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Optimal fiscal policies in booms and recessions: a case study for Slovenia

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Abstract

Optimal fiscal policies are determined for Slovenia for the next few years under alternative assumptions about global developments. We construct a baseline scenario, two scenarios with a recession and two with a boom, each with a demand side and a supply side shock. We use the macroeconometric model SLOPOL12 and assume an intertemporal objective function for Slovenian policy makers containing the main targets derived from a survey among policy makers as arguments. Approximately optimal policies are calculated for all scenarios. Fiscal policies are characterized by an unequal design for dealing with the trade-off between output stabilization and budgetary sustainability: instruments with demand side and supply side effects (direct taxes and public investment) are used for output and employment stabilization, while government consumption and other instruments with only demand side effects are assigned to budget consolidation. The results are rather similar in the different scenarios and only mildly counter-cyclical.

Keywords: macroeconomics, fiscal policy, dynamic optimization, Slovenia

1 INTRODUCTION

When policy makers in a certain country deliberate the appropriate design of economic policies, they usually cooperate with experts from research institutes and think tanks to obtain information about the effects of their measures on important variables like economic growth, (un)employment, inflation, the government budget and the current account. Often, they ask directly for advice on what measures would be best in a given situation. The advisors normally provide forecasts of future developments, often in the form of alternatives under certain assumptions about the global political and economic situation. What is often missing, however, is a detailed – and even quantitative – list of measures that would be best for the attainment of the policy makers' goals. Although in a democracy the ultimate decisions are the prerogative of elected policy makers, a systematic analysis of appropriate actions to reach the policy makers' goals in the form of a decision support system could be desirable.

The present paper is a step towards such a system. It provides a case study for deriving optimal macroeconomic policies, fiscal policies in particular, for a specific country. We use an econometric model, called SLOPOL12, and an optimal control approach to derive optimal fiscal policies for Slovenia under specific assumptions about future developments in relation to five scenarios: a baseline, two recession scenarios and two boom scenarios, in each case for global demand and supply shocks. The objective function used is based on the results of a survey among Slovenian policy makers. As a result, we can assess the appropriate course of budgetary policies for Slovenia, given the preferences of the policy makers and the state of the economy through the lens of the econometric model. Using an empirically estimated macroeconometric model has the advantage of including the specifics of a particular economy as compared to the stochastic dynamic general equilibrium models used in the theoretical literature on optimal fiscal policies

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(for a survey, see, e. g., Alogoskoufis, 2019) with more solid theoretical foundations but less empirical relevance.

The structure of the paper is as follows: section 2 gives a brief overview of the optimal control approach used in this paper, including the econometric model and the objective function. Section 3 describes five different scenarios of macroeconomic development: a baseline forecast and two recession and boom scenarios initiated by either demand or supply side shocks. The main results of the optimal policy design are presented in section 4. Section 5 concludes.

2 THE OPTIMAL CONTROL APPROACH USED IN THIS PAPER: ECONOMETRIC MODEL AND OBJECTIVE FUNCTION

The optimal control approach to quantitative economic policy design, which was initiated by Chow (1975, 1981) and Kendrick (1981, 1988), among others, consists of two elements: an empirical macroeconometric model and an objective function to be optimized. In this study, we use the SLOPOL12 model, a nonlinear medium-sized macroeconometric model of the small open economy of Slovenia. It consists of 75 equations, 23 of which are behavioural equations and 52 identities. In addition to the 75 endogenous variables, the model contains 41 exogenous variables. Almost all behavioural equations are specified in error correction form. The model allows for forecasts and policy simulations for the near future. The model was estimated with data up to the end of 2023.

The model contains behavioural equations and identities for the goods market, the labour market, the foreign exchange market, the money market and the government sector. It combines Keynesian and neoclassical elements, the former determining the short- and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. Graph 1 is a diagram of the building blocks of the model.[1] A more detailed description of an earlier version of the model with essentially the same structure is given in Weyerstrass et al. (2018).

Potential GDP is determined via a Cobb-Douglas production function with trend employment, capital stock and the trend of total factor productivity (TFP) as factors of production. Trend TFP is determined in a behavioural equation depending on public expenditures on research and development (R&D), the proportion of the population with tertiary education and the investment-GDP ratio. With public R&D expenditures and educational attainment (although the government can influence this only indirectly), two supply-side policy instruments can be considered in the simulations that are targeted primarily at potential GDP.

[1] A detailed description of the version used here can be obtained from the corresponding author at: reinhard.neck@aau.at.

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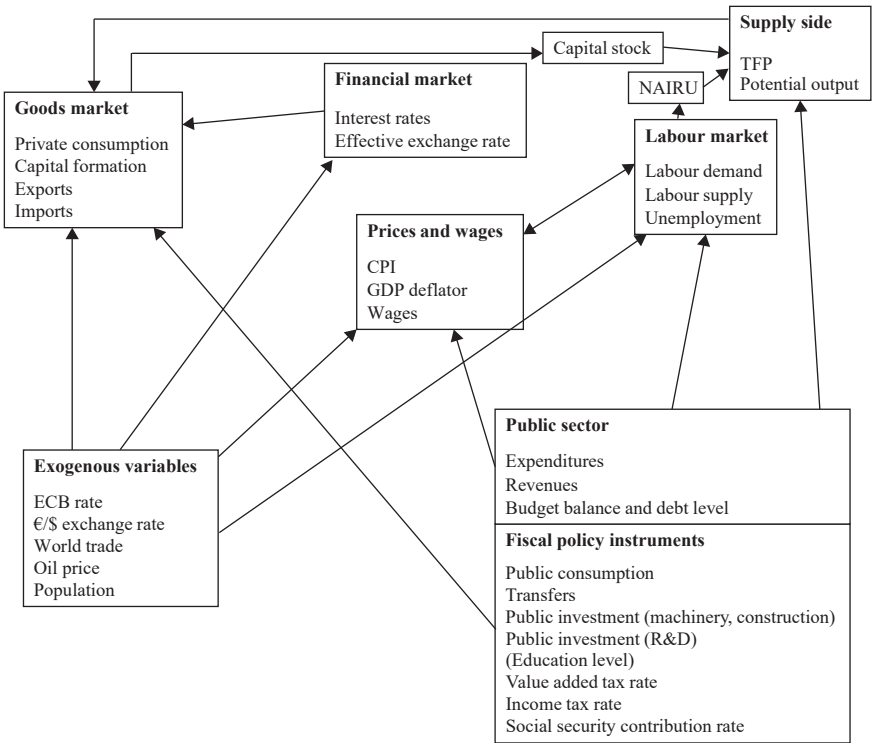
Graph 1
SLOPOL12 building blocks



Source: Authors' construction.

As can be seen from graph 1, the fiscal policy instruments directly affect the goods market, i.e., GDP and its components (both real and nominal). The primary effect is on the demand side, as in most Keynesian models. Indirect effects also come from the supply side via real GDP, capital stock, the labour market and the wage-price system. Simulations showed that the impact of government expenditures is stronger on GDP while government revenues (through tax rates) have stronger effects on the labour market and (un)employment. The side effects on public debt originate directly from the policy variables and indirectly from nominal GDP. In the long run, the model converges to a balanced growth path with real GDP equalling potential GDP, depending on the exogenous variables determining potential GDP. With appropriate paths of the exogenous variables, in the long run potential and actual real GDP and their components grow at approximately the same rate, as do nominal GDP and its components, albeit plus an inflation rate of 2%. Adapted for exogenous disturbances in the scenarios, this long-term path is the starting point for the "ideal" path (to be discussed below) from the viewpoint of the policy makers.

Modelling and estimating econometric models from empirical data is well researched and used in both academia and research institutes. By contrast, not much is known about the empirical specification of objective functions of policy

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makers. For practical purposes of policy analysis and design, the objective function will express the preferences of those responsible for actual policy making, that is, real politicians. In an earlier paper (Blueschke et al., 2024), we used a survey among Slovenian fiscal policy makers to obtain information about their goals. Their ordinal rankings of targets was then operationalized into the specification of a cardinal objective function.

The policy maker in this optimal control experiment is the government of Slovenia (or its advisors), which, at the beginning of 2024, needed to calculate the optimal trajectories of fiscal policy instruments for the period 2024 to 2030 based on forecasts from the SLOPOL12 model. There are nine control variables (fiscal policy instruments): government consumption, transfers, government investments, public expenditure for research and development (R&D), the average personal income tax rate, the proportion of the active working population with tertiary education (a proxy for human capital), the average social security contribution rate, remaining government revenues (a proxy for lump-sum tax revenues) and the value added tax rate.

We consider a so-called tracking problem, which consists of finding certain paths of control variables that minimize an intertemporal objective function involving squared deviations of the values of the politically relevant variables from some pre-specified "ideal" paths. As usual in economic policy applications, we assume a quadratic objective function with an annual discount factor of 3%[2]. The optimization is restricted by the dynamics of the system given in the form of a system of nonlinear difference equations, which in our case is given by the SLOPOL12 model. In order to specify the objective function, we have to decide on the weights of the different objective (evaluated control and target) variables and on the "ideal" paths for these variables.

For the weights of the objective variables, we take the results of the previous paper (Blueschke et al., 2024) based on the survey of policy makers. Accordingly, we choose eight "major" state variables to enter as arguments in the objective function, with weights in descending order, namely the growth rate[3] of real GDP (9), the public debt level ratio to GDP (8), the current account balance ratio to GDP (7), the unemployment rate (6), real private consumption (5), real private investment (4), the budget balance ratio to GDP (3), and the inflation rate (2). In addition, we define four "minor" target variables, which were not named by the policy makers and which are given a weight of 1: the level of real GDP, the level and the growth rate of potential real GDP and the ratio of government expenditures for R&D to GDP. The level variables are introduced to prevent the optimal time paths oscillating too strongly and the other ones to include the supply side of the economy, which is important in the SLOPOL12 model. Moreover, in order to

[2] As we showed in another paper (Weyerstrass and Neck, 2002), within a reasonable range, the discount factor has no significant effects on the optimal policy in such a framework.
[3] All growth rates in this paper are annual unless otherwise stated explicitly.

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formulate a well-defined optimal control problem, we have to include the instrument variables in the objective function as "minor" objectives. They are given the weight 1, except for the value added tax rate, the income tax rate and the social security contributions rate, which are more difficult to change in the political process and hence are given the high weight of 50, and the remaining tax revenues, which do not affect anything other than the budgetary variables in the model and hence are given the small weight of 0.01.

