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Are there more than three regimes in the output-unemployment relationship? A panel quantile regression estimates of Okun's gap model in EU countries

Mindaugas Butkus[a], **Laura Dargenyte-Kacileviciene**[a], **Kristina Matuzeviciute**✉ [a], **Dovile Rupliene** [a], **Janina Seputiene** [a]
[a] Vilnius University, Lithuania

Abstract
Until recently, the output-unemployment relationship (Okun's coefficient) was believed to follow two regimes, implying a uniform effect of expansionary fiscal policy on unemployment during economic booms and declines. However, research by Oh (2018) and Donayre (2022) introduced a three-regime approach, suggesting this relationship varies over different economic phases. Building on this, we propose a multinomial Okun's coefficient model using a gap model and quantile regression to estimate the coefficient at various unemployment levels. Our findings reveal that Okun's coefficient is significantly higher during severe recessions and lower at the onset of economic decline compared to the two-regime model. This indicates that the effectiveness of expansionary fiscal policy in reducing unemployment is limited when implemented at the start of a recession and is more effective during severe recessions, suggesting a need to re-evaluate the timing of such policies.

Keywords: output-unemployment relationship, Okun's gap model, panel quantile regression, EU countries

Introduction

The seminal Okun's (1962) paper inspired an enormously rich strand of research on the output-unemployment nexus. A sizeable interest in unemployment's reaction to output changes over the business cycle has increased since the Great Recession, as it significantly changed unemployment rates in EU countries. Economies also faced a crisis caused by coronavirus (COVID-19) and war in Ukraine, while unemployment is still higher in some countries than before the 2008–2009 crisis.

The vast literature strongly supports the validity of Okun's law. This relationship has attracted the attention of economists and macroeconomic

✉Kristina Matuzeviciute, Senior Researcher, Institute of Regional Development, Siauliai Academy, Vilnius University, Lithuania; email: kristina.matuzeviciute-balciuniene@sa.vu.lt.

policymakers but with no consensus on the size of Okun's coefficient, which substantially varies across countries and over time. These variations indicate that countries may require different fiscal and monetary policies to manage unemployment effectively. For example, if a country knows its Okun's coefficient is relatively low, it might focus more on structural reforms rather than solely relying on growth policies. Otherwise, a country with a higher Okun coefficient might need more aggressive growth policies to reduce unemployment. Recognizing these variations allows for more precise and effective interventions, helping countries achieve their economic and employment goals more efficiently.

An increasing number of studies confirm Okun's law asymmetry and non-linearity. Earlier research revealed that Okun's coefficient might vary across separate business cycle phases. Some studies raised the question of its instability, arguing that Okun's law was stable only during the recession (Knotek, 2007; Meyer & Tasci, 2012) or supporting the view that the law is nonlinear between recession and expansion periods (Owyang & Sekhposyan, 2012; Valadkhani and Smyth, 2015). Research also shows that unemployment's response to output weakens during expansions and during mild recessions compared to deep recessions, which is consistent with the previous findings that recession and recovery are not all the same and thus, the response of unemployment to output differs (Eo & Kim, 2016; Donayre & Panovska, 2021). Most research in this field concludes that unemployment is more responsive to economic recessions than expansions (Aguiar-Conraria et al., 2020; Christopoulos et al., 2023; Donayre, 2022; Kim et al., 2020; Novák & Darmo, 2019; Tang & Bethencourt, 2017). Butkus and Šeputienė (2019) summarize the arguments made by scholars, explaining a stronger response of the unemployment rate to a decrease in output than to its growth.

Oh (2018) and Donayre (2022) started a new strand of research that allows Okun's coefficient to vary across more than two phases of the business cycle. Oh (2018) estimated Okun's coefficients, separating three instead of two business cycle phases: early expansion, late expansion, and recession, including and interacting phase dummies to obtain different coefficients for various stages of the business cycle. Donayre (2022) divided the cycle into three regimes: expansions, mild recessions, and deep recessions defined by endogenously estimated thresholds for the unemployment rate. Authors state that division into three phases or regimes can reveal some hidden institutional change behind Okun's coefficient measured for entire cycles (Oh, 2018) and capture all the variation in the joint behavior of output and unemployment (Donayre, 2022).

In addition to the standard linear specification, there is an alternative technique – quantile regression – to evaluate differences in unemployment responsiveness to output change over different business cycle phases taking into account various levels of the unemployment rate (Kim, 2022; Lee et al., 2013; Wang and Huang, 2017). Research reveals that during periods of slower economic growth, Okun's coefficients are relatively higher (less negative), showing that the impact of changes in output on unemployment is not symmetric and is more significant during economic downturns than periods of growth.

Our research aims to examine the heterogeneity of the output-unemployment relationship over various stages of the business cycle considering age-, gender- and educational attainment level-specific unemployment in 28 EU countries. This research complements limited empirical evidence on analyzing the Okun coefficient over more than two phases dividing expansion and recession into two regimes. This approach is based on previous research by Oh (2018) and Donayre (2022) who divided expansion and recession phases into different regimes. Additionally, this study considers gender-, age-, and educational attainment level-specific Okun's coefficients, which previous research has shown to cause heterogeneity of the output-unemployment nexus. Examining the cyclical behaviour of gender-, age-, and educational attainment level specific Okun's coefficients provides a clearer picture of how different segments of the labour force are affected by output changes. This helps in identifying vulnerable groups and addressing the unique needs of these groups within the economy by promoting inclusive growth and adopting the targeted regulatory framework.

By examining the heterogeneity of the output-unemployment relationship using quantile regression, this research provides a more nuanced understanding of the relationship at the various levels of unemployment, as we might expect that output-unemployment relationship depends on the type of unemployment. Our results show a higher Okun coefficient for a positive gap and high unemployment rate than proposed by the two-regime approach. We also found that if unemployment remains relatively low, the Okun coefficient remains significantly lower for negative gap periods than the Okun coefficient suggested by the two-regime approach.

The rest of the paper is organized as follows: Section 1 summarises empirical evidence on the output-unemployment relationship across different business cycle stages. Section 2 presents the model, estimation strategy, and data. Section 3 discusses the main results, and the last section concludes the paper.

