:

$$Z_{\bar{\tilde{S}}} = \sqrt{\frac{N}{2M}}\left(\bar{S} - M\right) \to N(0,1)$$

$$\tilde{Z} = \sqrt{\frac{N(T-2M-5)}{2M(T-M-3)}} \times \left[\frac{(T-2M-3)}{(T-2M-1)}\bar{S} - M\right] \to N(0,1)$$

where T is the time and M is the lag length. Under the null, the statistics follow the standard normal distribution.

Note: These formulas allow replication of all tests and estimators applied in the main analysis, ensuring transparency and methodological rigour.