In addition, we assume "ideal" paths for all of the objective variables to be reached as closely as possible by the optimal policies in the optimal control framework. The "ideal" paths imply smooth growth in the income variables and low values for the rates of unemployment and inflation, as sketched above. Through a process of trial and error, we chose 4 percent as the "ideal" growth rate for real GDP and the other real aggregates (an ambitious value, emphasizing the importance of this target); 4 percent in 2024, 3 percent in 2023, and 2 percent afterwards for the inflation rate (the official goal of the ECB); and the sum of the "ideal" real growth rate and the "ideal" inflation rate for the nominal variables. The "ideal" values of the human capital variable grow by 0.2 percentage points per quarter from the 2023 level. The "ideal" values for the budgetary variables are also relatively ambitious: the "ideal" public debt to GDP ratio decreases from its 2023 initial value of 69.2 percent by 0.4 percentage points per quarter to the EU Stability and Growth Pact (SGP) target value of less than 60 percent at the end of the optimization period, and the "ideal" budget deficit to GDP ratio also decreases by 0.4 percentage points per quarter from its initial value of 3.5 percent.

3 SIMULATION OF POSSIBLE MACROECONOMIC SCENARIOS WITH THE SLOPOL12 MODEL

We use the SLOPOL12 model for simulating and optimizing five alternative macroeconomic scenarios over the period 2024 to 2030. Results for the last years of a forecast are less reliable than the earlier ones, and optimization results over a finite time horizon for the last few periods tend to suffer from a neglect of developments after the last period; therefore, we include a longer time horizon (until 2030) although we are interested primarily in the results for 2024 to 2028 in this study of short-term stabilization policies. We confine ourselves to relatively small shocks arising during a normal business cycle; for large global shocks, problems with structural changes of the model (the famous Lucas critique) may arise.

The scenarios are:

1) The *baseline* scenario, which we consider the most likely one. It was constructed using the most recent available forecast for Slovenia at the time we started working on the paper, the IMAD Spring Forecast 2024 (IMAD, 2024), to calibrate the time paths of the main macroeconomic variables of the model in the noncontrolled simulation as closely as possible to this IMAD forecast. This results in a modestly optimistic view for the years after the COVID-19 pandemic, with real GDP growing between 2 and 2.5 percent per year, a sharply decreasing inflation rate but also a fall in the human-capital variable by about one percentage point

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due to the long-term effects of the COVID-19-induced measures (school closures, etc.), an increasing unemployment rate and high budget deficits (well above the EU SGP reference value of 3 percent of GDP) and, hence, increasing public debt. The temporarily decreasing current account surplus is due to increasing import demand from forced savings during the pandemic. This scenario is the baseline for all the other simulations and the optimization experiments.

2) The scenario of a (mild) *demand recession* modelling an exogenous negative transitory demand shock. This is obtained from the baseline scenario by assuming a decrease in the growth rate of world trade volume by 2 percentage points relative to the baseline scenario in 2024 and 2025. This may be caused, for instance, by reduced global trade with countries like China due to political measures originating in the United States or Europe. It primarily affects Slovenian exports and aggregate demand variables as well as the unemployment rate in an unwanted way but has virtually no effect on the price level and inflation.
3) The scenario of a *demand boom* modelling an exogenous positive transitory demand shock. It is constructed in exactly the same way as the demand recession shock but with an increase in the growth rate of world trade by 2 percent percentage points relative to the baseline scenario in 2024 and 2025. The effects qualitatively mirror those of the demand recession shock, showing that in spite of the nonlinearities in the model, the negative and positive demand shocks affect the simulations in a nearly symmetric way[4].
4) The scenario of a (mild) *supply recession* modelling an exogenous negative transitory supply shock in 2024 and 2025. Here we combine the decrease in world trade growth by 2 percent percentage points relative to the baseline scenario in 2024 and 2025 from the demand recession with an exogenous increase in the import deflator. Actually, this is a combined supply shock, modelling a leftward shift of the aggregate supply curve, thereby raising the price level exogenously and lowering aggregate demand. This may result from a global increase in energy or food prices or from disturbances in supply chains, for example. We expect a depressing effect on output and an increasing price level effect from this supply shock. Actually, the supply recession scenario shows a slightly stronger depressing effect on real GDP and the other aggregate variables than the demand recession and especially affects the rate of unemployment, which rises by more than 0.5 percentage points in the later periods of the simulation. The combined effect on price level and inflation is negligible because the small negative effect of decreasing aggregate demand and the positive effect of the exogenous price increase on these variables nearly cancel out each other.
5) Finally, the scenario of a *supply boom* modelling the "best of all (macroeconomic) worlds" of an exogenous increase in output and decrease in inflation in 2024 and 2025. Here the effects are less symmetric than for the demand-side shocks but, as expected, favourable for nearly all of the macroeconomic target variables.

[4] This is due to the fact that the SLOPOL12 model is nonlinear as its equations contain products, ratios, logs and growth rates of variables but no nonlinearities that could easily produce more asymmetric affects, e.g., those that generate complex behaviour. In our case, we have qualitative but not quantitative asymmetries.

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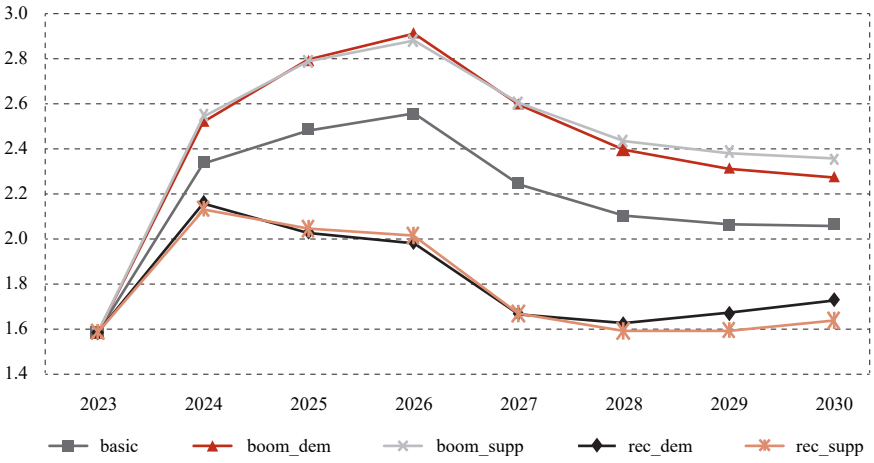
Graphs 2 to 8 show the results of the simulations for a few key variables in the model. The abbreviations "rec", "dem" and "supp" denote recession, demand and supply, respectively. To make the interpretation easier, level variables are presented as ratios to GDP.

Graph 2

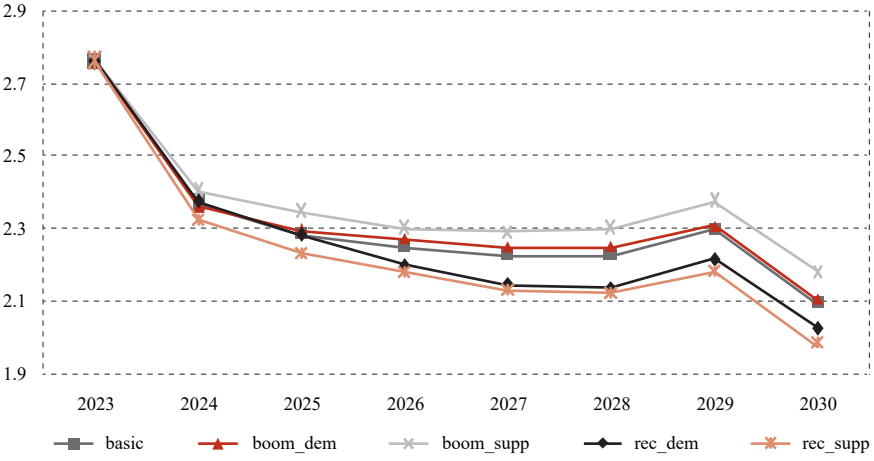
Growth rate of real GDP, percent



Source: Authors' calculations.

Graph 3

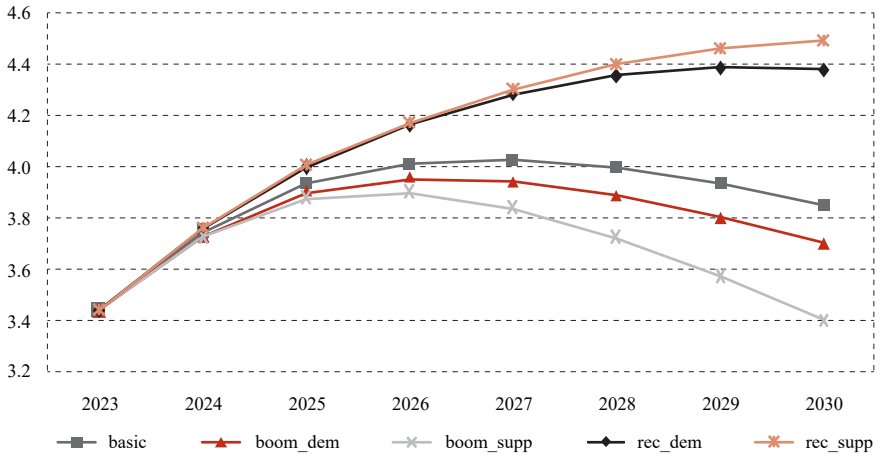
Growth rate of real potential GDP, percent



Source: Authors' calculations.

GRAPH 4

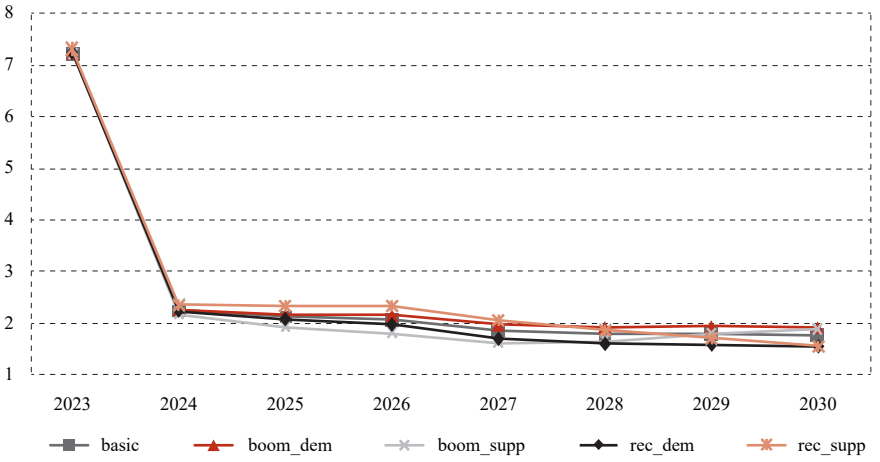
Unemployment rate, percent



Source: Authors' calculations.

GRAPH 5

Inflation rate, percent



Source: Authors' calculations.