1. Literature review

Voluminous literature provides strong support for the validity of Okun's law, but with no consensus on the size of Okun's coefficient, which substantially varies across countries and over time. An increasing number of studies confirm Okun's law asymmetry and non-linearity. Many researchers estimate how the reaction of total unemployment varies over two phases of the business cycle and conclude that the reaction to recessions is more robust than to expansions (Aguiar-Conraria et al., 2020; Christopoulos et al., 2023; Kim et al., 2020; Novák & Darmo, 2019; Tang & Bethencourt, 2017). Donayre (2022) argues that common agreement on asymmetric behavior in both output and unemployment rates serves as a background for regime-dependent Okun's relationship. Butkus and Šeputienė (2019) summarized the arguments made by scholars, explaining a stronger response of the unemployment rate to a decrease in production than to its growth. Firms lay off workers in recession, but during recovery, they focus primarily on increasing productivity rather than hiring new workers. Unions and labor laws can maintain wage inflexibility, leaving employers with no choice but to fire workers. Institutional regulations may restrict hiring and firing processes and cause weaker unemployment reactions to output changes.

Oh (2018) and Donayre (2022) started a new strand of research that allows Okun's coefficient to vary across more than two phases of the business cycle. Oh (2018) was the first to separate more than two business cycle phases. However, his estimates are based on the employment version of Okun's Law. By including and interacting dummies of three phases (recession, early, and late expansion), Oh (2018) obtains different coefficients for various business cycle stages. The responsiveness of the employment rate (Okun's coefficient) to output changes was the lowest during late expansions. In contrast, the size of estimates for recessions and early expansions varies across different periods.

Donayre (2022) tests Okun's law with quarterly real GDP and unemployment for the US using the three-regime threshold regression model. The results show that three regimes, namely expansion, mild recession, and deep recession, are necessary to identify all the output and unemployment relationship variations. Through empirical analysis, it has been determined that the relationship between unemployment and output is weaker not only during economic expansions but also during mild recessions in comparison to severe economic downturns. This dynamic pattern of Okun's relationship across different phases of business cycles is also linked to the existence of nominal wage rigidities.

An alternative but infrequently applied technique for investigating the asymmetry of Okun's law involves estimating how the response of the unemployment rate to changes in output varies with respect to the level of the unemployment rate (Kim, 2022; Lee et al., 2013; Wang & Huang, 2017). However, only Wang and Huang (2017) separated Okun's coefficient over recessions and recoveries.

Lee et al. (2013) used data for 12 OECD (Organization for Economic Cooperation and Development) countries to apply a quantile unit root test, which estimated the potential asymmetric response of the unemployment rate to changes in real GDP across a range of quantiles of conditional unemployment distribution. The results show that the magnitudes of shocks that affect the unemployment rate vary across quantiles. Furthermore, the estimated shocks are usually greater in the upper quantiles than in the lower quantiles (in absolute value), implying that economic downturns have a greater effect on unemployment compared to economic upturns.

Wang and Huang (2017) suggest a new way to study Okun's law using a threshold in regression quantiles approach with US quarterly data. The study confirms the validity of Okun's law, with negative coefficients in both recessionary and expansionary periods. Additionally, the study finds that the effect of output changes on unemployment changes is asymmetric, with the effect being more pronounced in relatively lower-growth regime. The Okun's coefficients are significantly different across most quantiles and range from -0.365 (quantile 0.9) to -0.129 (quantile 0.1) in the lower-growth regime and from -0.310 (quantile 0.1) to -0.150 (quantile 0.7) in the higher-growth regime.

Kim (2022) applied fixed effects quantile regression model to estimate the coefficient of Okun's law for Korea with quarterly regional panel data. The results show that estimates of the effects of GDP growth rates on unemployment rates, i.e., Okun's parameters, vary with respect to quantile and range from 0.28 to 0.42 in absolute values. The results suggest that unemployment rates are more responsive to growth rates during deep recessions or significant expansion periods.

All the studies that examined the asymmetry of Okun's law across multiple phases of the business cycle or estimated Okun's coefficients conditional on the unemployment rate did not consider gender, age, or educational attainment level as a potential moderator, and relied primarily on data from a single (in general US) country. Research by Butkus et al. (2020) accounted for gender and age factors when analyzing Okun's coefficients based on the level of the unemployment rate. This research revealed the differences in Okun's coefficients for males, females, and various age groups in 28 European Union (EU) countries. This supports the logic of our research to analyse age- and gender-specific unemployment over four business cycle regimes.

2. Materials and methods

Our estimation strategy to examine the heterogeneity of the output-unemployment relationship over different stages of the business cycle is based on the gap version of Okun's law. It states that the difference between the actual (u) and equilibrium ($u*$) unemployment rates is negatively related to a gap between actual real (Y) and potential ($Y*$) outputs, i.e.:

$$u - u^* = \beta \cdot (Y - Y^*) \quad (1)$$

where β is Okun's coefficient. Rearranging the equation and specifying it for the panel data, we get:

$$u_{i,t} = u^*_{i,t} + \beta \cdot \left(Y_{i,t} - Y^*_{i,t}\right) + \varepsilon_{i,t} \quad (2)$$

where i represents the country and t – period. Here we model that the equilibrium unemployment rate is country- and time-specific since economies vary regarding labor market regulation, industry structure, etc. Moreover, due to secular changes like (de)globalization, technological advances, workplace robotization, etc., equilibrium unemployment is also time-varying. This modeling allows us to address one of the critiques directed to alternative equations analyzing Okun's law, i.e., the equilibrium unemployment rate is time- and country-invariant.

Previous contributions assume that β is more prominent during the economic recession (when the gap is negative) compared to periods of economic expansion (when the gap is positive), i.e., unemployment is more sensitive to negative than positive output change. Using dummies to distinguish positive/negative gaps in output or positive/negative output changes, research mainly estimates two Okun's coefficients, one for the period of economic boom and one for the period of economic recession, using specifications similar to:

$$u_{i,t} = u_{i,t}^{*} + \beta \cdot \left(Y_{i,t} - Y_{i,t}^{*}\right) + \delta \cdot \left(Y_{i,t} - Y_{i,t}^{*}\right) \times D_{i,t}^{-} + \gamma \cdot D_{i,t}^{-} + \varepsilon_{i,t} \qquad (3)$$

where $D_{i,t}^{-}$ equals 1 when $\left(Y_{i,t} - Y_{i,t}^{*}\right) < 0$ and equals 0 otherwise. β represents Okun's coefficient over the phase of economic expansion and $\beta + \delta$ over the economic recession.