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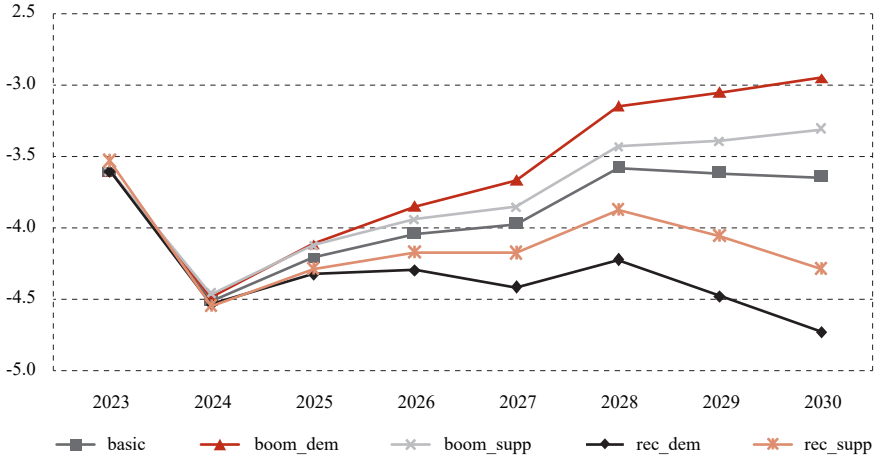
GRAPH 6

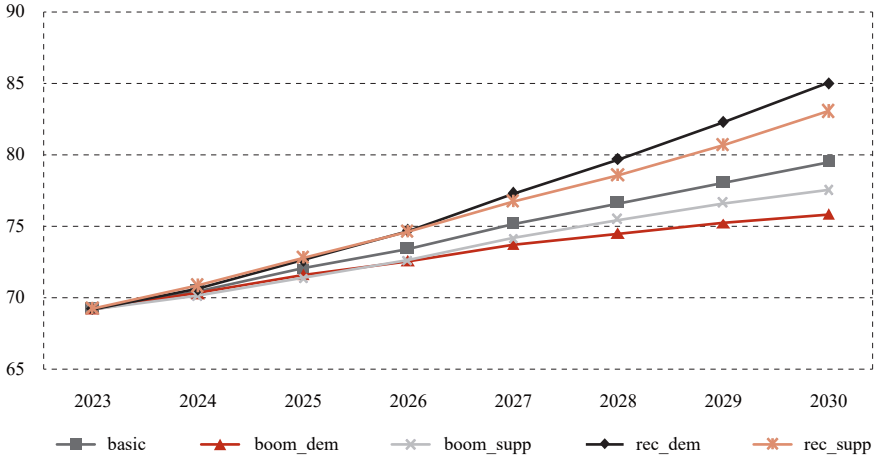
Budget balance, nominal, percent of nominal GDP



Source: Authors' calculations.

GRAPH 7

Public debt, nominal, percent of nominal GDP



Source: Authors' calculations.

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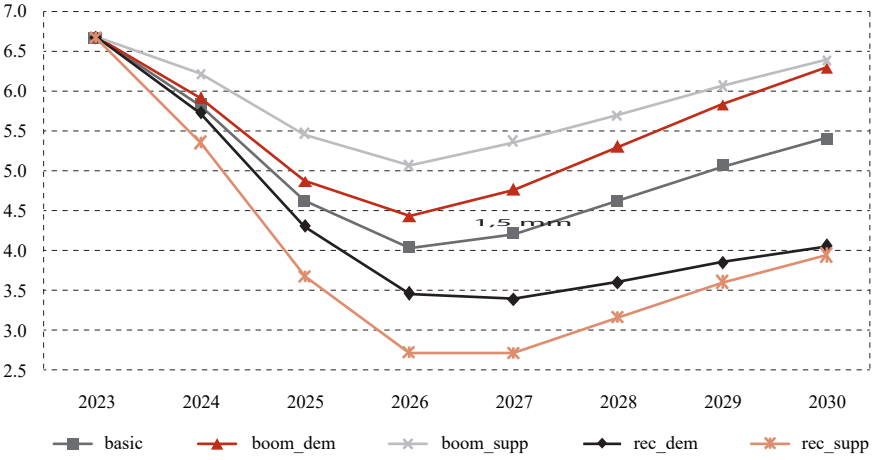
GRAPH 8

Current account surplus, nominal, percent of nominal GDP



Source: Authors' calculations.

4 OPTIMAL FISCAL POLICIES FOR THE FIVE SCENARIOS

In order to obtain optimal trajectories for the fiscal policy instruments, we run several optimal-control exercises using the OPTCON2 algorithm (Blueschke-Nikolaeva, Blueschke and Neck, 2012; Blueschke et al., 2024). The OPTCON2 algorithm allows us to calculate numerical solutions (approximately) for optimum control problems with a quadratic objective function and a nonlinear multivariate dynamic system with or without additive and parameter uncertainties. Here we confine ourselves to deterministic optimizations, which allows us to perform more optimization runs and avoid the time-consuming stochastic analysis. The intertemporal objective function minimizes the sum of the weighted sums of deviations of target and control (instrument) variables from given "ideal" paths of these variables over a finite time horizon. The SLOPOL12 model, in the form of a dynamic system of nonlinear difference equations, is the intertemporal constraint of the optimization problem. In the nonlinear optimal control problem, we determine trajectories of control variables that minimize the postulated objective function subject to the dynamic system.

In the following optimizations, the weights and the "ideal" paths of the control and target variables are the same for all five scenarios. We first present some results for the baseline scenario and then some for all five together to show the different impact of the shocks on the policy prescriptions. Graphs 9-23 show the results of the optimal policies together with the simulated and the "ideal" paths for the baseline scenario.

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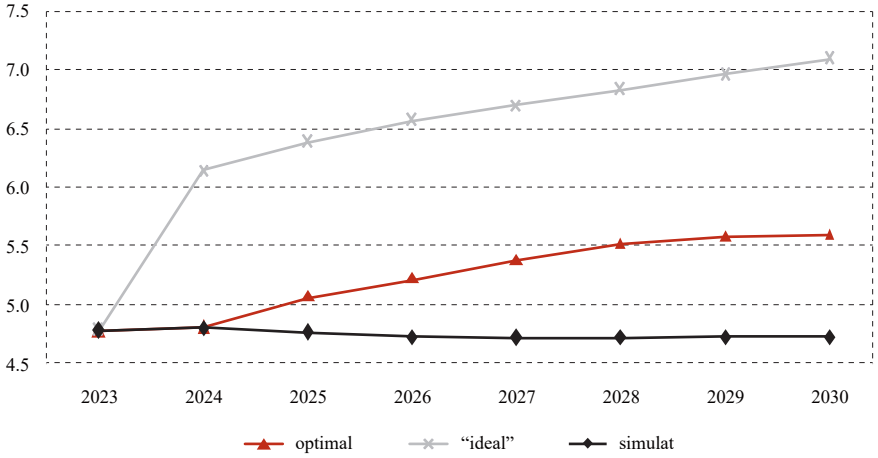
Graph 9

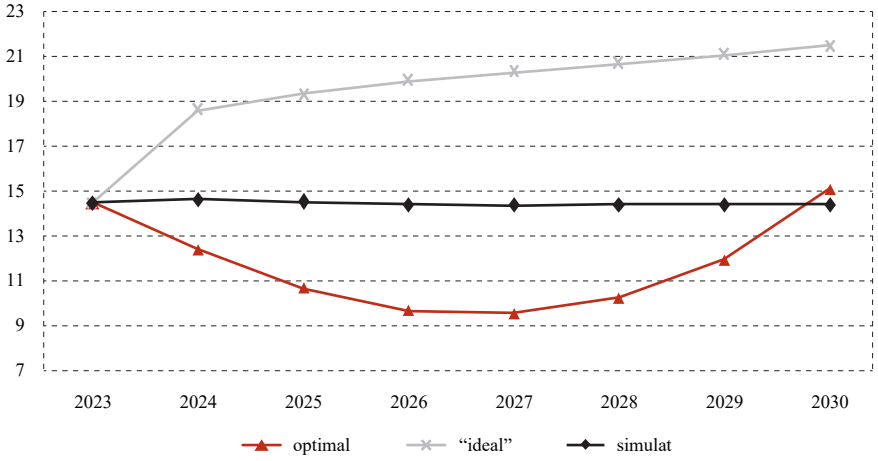
Government investment, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 10

Government consumption, nominal, percent of nominal GDP



Source: Authors' calculations.

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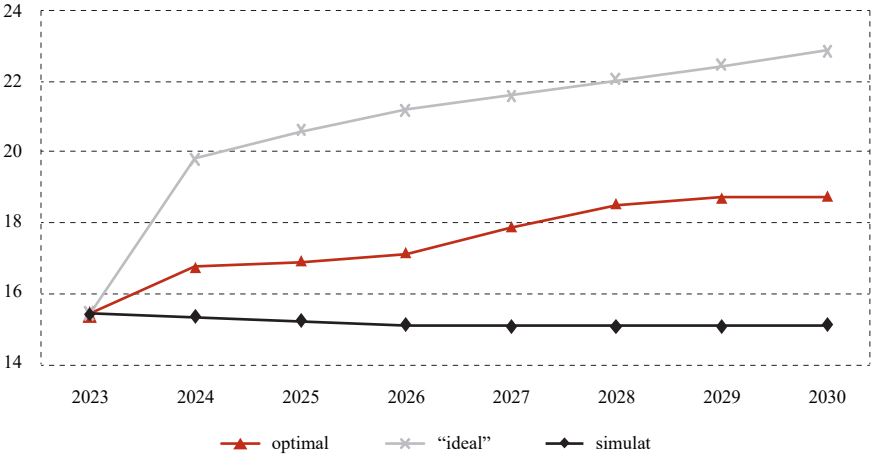
Graph 11

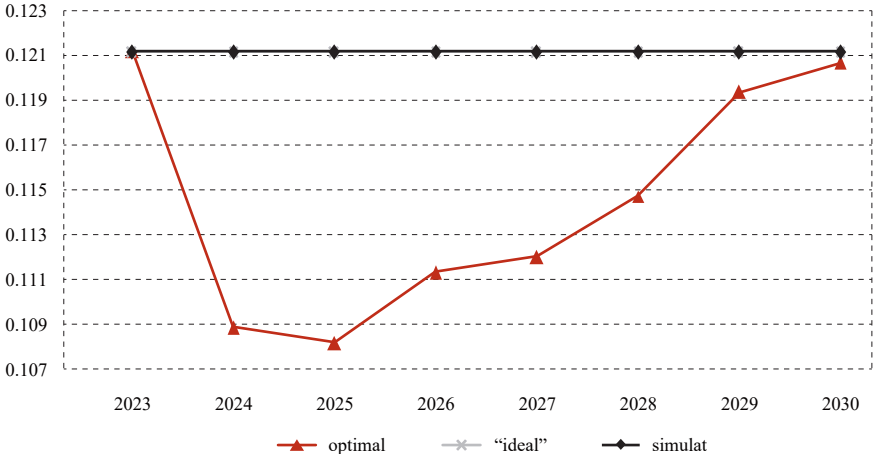
Transfers, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 12

Income tax rate, average percent of income



Source: Authors' calculations.