Departing from this traditional binomial setting (or so-called two regimes setting), we assume that β varies over the course of economic growth and decline phases. Here we assume that unemployment responsiveness to output change is not the same at the beginning of economic growth (when the unemployment rate is high) and when the economy reaches its peak (when the unemployment rate is low). The same is true considering the economic decline, one we can expect when the economy has just started to shrink (and unemployment is still relatively low) compared with the situation over the deepest recession point (when unemployment is exceptionally high).

To model multinomial β, we apply fixed effects quantile regression developed by Kim (2022) on specification (3), which estimates β and δ along with other parameters at the different levels of u, and in our case, separating periods of the positive and negative output gap. Here we assume that the unemployment rate is a good indicator of the business cycle stage, which is in line with Donayre (2022). Since some countries over economic boom might have higher unemployment rates than others over the deepest decline, modeling cross-country heterogeneity, i.e., country- and time-specific equilibrium unemployment rates, allow us to account for these differences. Moreover, we use autocorrelation and heteroscedasticity robust standard errors in all estimations to account for the fact that unemployment in some countries might be subject to the unite-root process and thus induce autocorrelation in the error term.

Our estimation strategy allows us to combine and test ideas discussed by Donayre (2022) and Oh (2018), who were the first ones departing from the two-regime setting in the output-unemployment relationship. Oh (2018) proposed a three-regime setting by splitting the phase of economic growth in two – early expansion and late expansion, while keeping economic decline as one phase. Meanwhile, Donayre (2022) keeps the economic growth phase unsplit but proposes mild and deep recessions in his three-regime setting. Our proposed specification allows looking for more than three regimes in the output-unemployment relationship by relaxing the assumption that there are two significantly different Okun's coefficients in times of economic expansion or recession.

The main drawback of Okun's law gap specification is that Y^* and u^* cannot be directly observed and require additional estimations. Various detrending techniques are used to measure the cyclical components of output and unemployment rate. Among the most used filters in Okun's law analysis is the Hodrick-Prescott (HP) filter

(Christopoulos et al., 2023; Donayre, 2022; Kim et al., 2020;), which is quite simple to use. Despite the gained popularity, the HP filter is criticized as it may lead to spurious dynamics and results (Hamilton, 2018). For that reason, other estimations techniques such as Baxter–King filter (Christopoulos et al., 2023), Hamilton filter (Christopoulos et al., 2023; Donayre, 2022), Kalman filter (Oh, 2018), Beveridge and Nelson filter (Donayre, 2022), Christiano–Fitzgerald or Butterworth filters (Acaroğlu, 2018) are used for the output gap estimates and the robustness check as well.

For our estimations, we apply the commonly used Hodrick and Prescott's (1997) (HP) filter, which is a two-sided moving average filter that decomposes an integrated time series into a stochastic trend and a cyclical component by minimizing the variance of the cyclical component (Lee, 2000). The smoothing parameter λ=1600 is used in estimations as it is compatible with quarterly data. Since the results can be sensitive to the filtering method, for a robustness check, we also apply alternative techniques such as the Hamilton filter (H) and the Beveridge-Nelson (BN) filter proposed by Hamilton (2018) and Kamber et al. (2018), respectively. Hamilton filter addresses all the HP filter drawbacks (Hamilton, 2018), and the Beveridge–Nelson filter provides an estimate of the cycle that is reliable in real-time and performs relatively well in terms of correlation with the true output gap (Kamber et al., 2018).

Table 1. Summary statistics

Variable	Mean	Median	S.D.	Min	Max	N
Output (Y)[(1)]	$1.24\cdot10^5$	$4.56\cdot10^4$	$1.93\cdot10^5$	$1.46\cdot10^3$	$8.14\cdot10^5$	2339
lnY	10.6	10.7	1.58	7.28	13.6	2339
Total unemployment (TU)[(2)]	8.57	7.50	4.37	1.90	27.6	2339
Male unemployment (MU)[(2)]	8.34	7.20	4.39	1.60	26.3	2339
Female unemployment (FU)[(2)]	8.93	7.70	4.73	2.30	31.6	2339
Youth unemployment (YU)[(2)]	19.8	18.5	9.71	4.30	59.4	2330
ISCED0-2 unemployment (ELU)[(2)(3)]	15.1	12.8	8.62	3.10	54.4	2201
ISCED3-4 unemployment (EMU)[(2)(3)]	8.75	7.40	4.91	1.70	31.4	2201
ISCED5-8 unemployment (EHU)[(2)(3)]	4.96	4.30	2.89	0.800	20.7	2144

(1) Quarterly seasonally adjusted Gross Domestic Product at constant 2015 prices, million euros.
(2) Quarterly seasonally adjusted unemployment rate, %.
(3) Educational attainment level (low, medium, high) specific unemployment: low corresponds to ISCED0-2 level education, medium – ISCED3-4 level education, and high – ISCED5-8 level education.
Source: Eurostat

Our specification requires estimating just $Y*$ using the abovementioned filters since $u*$ is routinely estimated along with other coefficients of the equation's parameters, i.e., time- and country-specific constant $u_{i,t}^*$ is the equilibrium unemployment rate when the gap is positive and $u_{i,t}^* + \gamma$ when the gap is negative.

The source of our data is Eurostat. We use quarterly data for the output (*Y*) and different unemployment (*U*) types. Data were collected from 2000 to 2020 for 28 EU countries (the United Kingdom included). Descriptive statistics of the data are presented in Table 1.

3. Results

We estimated our Eq. (3) using the least squares dummy variable (LSDV) estimator to get Okun's coefficients in a traditional two-regime setting, i.e., one for the period of the positive output gap (β) and one for the period of the negative output gap (β+δ). Alternatively, using a fixed effects quantile estimator, we estimated the same specification to get Okun's coefficients corresponding to a particular unemployment level decile in each regime. It allows us to test at which unemployment decile Okun's coefficient starts to significantly depart from the one estimated in a traditional two-regime setting. General estimation results when the output gap is calculated using potential output (Y*) estimated with HP filter are presented in Table 2.

LSDV estimates are consistent with the literature which applies Okun's law analyzing the output-unemployment nexus considering gender, age, and educational attainment-level specific unemployment in a two-regime setting. We find that unemployment is affected more over negative output gap periods than periods of a positive gap. Results also suggest that youth unemployment is more sensitive than the total, male or female unemployment which is in line with research by Hutengs and Stadtmann (2013, 2014), Zanin (2014), Banerji et al. (2014, 2015), Dietrich and Möller (2016), Dixon et al. (2017), Dunsch (2017), Evans (2018), Ahn et al. (2019), Butkus and Seputiene (2019), Kim and Park (2019). Moreover, we get the same results as Askenazy et al. (2015) and Butkus et al. (2020): the sensitivity of unemployment to the output gap decreases with the increase in education level, i.e., Okun's coefficient, and thus the unemployment sensitivity is almost four times smaller when comparing low and high educational attainment level-specific unemployment.