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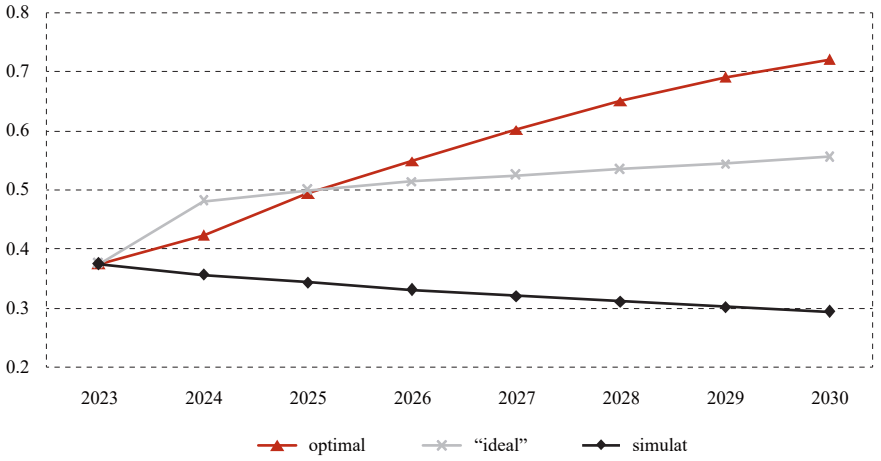
Graph 13

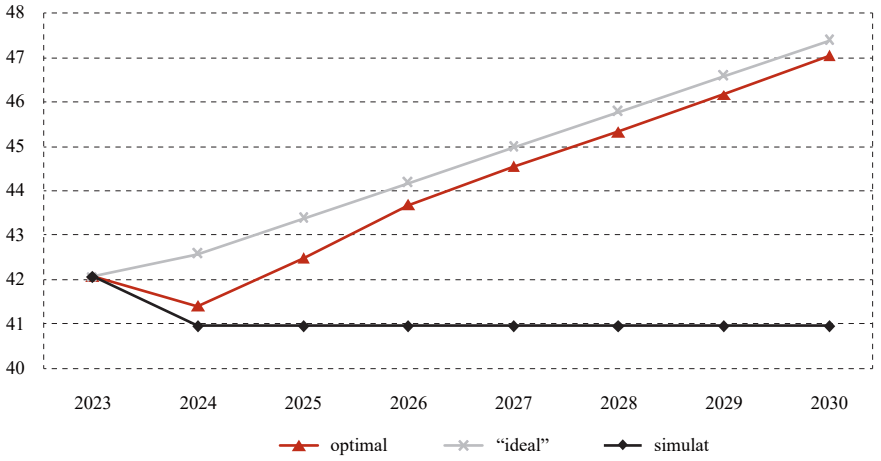
Government expenditures for R&D, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 14

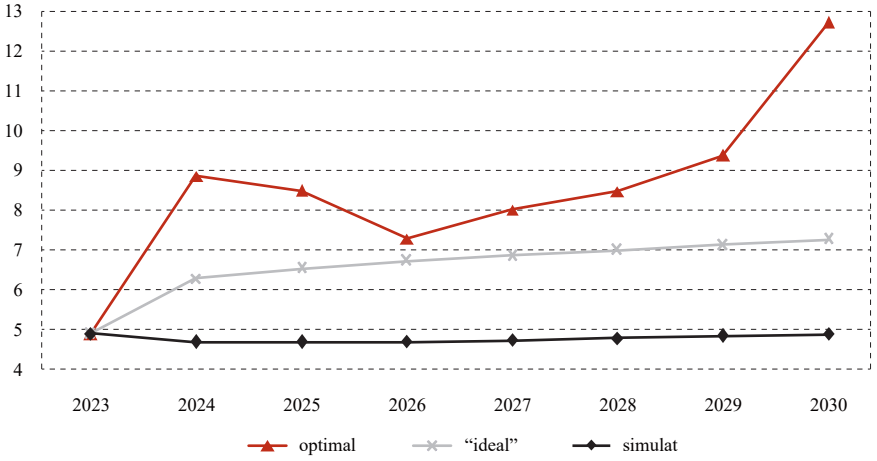
Human capital investment variable: persons with tertiary education as percent of active working population



Source: Authors' calculations.

Graph 15

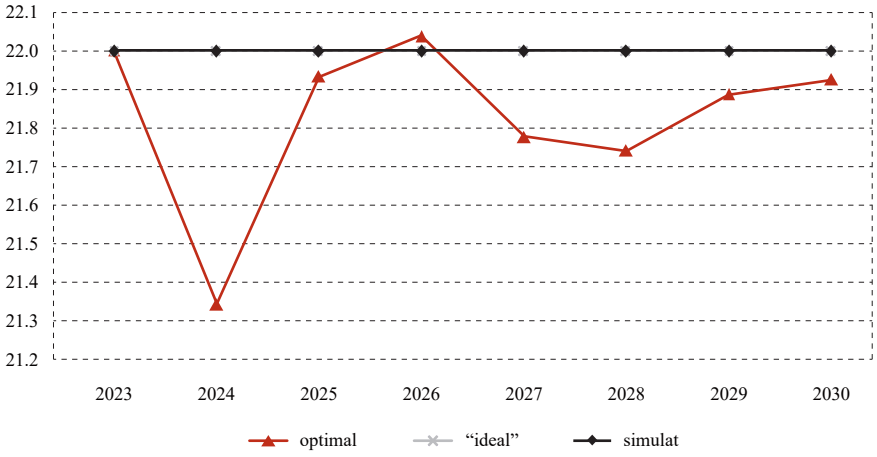
Remaining government revenues



Source: Authors' calculations.

Graph 16

Value added tax rate



Source: Authors' calculations.

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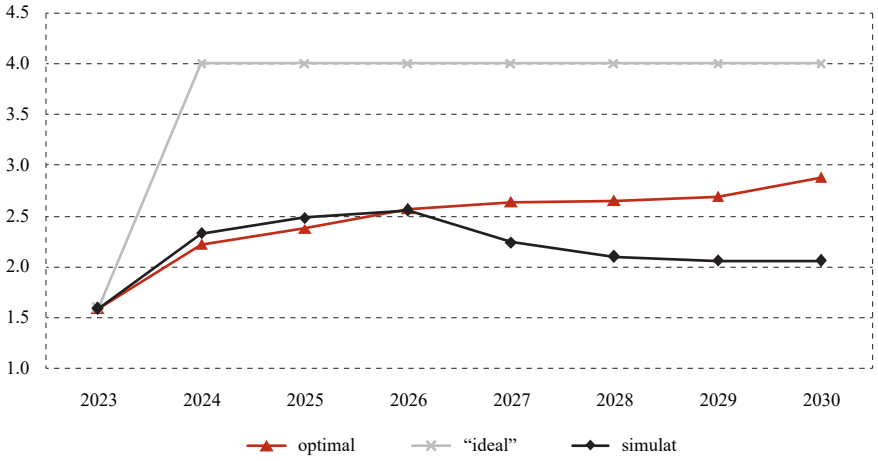
Graph 17

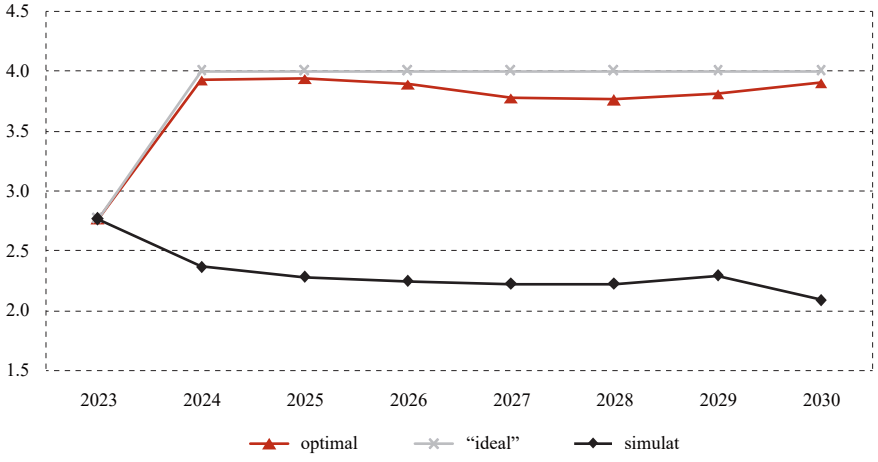
Growth rate of real GDP, percent



Source: Authors' calculations.

Graph 18

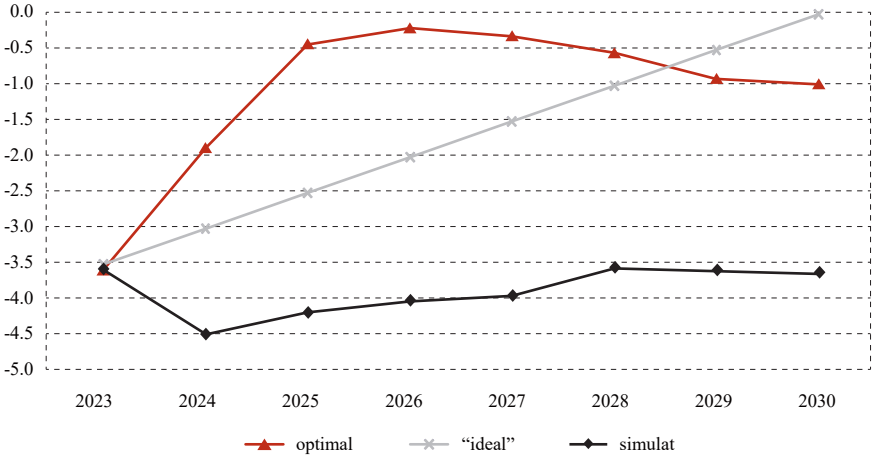
Growth rate of real potential GDP, percent



Source: Authors' calculations.

GRAPH 19

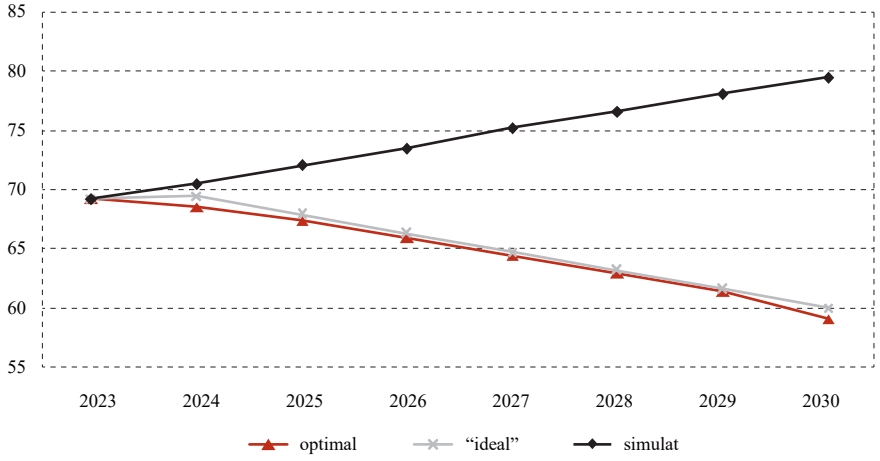
Budget balance, nominal, percent of nominal GDP



Source: Authors' calculations.

GRAPH 20

Public debt level in relation to GDP, nominal, percent



Source: Authors' calculations.

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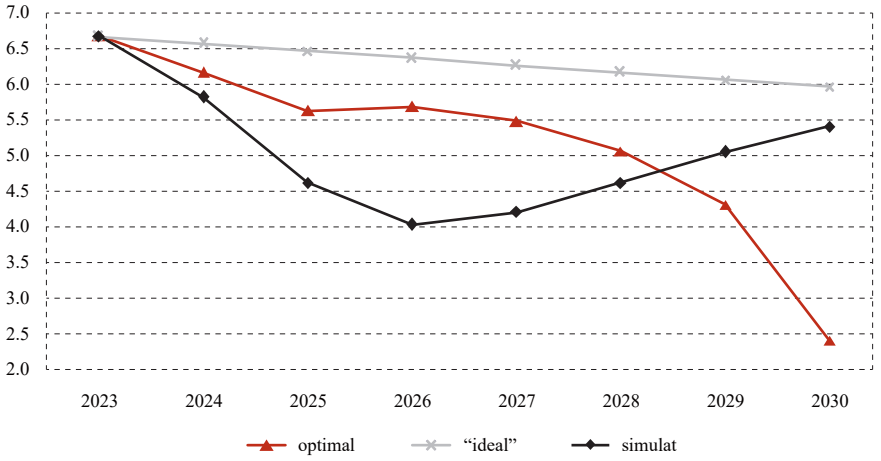
Graph 21

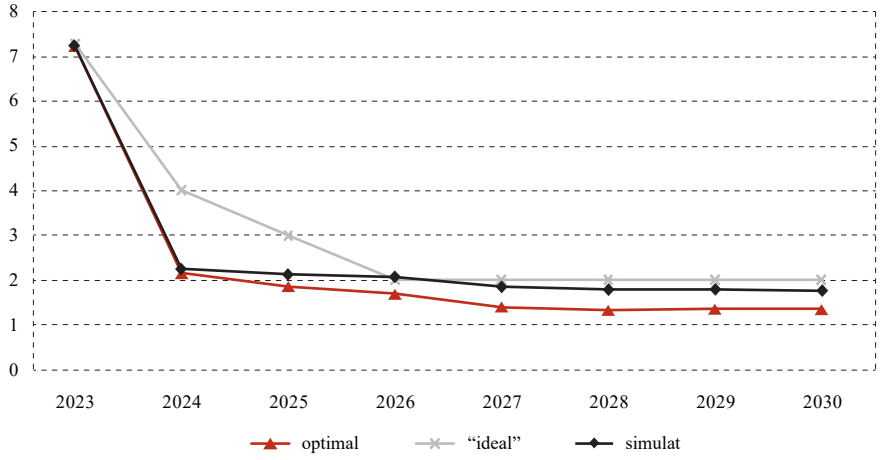
Current account, nominal, percent of nominal GDP



Source: Authors' calculations.

Graph 22

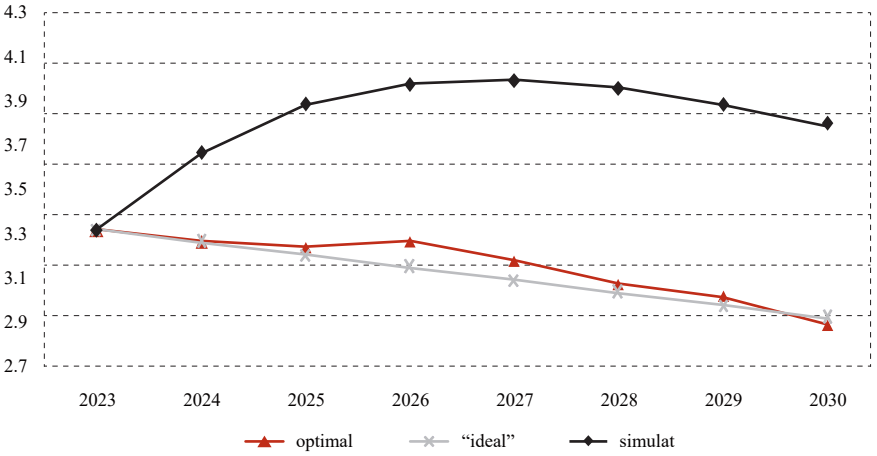
Inflation rate



Source: Authors' calculations.

Graph 23

Unemployment rate



Source: Authors' calculations.

In the baseline scenario, the optimization calls for a fiscal policy mix that is decidedly different for those instruments that affect real output and real potential output directly and indirectly (for instance, through the labour market) and for those instruments that have only direct effects on output or none at all. The former act in an expansionary manner compared to the uncontrolled simulation, increasing expenditures and reducing taxes to keep output and its components (especially private investment and consumption) closer to their "ideal" paths, while the latter act in a pro-cyclical way in order to keep the budget deficit and public debt on paths closer to their "ideal" ones. Alternative "ideal" paths for the budget variables show an even more pronounced highly restrictive tendency for public consumption, which serves to finance the expansionary course of income taxes, social security contributions and public investment.

For the baseline scenario shown here, this can be seen when the paths of government investment (graph 9) are contrasted with government consumption (graph 10): the optimal path of government investment is lower than its "ideal" but higher than the simulated path (the path without optimization) while government consumption is lower than the "ideal" and even the simulated values. The reason for this is the stronger effect of investment on real GDP, both directly and through its effect on potential GDP. The optimal policies call for increases in transfers (graph 11) to increase private consumption as well as a reduction in the income tax rate (graph 12) and a similar but weaker reduction in the social security contributions rate because these latter instruments have a direct expansionary (supply side) effect on labour supply by reducing the tax wedge and thereby increasing employment and output.

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A particularly interesting assignment of policy variables to the goal of boosting actual and potential GDP can be seen from the optimal path of government expenditures for R&D (graph 13) and for the human capital variable (graph 14). These instruments are known from growth theory to drive output higher through their supply-side effects. Our results show that these instruments are also very effective in the short run and should therefore be used to lead the economy towards full capacity utilization when stabilizing the economy in the short run. It is optimal to increase government expenditures for R&D in a smooth expansion path from its initial share of less than 0.4 percent of GDP to nearly twice that share in 2030, even surpassing their "ideal" values in the later periods due to their strong effects on both actual and potential GDP. The human capital variable, which is hampered by the long-run pandemic effects at the beginning, should also increase immediately afterwards to reach its "ideal" value of 47 percent of the population with tertiary education by 2030.

The remaining government revenues, which have no direct effect on non-budgetary variables, are increased much above their "ideal" values to contribute to the consolidation of the government budget (graph 15). On the other hand, the value added tax (VAT) rate, is used in a more countercyclical, mostly expansionary way, being reduced by up to 1.5 percentage points, thereby boosting private consumption, which is an important target according to the politicians' preferences (graph 16). It is interesting to note that, in spite of their own high weights, the income tax rate, the social security contribution rate and the VAT rate are used more actively than expected.

The combined effect of this policy mix can be seen from the variables primarily targeted by fiscal policy in this simulation. Real GDP growth (graph 17) increases only slowly to less than 3 percent in 2030 while the growth rate of potential output (graph 18) approaches its "ideal" value nearly immediately, although its weight is smaller since policy makers did not designate it a target variable. Conversely, the restrictive design of the instruments that are less effective for output leads to a budget deficit (graph 19) that is much smaller than in the simulation and leads quickly to a nearly balanced government budget, staying below 1 percent of GDP over the last six years. This drives government debt to its final "ideal" value, even below the EU SGP target of 60 percent of GDP, along a path that is nearly identical to the "ideal" one (graph 20). This policy also reduces imports more than in the uncontrolled simulation, leading to a slower reduction in the current account surplus except for the last two periods (graph 21).

One of the trade-offs most debated in macroeconomic policy is that between GDP growth (and unemployment) on the one hand and the fiscal variables public budget deficit and public debt on the other hand. Policies aimed at increasing growth and reducing unemployment in recessions have led to increases in government deficit and debt beyond sustainable values in many European countries and were critical in the European sovereign debt crisis in the 2010s. In view of this, at first sight it

is astonishing that here this trade-off does not seem to be present. Although real GDP growth is only modestly increased to less than over one percentage point below its "ideal" value of 4 percent by optimizing the objective function, the "ideal" debt is virtually reached in every period, which is achieved by reducing the deficit strongly in the first few periods – a "cold turkey" fiscal policy (shock therapy), without undesirable side effects on targets such as unemployment, for instance. When looking at the contributions of GDP growth and public debt to the value of the objective function, one can see that they are 2789.65 for growth and 2,318.50 for debt in the noncontrolled solution and 1718.36 for growth and only 3.09 for debt in the optimal solution, meaning that it is by far easier to control public debt than GDP. The optimal policy therefore drives debt to its "ideal" path, using some of those expenditures and taxes which have little or no effect on GDP, and then uses its more effective policy instruments to achieve better paths for the non-fiscal variables.

The famous Phillips curve trade-off between inflation and unemployment does not seem to be present in Slovenia. This is mainly due to the behaviour of the inflation rate, which is only marginally affected by fiscal policy but nearly fully determined by exogenous factors, especially the Euro Area wide monetary policy of the European Central Bank (graph 22). The unemployment rate, on the other hand, is strongly influenced by the fiscal policy mix suggested by the optimal policy design: it moves along a path that is nearly identical to the "ideal" one, despite the only slow increase in GDP growth and the resulting output gap (graph 23). A modest increase in GDP growth is sufficient to drive the unemployment rate along its desired values, which effect is supported by the supply side orientation of the policy mix.

Next, we consider the optimal policies when confronted with short-term recessions or booms from the demand or the supply side. This is illustrated by comparing optimal fiscal policies in the five scenarios (graphs 24-30). It turns out that for the instruments aiming at increasing the productive capacity of the economy, the optimal paths are very close to those for the baseline scenario. This is true especially for the relatively expansionary design of government investment, government expenditures for R&D and the human capital variable. In contrast, financing these expenditures by reducing government consumption and some taxes is done in a similar procyclical way as in the baseline scenario: restrictive in recessions, less so in booms.