Quantile estimates provide strong evidence that we should consider at least four regimes while analysing the output-unemployment relationship in the EU based on Okun's law.

For example, results suggest that when the output gap is positive, the reaction of total unemployment to output fluctuations is statistically significantly higher when total unemployment is above 8.4% compared to when it is below this level. It means that if the economy is producing above its potential output level (the output gap is positive) and labor resources are not being utilized efficiently in the short term, output fluctuations have a significantly higher effect on unemployment than when unemployment levels are low, i.e., the economy is operating above its full capacity and utilizing all available resources efficiently.

Table 2. Panel LSDV and fixed effects quantile estimates of Okun's coefficients of the two-regime setting

U	Okun's coeff.	LSDV estimates	Quantile estimates								
			Deciles								
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
TU	β	-0.198***	-0.218***	-0.196***	-0.228***	-0.195***	-0.219***	-0.271***	-0.366***‡	-0.414***‡	-0.341***‡
		(0.060)	(0.022)	(0.023)	(0.029)	(0.020)	(0.044)	(0.038)	(0.046)	(0.054)	(0.057)
	β+δ	-0.718***	-0.185***‡	-0.317***‡	-0.542***‡	-0.613***	-0.772***	-0.823***	-0.835***	-0.727***	-0.753***
		(0.055)	(0.024)	(0.038)	(0.102)	(0.072)	(0.077)	(0.033)	(0.065)	(0.055)	(0.055)
	U^+, %	7.7	3.9	4.7	5.4	6.2	6.8	7.6	8.4	9.8	12.9
	U^-, %	9.4	4.8	5.7	6.5	7.3	8.1	9.0	10.4	12.7	16.0
MU	β	-0.201***	-0.222***	-0.204***	-0.22***	-0.203***	-0.188***	-0.256***	-0.352***‡	-0.425***‡	-0.332***‡
		(0.064)	(0.020)	(0.015)	(0.028)	(0.047)	(0.040)	(0.042)	(0.059)	(0.061)	(0.048)
	β+δ	-0.848***	-0.169***‡	-0.270***‡	-0.440***‡	-0.694***‡	-0.982***	-1.01***	-0.947***	-0.95***	-0.901***
		(0.059)	(0.037)	(0.037)	(0.123)	(0.115)	(0.104)	(0.07)	(0.073)	(0.035)	(0.056)
	U^+, %	7.4	3.6	4.5	5.3	5.9	6.6	7.2	8.1	9.3	12.6
	U^-, %	9.2	4.6	5.6	6.3	7.1	7.8	8.8	10.1	12.6	16.8
FU	β	-0.209***	-0.2000***	-0.208***	-0.235***	-0.237***	-0.281***	-0.339***‡	-0.313***	-0.371***‡	-0.266***
		(0.057)	(0.015)	(0.028)	(0.039)	(0.036)	(0.041)	(0.027)	(0.048)	(0.056)	(0.058)
	β+δ	-0.579***	-0.206***‡	-0.407***‡	-0.467***‡	-0.536***	-0.539***	-0.62***	-0.653***	-0.651***	-0.532***
		(0.052)	(0.071)	(0.066)	(0.052)	(0.052)	(0.075)	(0.057)	(0.032)	(0.035)	(0.035)
	U^+, %	8.2	4.1	4.8	5.4	6.2	7.1	7.9	8.9	10.6	13.7
	U^-, %	9.6	4.9	5.7	6.6	7.4	8.3	9.5	10.7	13.0	16.2
YU	β	-0.271**	-0.347***	-0.404***	-0.419***	-0.371***	-0.435***	-0.542***‡	-0.592***‡	-0.610***‡	-0.629***‡
		(0.122)	(0.041)	(0.059)	(0.074)	(0.065)	(0.093)	(0.101)	(0.106)	(0.062)	(0.101)
	β+δ	-1.407***	-0.470***‡	-0.886***‡	-1.111***‡	-1.388***	-1.448***	-1.612***	-1.687***‡	-1.701***‡	-1.503***
		(0.111)	(0.137)	(0.103)	(0.191)	(0.129)	(0.143)	(0.135)	(0.136)	(0.076)	(0.127)
	U^+, %	17.9	8.6	10.0	11.8	14.6	16.8	18.7	20.6	23.3	29.5
	U^-, %	21.6	10.2	12.5	15.0	17.9	20.3	22.2	24.6	28.5	36.4
ELU	β	-0.447***	-0.501***	-0.468***	-0.42***	-0.366***	-0.394***	-0.611***	-0.654***‡	-0.706***‡	-0.524***
		(0.094)	(0.038)	(0.073)	(0.091)	(0.07)	(0.072)	(0.08)	(0.093)	(0.092)	(0.127)
	β+δ	-1.027***	-0.37***‡	-0.57***‡	-0.826***‡	-1.029***	-1.278***‡	-1.219***‡	-1.126***	-1.089***	-1.024***
		(0.086)	(0.082)	(0.118)	(0.129)	(0.143)	(0.103)	(0.079)	(0.088)	(0.084)	(0.079)
	U^+, %	13.9	6.6	7.8	8.8	10.1	11.8	13.6	16.1	18.7	24.5
	U^-, %	16.1	7.1	8.6	10.0	11.8	13.7	15.9	18.4	22.5	28.4
EMU	β	-0.217***	-0.291***	-0.307***	-0.324***	-0.273***	-0.279***	-0.328***	-0.325***	-0.346***‡	-0.361***‡
		(0.066)	(0.025)	(0.039)	(0.041)	(0.037)	(0.036)	(0.048)	(0.04)	(0.053)	(0.038)
	β+δ	-0.850***	-0.223***‡	-0.402***‡	-0.655***‡	-0.864***	-0.945***	-0.945***	-0.952***	-0.957***	-0.909***
		(0.060)	(0.036)	(0.073)	(0.102)	(0.098)	(0.066)	(0.05)	(0.068)	(0.046)	(0.039)
	U^+, %	7.8	3.6	4.4	5.0	5.8	6.8	7.6	8.8	10.3	13.5
	U^-, %	9.6	4.4	5.3	6.5	7.3	8.3	9.4	10.9	13.3	17.4
EHU	β	-0.061*	-0.006	-0.016	-0.032*	-0.068***‡	-0.088***‡	-0.096***‡	-0.114***‡	-0.131***‡	-0.135***‡
		(0.036)	(0.027)	(0.017)	(0.018)	(0.017)	(0.016)	(0.019)	(0.03)	(0.024)	(0.035)
	β+δ	-0.394***	-0.151***‡	-0.178***‡	-0.255***‡	-0.315***‡	-0.360***	-0.417***	-0.43***	-0.384***	-0.394***
		(0.032)	(0.035)	(0.021)	(0.044)	(0.046)	(0.04)	(0.032)	(0.034)	(0.03)	(0.042)
	U^+, %	4.5	2.2	2.6	3.0	3.3	3.8	4.3	5.1	5.8	7.4
	U^-, %	5.4	2.5	3.2	3.8	4.2	4.6	5.2	6.0	6.9	8.8