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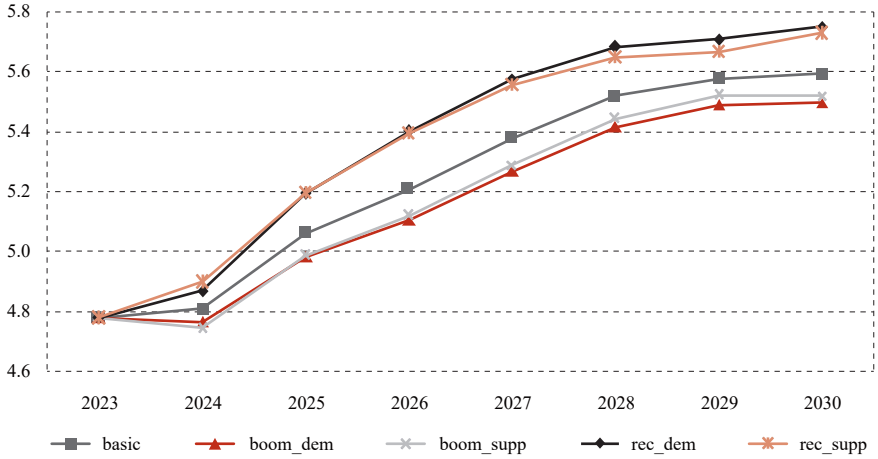
Graph 24

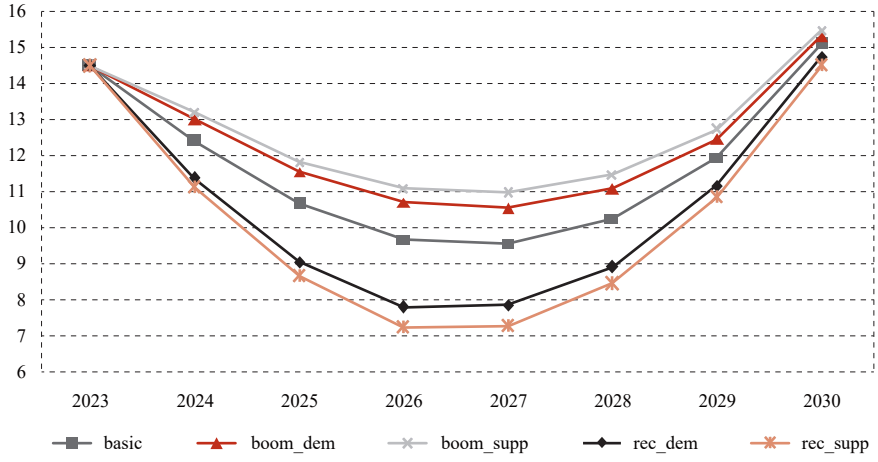
Government investment, nominal, percent of GDP



Source: Authors' calculations.

Graph 25

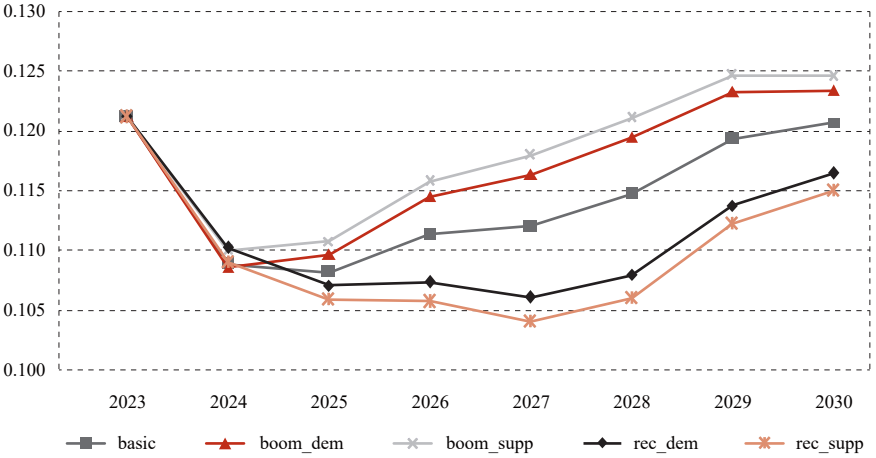
Government consumption, nominal, percent of GDP



Source: Authors' calculations.

Graph 26

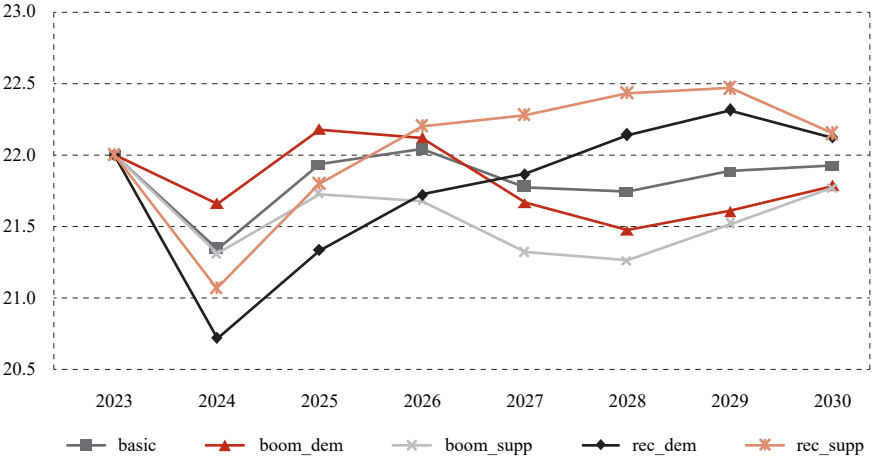
Income tax rate, average percent of income



Source: Authors' calculations.

Graph 27

Value added tax rate



Source: Authors' calculations.

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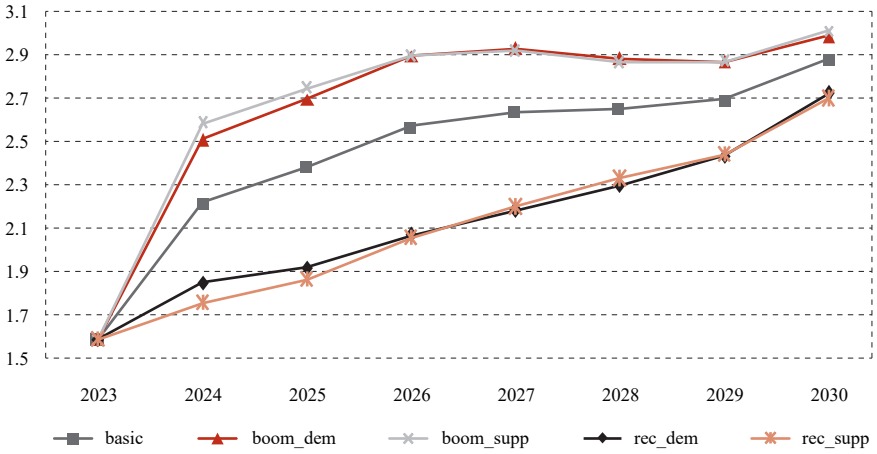
Graph 28

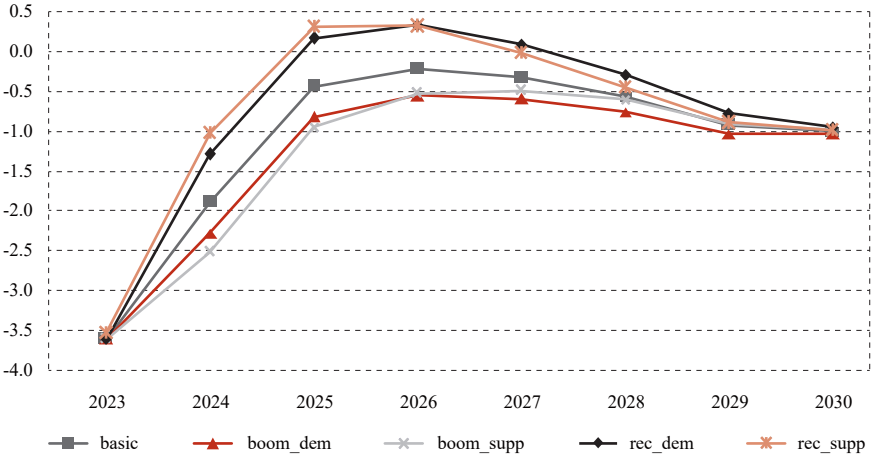
Growth rate of real GDP, percent



Source: Authors' calculations.

Graph 29

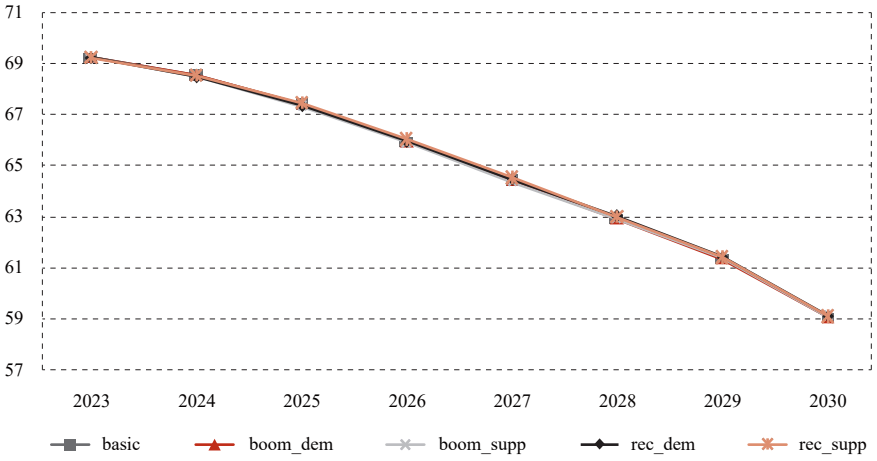
Government budgetary surplus, percent of GDP



Source: Authors' calculations.

Graph 30

Public debt level in relation to GDP, nominal, percent



Source: Authors' calculations.

This is shown in graph 24 for government investment, in graph 25 for government consumption and in graphs 26 and 27 for two categories of taxes. While government investment as a strong countercyclical policy instrument is higher in the recession and lower in the boom than in the baseline scenario, the contrary is true for government consumption. The two tax rates also differ in their reaction to business cycle shocks: income tax rates (graph 26), which already behave countercyclically in the baseline scenario, do so more intensively in recessions (becoming lower than in the baseline scenario) and booms (becoming higher). The VAT rate (graph 27) in the two recession scenarios behaves countercyclical in the first half of the optimization period and procyclical in the second, thus turning from an orientation towards output and private consumption to one addressing public debt and deficits. In the boom scenarios, its orientation is less clear and expresses its contribution to both output and the public budget. The remaining tax revenues, which do not affect aggregate demand and output, actively contribute to financing the increases in government expenditures and reductions in income tax.