Potential output (Y^*) is estimated using the HP filter. All estimations include time- and country-specific dummies. Autocorrelation and heteroscedasticity robust standard errors are presented in parentheses. *** for p-values ≤ 0.01, ** for p-values ≤ 0.05, * for p-values ≤ 0.10. ‡ indicate at which unemployment deciles Okun's coefficients are statistically significantly (at 0.05 level) different from one estimated using LSDV (least squares dummy variable estimator). U^+ and U^- represent the average (next to LSDV estimates) and deciles (next to quantile estimates) of the corresponding unemployment level when the output gap is positive and negative, respectively. β represents Okun's coefficient when the output gap is positive, and $\beta+\delta$ represents Okun's coefficient when the output gap is negative.
Source: Eurostat

We observe a similar situation over the periods of the negative output gap. With the unemployment level not exceeding 6.5%, unemployment's reaction to output fluctuations is statistically significantly lower than when unemployment is high during a deep recession. These results are consistent across all types of analyzed unemployment, just threshold decile, and thus, the unemployment level at which we observe the switch of the regimes differs.

Based on the estimated threshold deciles (Table 2), we constructed the specification similar to Eq. (2), just with four regimes: (i) PG1 – the GDP gap is positive, and the unemployment rate is above the threshold decile (relatively high). This situation suggests that the economy is producing above its potential output level in the short term, but labor resources are not being utilized efficiently; the natural unemployment rate is higher compared to other periods. (ii) PG2 – the GDP gap is positive, and the unemployment rate is below the threshold decile (relatively low). This situation suggests that the economy is operating above its full capacity and is utilizing all available resources efficiently. (iii) NG1 – the GDP gap is negative, and the unemployment rate is below the threshold decile (relatively low). The negative GDP gap indicates that the economy is experiencing a recession. However, the relatively low unemployment level suggests the recession is not severe (there may be the beginning or the end of a recession). (iv) NG2 – the gap is negative, and the unemployment rate is above the threshold decile (relatively high). This situation represents a deep recession.

We estimated gender-, age- and educational attainment level-specific Okun's coefficients for these four regimes. Results are presented in Table 3.

Table 3. LSDV estimates of Okun's coefficients across the four-regime setting

Unemployment			**Regime**			
			Positive gap (PG)		Negative Gap (NG)	
			PG1	PG2	NG1	NG2
Total	Threshold	decile	0.7		0.3	
		TU, %	≥8.4	<8.4	≤6.5	>6.5
	Okun's coef.		-0.375***	-0.117*	-0.584***	-0.676***
			(0.096)	(0.065)	(0.081)	(0.052)
Male	Threshold	decile	0.7		0.4	
		MU, %	≥8.1	<8.1	≤7.1	>7.1
	Okun's coef.		-0.370***	-0.106*	-0.584***	-0.756***
			(0.102)	(0.059)	(0.080)	(0.053)
Female	Threshold	decile	0.6		0.3	
		FU, %	≥7.9	<7.9	≤6.6	>6.6
	Okun's coef.		-0.475***	-0.024	-0.556***	-0.491***
			(0.084)	(0.055)	(0.072)	(0.049)
Youth	Threshold	decile	0.6		0.3	
		Y, %	≥18.7	<18.7	≤15.0	>15.0
	Okun's coef.		-0.829***	-0.028	-0.572***	-1.192***
			(0.146)	(0.104)	(0.150)	(0.102)
ISCED0-2	Threshold	decile	0.7		0.3	

Unemployment			**Regime**			
			Positive gap (PG)		Negative Gap (NG)	
			PG1	PG2	NG1	NG2
		ELU, %	≥16.1	<16.1	≤10.0	>10.0
	Okun's coef.		-0.466***	-0.199	-0.752***	-1.147***
			(0.099)	(0.173)	(0.155)	(0.089)
ISCED3-4	Threshold	decile	0.8		0.3	
		EMU, %	≥10.3	<10.3	≤6.5	>6.5
	Okun's coef.		-0.483***	-0.046	-0.697***	-0.784***
			(0.095)	(0.068)	(0.090)	(0.057)
ISCED5-8	Threshold	decile	0.4		0.4	
		TU, %	≥3.3	<3.3	≤4.2	>4.2
	Okun's coef.		-0.504***	-0.034	-0.145***	-0.268***
			(0.111)	0.031	(0.036)	(0.036)

Potential output (Y^*) is estimated using the HP filter. All estimations include time- and country-specific dummies. Autocorrelation and heteroscedasticity robust errors are presented in parentheses. *** for p-values ≤ 0.01, ** for p-values ≤ 0.05, * for p-values ≤ 0.10.
Source: Eurostat

Results suggest that estimated Okun's coefficients over PG1 regime are much higher (in absolute terms) than those estimated using the traditional two-regime specification for positive gap periods. For example, considering the total unemployment, the coefficient increases from -0.198 to -0.375. In the case of male unemployment from -0.201 to -0.370, female – from -0.209 to -0.474, youth – from -0.271 to -0.829, middle educational attainment level – from -0.217 to -0.483, and high educational attainment level – from insignificant to -0.504. We do not observe a significant difference in the case of low educational attainment level-specific unemployment. Results reveal that considering the period when the gap is positive as continuous, using the two-regime specification we would underestimate the possibilities for growth to reduce unemployment, i.e., even when the economy is producing above its potential output level, but labour resources are not being utilized efficiently further increase in the gap has a significant unemployment-reducing effect.

Analysing Okun's coefficients estimated for the PG2 regime, we see that all of them are insignificant. It suggests that output growth has limited possibilities to reduce unemployment, i.e., when the economy is growing for some time and unemployment levels become relatively low, further growth has no unemployment-reducing effect. Our findings are consistent with the literature suggesting that it is almost impossible to reduce unemployment below its equilibrium level, and expansionary policy over the periods of full employment could cause the price levels to soar. Thus, the assumption suggested by two-regime estimates that output growth is related, despite weakly, to unemployment reduction whenever the gap is positive is naive and does not hold a more rigorous specification.

We do not observe such huge differences comparing NG1 and NG2 regimes as when comparing PG1 and PG2. Still, they are significant. During NG1, when the output gap is negative but the unemployment level is still low, as economic growth ended just recently, changes in output have a significantly smaller effect (in some cases, half as much) on unemployment compared with the NG2 regime, except for female unemployment. A possible explanation is that women tend to work in sectors relatively insulated from the impact of economic recessions, such as education or healthcare. However, in the early stage of a recession, the economic downturn can notably affect female unemployment rates in cyclical sectors. Nevertheless, as the recession persists, the impact on unemployment becomes smaller because non-profit organizations tend to refrain from laying off employees during a crisis, or at least the extent of layoffs is significantly less compared to for-profit companies.

We re-estimated our specifications using Hamilton (see Table A1 in Appendix A) and Beveridge-Nelson (see Table A2 in Appendix A) filters for the robustness check. Results are consistent with our general estimates. Considering the Hamilton filter, our estimated Okun's coefficients are smaller, suggesting a weaker unemployment reaction to output fluctuations since filtering yielded a smaller gap. Still, tendencies across unemployment types and deciles remain the same. In the case of the Beveridge Nelson filter, the results are almost identical.

This research reveals that the output-unemployment relationship is more complex and dynamic than the traditional Okun's law or the two-regime models suggest. Our findings indicate that a four-regime model is necessary to fully understand this nexus, highlighting the nuanced effectiveness of countercyclical policies. The study shows significant variations in the effects of output changes on unemployment, particularly during severe versus mild recessions, suggesting that labour market interventions are less effective at the beginning of a recession but become more effective as the recession deepens. In addition, when the output gap is positive, the potential for growth to reduce unemployment is much higher compared to estimates suggested by two-regime models. The findings of the paper indicate the need for nuanced, targeted policy interventions that consider the specific phase of the business cycle, unemployment levels, and demographic characteristics of the labour force, with a particular focus on youth and the less educated.

Conclusions

Numerous studies have extensively explored Okun's law's validity and estimated Okun's coefficient, which varies across countries and over time. Most of the research indicates that the relationship between unemployment and economic growth is asymmetric and nonlinear, with unemployment being more responsive to recessions than expansions. A nascent research strand has emerged, advocating that more than two phases are necessary to identify the output and unemployment relationship fully. This paper contributes to this underdeveloped area of research, in addition examining the effects of age, gender, and educational attainment levels.

Our research was based on the estimation of the Okun's coefficients in a traditional two-regime setting using the least squares dummy variable (LSDV) estimator. Alternatively, we estimated Okun's coefficients for unemployment level deciles in each regime using a fixed effects quantile estimator. It allowed us to determine at which unemployment decile Okun's coefficient starts to significantly differ from the one estimated in a traditional two-regime setting. The findings from the quantile estimates strongly suggest that we need to consider a minimum of four different regimes when analysing the relationship between output and unemployment in the European Union, based on Okun's law. The results indicate that when the output gap is positive, the effect of output fluctuations on total unemployment is significantly higher when total unemployment is above the seventh decile compared to when it is below this level. This means that if the output gap is positive, but the unemployment rate is still relatively high, the impact of output change on unemployment is significantly greater than when unemployment levels are low. Similarly, during periods of negative output gaps, we observed a significantly lower reaction of unemployment to output fluctuations when unemployment is below the third or fourth decile (the threshold decile slightly varies in different labour force groups) compared to when it is above this level.

Given these results, we identified four regimes by defining the threshold deciles across unemployment for all the analysed unemployment types and estimated Okun's coefficients for each regime. The Okun's coefficients estimated for the PG1 regime, which refers to a period where the GDP gap is positive and the unemployment rate is relatively high, are much greater than those estimated using the traditional two-regime approach for a continuous positive gap period. This indicates that there are good prospects for reducing unemployment when the economy continues to grow even when the output gap is positive. On the other hand, Okun's coefficients estimated for the PG2 regime, which corresponds to a period where the GDP gap is positive and the unemployment rate is relatively low, are not significant, suggesting that further growth has no effect on reducing unemployment. The difference between the NG1 regime, which is characterized by a negative GDP gap and a relatively low unemployment rate, and the NG2 regime, which is characterized by a negative GDP gap and a relatively high unemployment rate, is not as large as in the case of PG1 and PG2, but it is still significant.

This research demonstrates that the output-unemployment relationship is more complex and variable than recent literature suggests. Our findings advocate for at least a four-regime model to capture this complexity and highlight the need for targeted policy interventions that consider the business cycle phase, unemployment levels, and labour force demographics, particularly focusing on youth and the less educated. This research enriches the existing literature by showing that the output-unemployment relationship is more contingent on various factors than previously understood.

The main drawback of our research is the omission of other than output gap unemployment factors, such as labour market institutions, etc., even though we assumed country- and time-specific equilibrium unemployment, i.e., structural plus frictional unemployment, which is related to other than cyclical factors and the fact that we used quarterly data for which additional unemployment factors are not available and that original Okun's law does not consider these factors.

In future research, it is worth analysing the factors that determine the varying relationship between economic growth and unemployment across different regimes. Additionally, it would be meaningful to consider why the differences in this relationship between regimes are more pronounced during periods of economic expansion compared to periods of recession.

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Appendix A.