Graph 28 shows the results of the policy mix in the different scenarios for the main target variable growth rate of real GDP. This, as well as the growth rate of potential output, exhibits behaviour qualitatively similar to that in the baseline scenario but the effects of the recessions and the booms are closer to the respective uncontrolled simulations than to the "ideal" paths. This means that only part of the seemingly additional stabilization need is fulfilled by optimal fiscal policy. The reason for this is, again, the trade-off between output stabilization and budgetary prudence. Graph 29 shows that in all scenarios, the government budget deficit behaves in a way similar to that in the baseline scenario. In particular, irrespective of the shocks investigated here, the optimal policy calls for a strong reduction of the budget deficit as soon as at the beginning of the planning period. This results in a path of government

debt that in all scenarios is nearly identical to the "ideal" one, which results from the ease of obtaining this path with the optimal assignment of the different fiscal instruments (graph 30). Thus, to secure fiscal sustainability, it is optimal to design countercyclical policy actions with moderation, using only those instruments with more than immediate effects on output and employment, especially supply-side oriented measures such as reductions of direct taxes and increases in expenditures boosting actual and potential output.

As a policy conclusion, the optimization experiment suggests combining the fiscal policy instruments in a different way in view of the trade-off between output and the sustainability of public finances. According to the SLOPOL12 model, Slovenian fiscal policy makers can be advised to divert a large amount of its budget from consumptive expenditures to physical and human capital, while reducing income taxes and social security contributions, to obtain smooth growth with favourable effects on the state budget and debt. The task of budget consolidation should be accomplished as early as possible.

5 CONCLUSIONS

In this paper, we determined optimal fiscal policies for the next few years for Slovenia under alternative assumptions about global development. We used the macroeconometric model SLOPOL12 and assumed an intertemporal objective function for Slovenian policy makers containing output, unemployment, inflation, the budget deficit, public debt, and the current account as its main arguments. Using the OPTCON2 algorithm, approximately optimal policies were calculated under different scenarios, modelling modest global shocks. This serves to obtain information about trade-offs for Slovenian fiscal policy makers and advisable policy measures over the next few years under different conditions of the global economy. For an analysis of major global shocks (such as the COVID-19 shock or further geopolitical tensions), a different framework must be adopted.

The most important results of this study are:

1) Fiscal policy can, in the absence of a national monetary instrument, perform the task of stabilizing the economy to a certain extent by using some of its instruments in a Keynesian way to deal with recessions and booms in a qualitatively symmetric way to exert an influence on target variables such as GDP growth and unemployment, but not inflation.
2) There is a trade-off between output stabilization and the sustainability of budgetary policy, where the latter aim can be dealt with by the fiscal instruments very effectively, but at the price of a relatively low effectiveness of optimal fiscal policy with respect to GDP and its components in the short run.
3) Reactions of fiscal policy on negative (recession) and positive (boom) shocks should be dealt with in a moderate way and, at least for the shocks investigated here, without deviating much from the optimal policy course without these shocks.

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4) Assigning policy instruments with supply side effects on potential output, real GDP and employment (such as income taxes, social security contributions, and public investment, especially in physical and human capital) to the task of output stabilization (countercyclical policies) and other policy instruments (such as public consumption) to budgetary consolidation (procyclical policies) turned out to produce the optimal policy design. This is a relevant new insight as Keynesian policy prescription often miss the importance of supply side instruments also for short run stabilization policies.

A more comprehensive analysis would systematically consider variations in all of the parameters of the objective function. Previous work in this direction by Weyerstrass and Neck (2002) showed that the variation most relevant for the results was the weights and the "ideal" paths so these elements of the optimization problem should be the main focus of such an investigation. This could be followed by presentation of the results to policy makers to obtain their views about the desirability of the resulting scenarios. For this purpose, not only actual policy makers but also their advisors and other experts (and possibly a representative sample of voters) should participate in an interactive process in which the results of their stated preferences are demonstrated and the simulations are adapted accordingly. This would include presenting the results to the respondents in several rounds to obtain their views on the different scenarios. The ultimate aim of such an iterated interaction between modellers and policy makers could be a decision support system for actual policy decisions relating to current or future fiscal policy.

Disclosure statement

The authors have no conflicts of interest to declare.

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

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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

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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,

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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

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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).

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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

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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.

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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.

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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

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(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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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).

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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.*

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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.

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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*

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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).

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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

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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.

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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

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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.

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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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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

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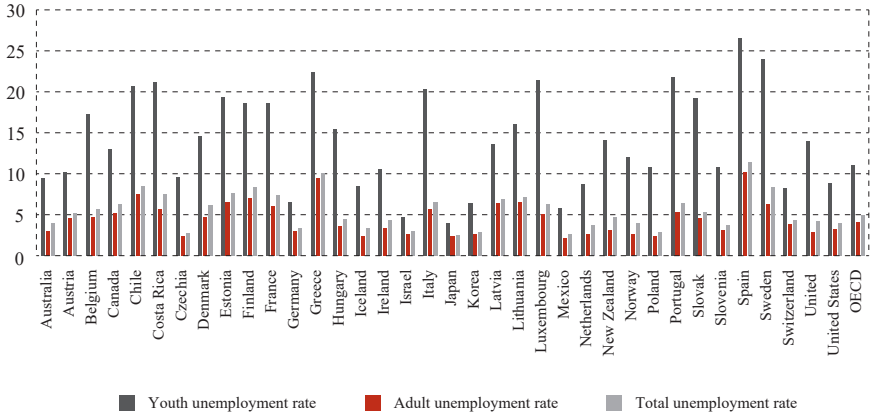
TABLE A3

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.

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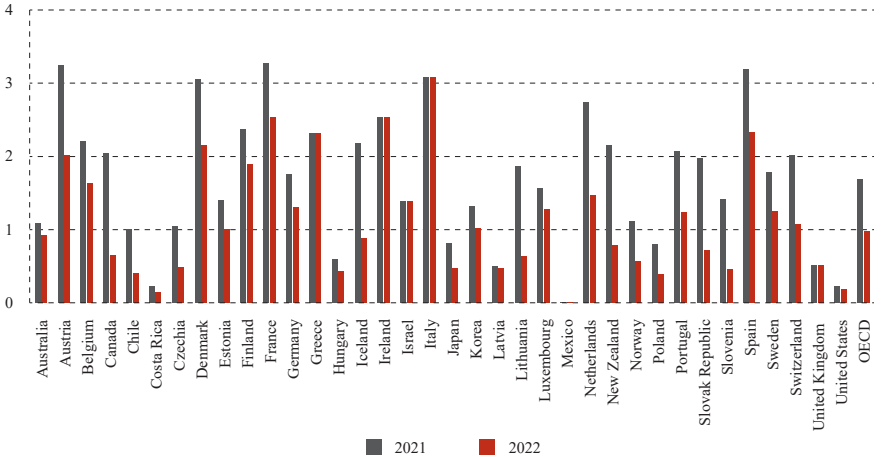
FIGURE A2

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.

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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.

The role of pay-for-performance in promoting integrated care

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Abstract

This work discusses the role pay-for-performance schemes (P4Ps) have in mitigating coordination problems between two sequentially organized providers (first and second). We analyse global budgets as well as three P4Ps that differ with respect to the targeted provider (the first, the second or both). It follows that global budgets introduce coordination problems being reduced when P4Ps are brought in. With respect to coordination, P4Ps that target the first provider do better than P4Ps that target the second provider due to the first provider having sole responsibility for some coordination problems. Furthermore, the optimal P4Ps are found, not only to define optimal quality levels, but also to depend on the providers' altruism, the providers' productivity, their position in the production chain and spill-over effects. The collection of relevant information will thus be costly for P4Ps, and it cannot be ruled out that global budgets do better than the optimal P4Ps.

Keywords: vertical relations, inter-organizational coordination, client-regarding preferences

1 INTRODUCTION

Production activities are often organized in value-generating chains with multiple providers in which production occurs sequentially. A typical example is that of manufacturers and retailers, but similar relationships are also frequent in the provision of services. For instance, in the health care industry, the social care industry, and the educational industry, various providers are active at different stages of the supply chain, and they seldom trade with each other. Concerning health care, a patient may demand assistance from primary care physicians, specialized healthcare institutions, and from rehabilitation centers. Elderly people and individuals with complex and chronic conditions need health services, nursing services (home care or institutional care), rehabilitation services and social services. For social care services, providers are typically involved in supplying economic support, housing services and vocational training. Because of provider interdependencies that might arise from both production and cost structures, coordination and integration among chain members become important for the overall performance (Gittel and Weiss, 2004).

Recent literature has shown a concern for the role new payment systems (integrated funding) may have in promoting integrated care. The Organization for Economic Cooperation and Development (OECD, 2016) classifies the new funding initiatives into the following three groups, (i) bundled payments, (ii) population-based payments, and (iii) add-on payments. Bundled payments are payments in which a defined part of the care pathway is reimbursed by a single payment (a tariff or a package price), while population-based payments refer to a group of providers that receives a pooled fund as compensation for being responsible for the delivery of a set of services to a pre-determined population. The common factor for bundled payments and population-based payments is that provider funding streams do not stay entirely separate (McDaid and Park, 2016; Mason et al., 2015;

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McGuire et al., 2019).[1] Add-on payments include pay-for-coordination schemes, whereby providers are reimbursed for performing certain coordination activities, and pay-for-performance schemes (P4P), where payments are tied to absolute or relative quality performances. In this work we are concerned with analysing the role P4P schemes may play in promoting coordinated care and to identify what type of information is needed to be able to implement such contracts.[2]

Our model set-up assumes that the joint outcome (improvements in client utility) is unobservable (non-contractable) and depends on the quality levels provided by two service chain members (a first and a last mover). Second, both providers have client-regarding preferences (semi-altruistic). Third, the quality-level supplied by the provider early in the chain has implications for the production costs of the subsequent provider (cost-externality). Under these assumptions, the paper considers various P4P schemes, that differ with respect to the information being available to the sponsor (observability and contractibility).

To our knowledge, this work is the first to discuss the role of P4P schemes in sequential production chains. However, our study relates to various stands of literature. First, it is inspired by the literature on non-pecuniary motivations such as public service motivation and altruism (see Francois, 2000; Francois and Vlassopoulus, 2008; Benabou and Tirole, 2003, 2006; Glazer, 2004 and Delfgaauw and Dur, 2008). In the health economics literature, works concerned primarily with quality competition in hospital markets (Brekke, Siciliani and Straume, 2011, 2017) and the optimal design of payment schemes (Ellis and McGuire, 1986, 1990; Chalkley and Malcomson, 1998; Kaarboe and Siciliani, 2011) include patient utility as part of the provider pay-off function. An important finding from this literature is that optimal quality and the optimal contracts will depend on the extent to which the provider holds altruistic preferences. Second, it relates to the multi-tasking literature, since being concerned with the challenges that arise from selective payments (Holmstrom and Milgrom, 1991; Kaarboe and Siciliani, 2011). Third, our analysis also relates to works on hidden information in sequential agencies. This literature is concerned with issues such as collusion (Baliga and Sjostrom, 1998; Macho-Stadler and Perez-Castrillo, 1993; Che, Yangguang and Zhang, 2021), transparency[3] (Cato and Ishiman, 2017; Nafziger and Schumacher, 2013 and Winter, 2010), integration versus separation[4] (Schmitz, 2005; Tamada

[1] A similar typology is presented by Tsiachristas et al. (2013). Here bundled payments and global payments are labelled as "all-inclusive payments".