Table A1. Panel LSDV and fixed effects quantile estimates of Okun's coefficients of the two-regime setting based on Hamilton filter

U	Okun's coeff.	LSDV estimation	Quantile estimation								
			Deciles								
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
TU	β	-0.098***	-0.075***	-0.082***	-0.094***	-0.121***	-0.136***	-0.167***‡	-0.172***‡	-0.177***‡	-0.193***‡
		(0.033)	(0.013)	(0.018)	(0.018)	(0.028)	(0.027)	(0.026)	(0.035)	(0.036)	(0.034)
	β+δ	-0.322***	-0.095***‡	-0.219***‡	-0.320***	-0.349***	-0.337***	-0.340***	-0.378***	-0.385***	-0.373***
		(0.025)	(0.023)	(0.043)	(0.032)	(0.028)	(0.026)	(0.025)	(0.032)	(0.018)	(0.028)
	U^+, %	7.6	4.1	4.9	5.5	6.2	6.9	7.6	8.3	9.5	11.5
	U^-, %	9.6	5.0	5.8	6.8	7.6	8.3	9.3	11.1	13.2	16.4
MU	β	-0.114***	-0.102***	-0.103***	-0.109***	-0.123***	-0.159***	-0.170***‡	-0.186***‡	-0.213***‡	-0.211***‡
		(0.035	(0.024)	(0.018)	(0.017)	(0.019)	(0.02)	(0.023)	(0.029)	(0.037)	(0.034)
	β+δ	-0.403***	-0.093***‡	-0.220***‡	-0.337***‡	-0.378***	-0.439***	-0.441***	-0.453***	-0.523***	-0.527***
		(0.027)	(0.023)	(0.043)	(0.049)	(0.033)	(0.034)	(0.023)	(0.04)	(0.033)	(0.023)
	U^+, %	7.4	3.9	4.8	5.5	6.0	6.5	7.2	8.0	9.2	11.3
	U^-, %	9.5	4.6	5.7	6.5	7.5	8.2	9.1	11.1	13.3	17.0
FU	β	-0.081**	-0.075***	-0.065***	-0.090***	-0.087***	-0.105***	-0.104***	-0.126***‡	-0.144***‡	-0.142***‡
		(0.032)	(0.010)	(0.010)	(0.031)	(0.015)	(0.023)	(0.026)	(0.037)	(0.024)	(0.029)
	β+δ	-0.234***	-0.124***‡	-0.205***	-0.237***	-0.245***	-0.237***	-0.242***	-0.27***	-0.282***	-0.265***
		(0.024)	(0.016)	(0.022)	(0.023)	(0.021)	(0.027)	(0.026)	(0.03)	(0.037)	(0.026)
	U^+, %	8.0	4.2	5.0	5.6	6.2	7.1	7.8	8.8	10.1	12.8
	U^-, %	9.8	5.1	6.0	6.9	7.6	8.5	9.6	11.0	13.1	16.1
YU	β	-0.137**	-0.108***	-0.128***	-0.139***	-0.160***	-0.181***	-0.201***‡	-0.218***‡	-0.245***‡	-0.281***‡
		(0.067)	(0.024)	(0.029)	(0.052)	(0.05)	(0.081)	(0.072)	(0.051)	(0.051)	(0.061)
	β+δ	-0.658***	-0.312***‡	-0.506***‡	-0.659***	-0.712***	-0.710***	-0.721***	-0.713***	-0.809***‡	-0.801***
		(0.051)	(0.045)	(0.088)	(0.056)	(0.044)	(0.057)	(0.054)	(0.033)	(0.062)	(0.04)
	U^+, %	17.9	8.9	10.8	12.3	14.7	16.9	19.0	20.7	22.9	27.3
	U^-, %	22.5	10.6	13.5	16.0	18.9	20.9	22.9	25.8	31.0	37.2
ELU	β	-0.158***	-0.098***	-0.100***	-0.130***	-0.152***	-0.159***	-0.22***	-0.229***‡	-0.204***‡	-0.246***‡
		(0.055)	(0.039)	(0.038)	(0.020)	(0.014)	(0.038)	(0.049)	(0.051)	(0.033)	(0.06)
	β+δ	-0.498***	-0.204***‡	-0.373***‡	-0.436***	-0.481***	-0.515***	-0.531***	-0.568***	-0.626***	-0.606***
		(0.042)	(0.053)	(0.058)	(0.046)	(0.049)	(0.044)	(0.041)	(0.05)	(0.041)	(0.046)
	U^+, %	14.2	7.0	8.1	9.2	10.4	12.1	13.9	16.1	18.6	24.8
	U^-, %	16.6	7.1	8.9	10.3	12.5	14.3	16.5	19.0	23.5	28.4
EMU	β	-0.098***	-0.083***	-0.089***	-0.119***	-0.124***	-0.160***	-0.169***	-0.194***‡	-0.229***‡	-0.203***‡
		(0.036)	(0.018)	(0.021)	(0.017)	(0.027)	(0.022)	(0.027)	(0.029)	(0.035)	(0.03)
	β+δ	-0.379***	-0.141***‡	-0.258***‡	-0.363***	-0.368***	-0.396***	-0.397***	-0.435***	-0.453***	-0.493***
		(0.028)	(0.020)	(0.042)	(0.039)	(0.029)	(0.022)	(0.028)	(0.044)	(0.014)	(0.016)
	U^+, %	7.7	3.8	4.5	5.2	6.0	6.9	7.7	8.6	10.2	12.6
	U^-, %	10.0	4.5	5.5	6.7	7.4	8.4	9.9	11.3	14.0	18
EHU	β	-0.024	-0.021*	-0.020**‡	-0.028***‡	-0.050***‡	-0.043**‡	-0.049***‡	-0.051***‡	-0.065***‡	-0.073***‡
		(0.020)	(0.012)	(0.010)	(0.010)	(0.013)	(0.017)	(0.015)	(0.012)	(0.015)	(0.014)
	β+δ	-0.180***	-0.103***‡	-0.126***‡	-0.157***	-0.165***	-0.176***	-0.173***	-0.184***	-0.191***	-0.190***
		(0.015)	(0.006)	(0.018)	(0.019)	(0.013)	(0.013)	(0.012)	(0.01)	(0.014)	(0.021)
	U^+, %	4.5	2.3	2.7	3.1	3.5	3.9	4.3	5.1	5.8	7.0
	U^-, %	5.7	2.8	3.4	4.0	4.4	4.8	5.4	6.2	7.4	9.7

Potential output (Y^*) is estimated using the Hamilton filter. All estimations include time- and country-specific dummies. Autocorrelation and heteroscedasticity robust errors are presented in parentheses. *** for p-values ≤ 0.01, ** for p-values ≤ 0.05, * for p-values ≤ 0.10. ‡ indicate at which unemployment deciles Okun's coefficients are statistically significantly (at 0.05 level) different from one estimated using LSDV (least squares dummy variable estimator). U^+ and U^- represent the average (next to LSDV estimates) and deciles (next to quantile estimates) of the corresponding unemployment level when the output gap is positive and negative, respectively. β represents Okun's coefficient when the output gap is positive, and β+δ represents Okun's coefficient when the output gap is negative.

Table A2. Panel LSDV and fixed effects quantile estimates of Okun's coefficients of the two-regime setting based on Beveridge-Nelson filter

U	Okun's coeff.	LSDV estimation	Quantile estimation								
			Deciles								
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
TU	β	-0.178	-0.116	-0.102	-0.055	-0.066	-0.037	-0.082	-0.300***‡	-0.34***‡	-0.345***‡
		(0.110)	(0.081)	(0.068)	(0.085)	(0.086)	(0.051)	(0.121)	(0.022)	(0.069)	(0.013)
	β+δ	-0.531***	-0.158***‡	-0.229***‡	-0.295***‡	-0.347***‡	-0.532***	-0.459***	-0.588***	-0.649***	-0.579***
		(0.075)	(0.012)	(0.03)	(0.087)	(0.055)	(0.112)	(0.081)	(0.109)	(0.1)	(0.039)
	U^+, %	8.2	4.2	5.0	5.7	6.5	7.2	8.1	9.1	10.8	13.8
	U^-, %	9.1	4.5	5.5	6.5	7.1	7.7	8.5	10.0	12.3	16.1
MU	β	-0.222*	-0.019	-0.067	-0.028	-0.018	-0.033	-0.145***	-0.256**‡	-0.32***‡	-0.469***‡
		(0.117)	(0.07)	(0.07)	(0.043)	(0.09)	(0.047)	(0.024)	(0.128)	(0.08)	(0.074)
	β+δ	-0.684***	-0,111***‡	-0,199***‡	-0,316***‡	-0,409***‡	-0,526***	-0,679***	-0,799***	-0,839***	-0,886***
		(0.080)	(0,022)	(0,072)	(0,069)	(0,092)	(0,124)	(0,13)	(0,154)	(0,085)	(0,058)
	U^+, %	7.8	3.9	4.9	5.6	6.2	6.8	7.6	8.5	10.0	13.6
	U^-, %	9.1	4.3	5.5	6.1	7.0	7.7	8.7	10.0	12.6	17.0
FU	β	-0.130	-0.039	-0.11	-0.126	-0.087	-0.028	-0.037	-0.194**‡	-0.213***‡	-0.261***‡

		(0.104)	(0.071)	(0.074)	(0.082)	(0.09)	(0.107)	(0.06)	(0.086)	(0.049)	(0.075)
	β+δ	-0.367***	-0.181***‡	-0.258***	-0.205***‡	-0.212***‡	-0.275***	-0.283***	-0.417***	-0.41***	-0.416***
		(0.071)	(0.031)	(0.038)	(0.073)	(0.036)	(0.078)	(0.042)	(0.123)	(0.058)	(0.052)
	U^+, %	8.7	4.4	5.0	5.7	6.6	7.5	8.6	9.8	11.9	15.2
	U^-, %	9.2	4.7	5.5	6.4	7.2	7.9	8.7	10.1	11.8	15.5
YU	β	-0.155	-0.03	-0.121	-0.268	-0.154**‡	-0.214**‡	-0.297**‡	-0.416**‡	-0.704***‡	-0.602***‡
		(0.222)	(0.213)	(0.112)	(0.201)	(0.062)	(0.098)	(0.129)	(0.193)	(0.187)	(0.098)
	β+δ	-1.176***	-0.245***‡	-0.438***‡	-0.66***‡	-0.93***	-1.213***	-1.233***	-1.176***	-1.384***	-1.176***
		(0.152)	(0.082)	(0.103)	(0.148)	(0.239)	(0.159)	(0.081)	(0.165)	(0.108)	(0.172)
	U^+, %	18.8	8.7	10.8	12.5	15.5	17.9	20.1	21.8	24.9	31.6
	U^-, %	21.3	9.6	12.5	14.9	17.0	19.3	21.4	24.2	28.2	37.1
ELU	β	-0.367**	-0.021	-0.020	-0.084	-0.102	-0.188***‡	-0.253**‡	-0.282*	-0.378**‡	-0.443***‡
		(0.175)	(0.099)	(0.107)	(0.124)	(0.114)	(0.063)	(0.106)	(0.169)	(0.19)	(0.121)
	β+δ	-0.643***	-0.15**‡	-0.164***‡	-0.307**‡	-0.608***	-0.762***	-0.758***	-0.789***	-0.861***	-0.927***
		(0.119)	(0.059)	(0.062)	(0.154)	(0.163)	(0.172)	(0.251)	(0.128)	(0.086)	(0.094)
	U^+, %	14.2	6.8	8.0	9.2	10.4	11.9	13.6	15.8	18.6	23.8
	U^-, %	16.4	7.0	8.3	10.0	12.2	14.4	16.9	19.7	24.2	29.0
EMU	β	-0.151	-0.013	-0.013	-0.072	-0.092	-0.160**‡	-0.145**‡	-0.243***‡	-0.312***‡	-0.384***‡
		(0.122)	(0.123)	(0.092)	(0.092)	(0.119)	(0.076)	(0.062)	(0.075)	(0.107)	(0.082)
	β+δ	-0.634***	-0.231***‡	-0.295***‡	-0.358***‡	-0.422***‡	-0.444***‡	-0.540***	-0.764***	-0.742***	-0.786***
		(0.083)	(0.02)	(0.07)	(0.052)	(0.092)	(0.075)	(0.112)	(0.121)	(0.138)	(0.156)
	U^+, %	8.3	3.9	4.6	5.3	6.3	7.1	8.1	9.4	11.0	14.3
	U^-, %	9.5	4.3	5.1	6.3	7.1	8.0	9.0	10.7	13.0	18.0
EHU	β	-0.071	-0.013	-0.029	-0.033	-0.047	-0.043	-0.039	-0.072*	-0.136**‡	-0.173***‡
		(0.066)	(0.015)	(0.028)	(0.031)	(0.042)	(0.027)	(0.052)	(0.043)	(0.057)	(0.053)
	β+δ	-0.327***	-0.110**‡	-0.146***‡	-0.159***‡	-0.212***‡	-0.298***	-0.319***	-0.351***	-0.307***	-0.324***
		(0.044)	(0.05)	(0.028)	(0.046)	(0.062)	(0.039)	(0.055)	(0.044)	(0.055)	(0.093)
	U^+, %	4.7	2.3	2.7	3.1	3.6	4.1	4.6	5.4	6.3	7.7
	U^-, %	5.3	2.5	3.1	3.6	4.1	4.5	5.0	5.7	6.7	9.3

Notes are the same as below Table A1.
Source: authors' representation