[2] For practical examples of P4P schemes (case studies) see for example Allard, Jelovac and Leger (2011) who discuss altruism in relation to referral decisions, and Li (2018) who discusses altruism and career choices. Most theoretical studies that consider optimal incentives in the presence of altruism (patient-regarding preferences), presuppose that such preferences are observable. An exception is Jack (2005) who studies incentive mechanisms when physician altruism is private information (asymmetric information) for the third-party payer. Jack (2005) shows that when physician altruism is not contractible, incentive mechanisms need to be designed such that physicians reveal their true type.

[3] This literature discusses whether the actions of leaders should be observable to followers (transparent organizations) or not (opaque organizations).

[4] This literature discusses whether a single agent (integration) or two different agents (separation) should be in charge of the two productive stages.

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and Tsai, 2007) and optimal sharing rules (Strausz, 1999; Winter, 2006). These works, however, consider contracts that are contingent upon joint outcomes.[5]

Our analysis identifies several coordination problems (distortions) that arise in sequential production chains. For the case of global budgets, where no information about quality is available for the sponsor, we identify distortions that arise from the presence of (i) a cost externality, (ii) a strategic incentive, (iii) a marginal cost of public funds, and (iv) one or both providers being imperfectly altruistic. Furthermore, we find that the introduction of P4P schemes improves coordination, the degree of coordination varying, however, according to the information available to the sponsor. When information about the quality provided by both providers is available, the optimal P4P scheme realizes the welfare-optimal solution. Two additional P4P schemes are considered. Here the sponsor is assumed to have partial quality information from observing only the quality supplied by one of the providers. The two partial P4P schemes do not attain welfare-optimality; however, both schemes do better than global budgets. Furthermore, the number of coordination problems is lower for the scheme that targets the first mover than for the scheme that targets the late mover. This conclusion follows since the first mover alone is responsible for some of the coordination problems (cost-externality and strategic effects). The derived expressions for the optimal P4P schedules make clear that all three schemes are quite information intensive since optimal contract design requires detailed information about provider productivities, funding costs, marginal production costs and the degree of altruism held by the providers. This means that the implementation of the optimal P4P schemes might be challenging in practice. Significant costs associated with the collection of information might imply that global budgets do better in welfare terms than P4P schemes.

The outline of the paper is as follows. In section 2, we present the model and the first best solution. Section 3 analyses the global budgets case where the sponsor offers each provider a separate global contract. Sections 4, 5 and 6 present three optimal P4P schemes. First, we consider a scheme that assumes that the sponsor has collected information about the quality provided by the last mover (section 4). Subsequently, we analyse a scheme in which the sponsor has collected information about the quality provided by the first mover (section 5). Finally, a scheme where the sponsor collects information about the quality provided by both providers is discussed (section 6). In section 7, we summarize and discuss our findings, while section 8 concludes.

[5] Some analyses consider principals that can choose between which performance measures to monitor (input monitoring or output monitoring); however, this literature is concerned with agents that are not organized sequentially (McAfee and McMillian, 1991; Khalil and Lawaree, 1995; Bag and Wang, 2019).

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2 THE MODEL AND THE FIRST-BEST SOLUTION

We study a sponsor that contracts with two subordinates (providers). The two providers, provider F (first mover) and provider L (last mover), are organized into a sequential production chain that provides services to a representative client. The client, after having consumed services from provider F, receives additional services from provider L. Both providers are partly altruistic, meaning that they, to some extent, care about client welfare (agency). $U = (X,Y)$, the client utility function, represents the joint non-contractible outcome (improvements in health and life quality), where X is the quality provided by provider L (L-quality) and Y the quality provided by provider F (F-quality). The client utility function is supposed to be strictly increasing and concave in X and Y, i.e.:

$$U_X > 0, U_Y > 0, U_{XX} < 0, U_{YY} < 0 \text{ and } U_{XX}U_{YY} - (U_{XY})^2 > 0 \tag{1}$$

The objective function of provider L is the sum of a share, α, of client utility, $\alpha U(X,Y)$, where $0 < \alpha \leq 1$, and income t_L (the sponsor outlays to provider L), subtracted production (quality) costs $k(X,Y)$. Given this, the objective function of provider L, $v(X,Y)$, becomes:

$$v(X,Y) = \alpha U(X,Y) + t_L - k(X,Y) \tag{2}$$

The production cost function $k = k(X,Y)$, is strictly increasing and convex in X, i.e., $k_X > 0$ and $k_{XX} > 0$. Moreover, due to chain interdependencies, the more F-quality, the lower the cost of provider L for any L-quality level, i.e., $k_Y < 0$. This assumption of a positive externality is in accordance with an extensive literature confirming that community care, primary care and rehabilitation services reduce the need for hospital services and that hospital services reduce the use of home care and long-term services (Fortney et al., 2005; Forder, 2009; Deraas et al., 2011; Turner-Stokes et al., 2016; Duarte et al., 2018; Lau et al., 2021).

The objective function of provider F, $V(X, Y)$ is given by:

$$V(X,Y) = \beta U(X,Y) + t_F - C(Y) \tag{3}$$

where β is the weight provider F puts on client utility, where $0 < \beta \leq 1$, t_F is the financial sponsor compensation and $C = C(Y)$ is the production costs being increasing and strictly convex in Y, i.e., $C_Y > 0$ and $C_{YY} > 0$.[6]

The welfare, W, is described by the following function:

[6] The total costs, $k(X,Y) + C(Y)$, are consistent with economics of scope (see Baumol, Panzar and Willig, 1982; Gravelle and Rees, 2004; Lipczynski, Willson and Goddard, 2017) implying that provider-merging might be socially preferable. However, here we assume that it is desirable to keep production separate in two units. An obvious reason might be that the providers are specialized in terms of technologies, inputs and skills, in which case merging might lead to a lower quality with full integration possibly creating intra-organizational coordination problems not specified in the cost functions.

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$$W = U(X,Y) - (1+\lambda)[C(Y) + k(X,Y)] \tag{4}$$

where $\lambda > 0$ is the marginal cost of public funds (the funding cost). From maximizing (4) with respect to each of the two qualities, we arrive at the following expressions that define the first-best quality levels (*w* denotes the welfare-optimal values):

$$U_X = (1+\lambda)k_X\left(X^w, Y^w\right) \tag{5}$$

$$U_Y = (1+\lambda)[C_Y\left(Y^w\right) + k_Y\left(X^w, Y^w\right)] \tag{6}$$

The second-order conditions, $W_{XX} < 0$ and $[W_{XX}W_{YY} - (W_{XY})^2] > 0$, are satisfied given prior assumptions. From (5-6) it follows that the welfare optimal levels are determined by the marginal client utility being equal to the marginal social production cost (the production cost adjusted for the funding cost). Notice that for provider *F*, the marginal production cost includes a positive external effect on the production costs of provider *L*, i.e., the negative term $k_Y < 0$. We symbolize welfare stemming from these first best values of qualities by $W^w = U\left(X^w, Y^w\right) - (1+\lambda)[C\left(Y^w\right) + k\left(X^w, Y^w\right)]$.

3 NON-CONTRACTIBLE QUALITIES (THE GLOBAL BUDGETS CASE)

Given non-contractible qualities, the sponsor is left with the option to reimburse each provider by the means of global budgets.[7] In such a case, the sponsor compensates each provider by a fixed amount that is determined on the basis of expected costs (*ex-ante*).[8] Throughout the paper it is assumed that the participation constraints of both providers are satisfied, i.e. the sponsor's transfer to each of the providers is high enough to cover their costs; i.e. $t_L - k(X,Y) \geq \overline{v}$ and $t_F - C(Y) \geq \overline{V}$ where $\overline{v} = \overline{V} = 0$. The sequential game is as follows: first, the sponsor decides on the global budgets A_F and A_L ($t_F = A_F$ and $t_L = A_L$), thereafter provider *F* sets *Y*, and finally provider *L* sets *X*. The model is solved by backward induction. At stage 3, based on (2), provider *L* must satisfy the following first-order condition:[9]

$$\alpha U_X(X,Y) = k_X(X,Y) \tag{7}$$

Eq. (7) implicitly defines *X* as a function of *Y* and α, $X = X(Y; \alpha)$, being the reaction function of provider *L*. It follows that:

$$\frac{dX}{d\alpha} = X_\alpha = -\frac{U_X}{\alpha U_{XX} - k_{XX}} > 0 \qquad \text{as} \qquad \alpha U_{XX} - k_{XX} < 0.^{10} \tag{8}$$

[7] Health care providers have typically been compensated by fixed budgets or volume (number of patients and services), in terms fee-for-service, capitation and diagnosis-based payments, rather than value (health improvements). Such observations suggest that values are costly to measure.

[8] Global budget contracts are often practiced in public sector service provision. A somewhat different interpretation of the global budgets case is that the sponsor sets the budgets based on realized costs (*ex-post*).

[9] In the following, the functional arguments are omitted whenever it creates no confusion.

[10] The denominator in (8) represents the second order condition of the problem for provider *L*.

From (8) we observe that optimal *L*-quality, not surprisingly, increases with its degree of altruism. The slope of the reaction function, with regard to *Y*, is given by:

$$\frac{dX}{dY} = X_Y = \frac{k_{XY} - \alpha U_{XY}}{\alpha U_{XX} - k_{XX}} \geq (<) 0 \qquad \text{as} \qquad k_{XY} - \alpha U_{XY} \leq (>) 0 \tag{9}$$

According to Bulow, Geanakopolos and Klemperer (1985), the qualities are strategic complements (strategic substitutes) if $X_Y \geq (<)\ 0$. Hence, for qualities being complements (substitutes) in *L*-costs $k_{XY} \leq (>)\ 0$, and complements (substitutes) in client utility, $U_{XY} \geq (<)\ 0$, describing a situation with decreasing (increasing) marginal costs in *L*-quality, as *F*-quality becomes higher, imply that the qualities are strategic complements (substitutes).[11] In the following, the qualities are defined as "overall complements" if $k_{XY} - \alpha U_{XY} < 0$, "overall substitutes" if $k_{XY} - \alpha U_{XY} > 0$ and "overall independent" if $k_{XY} - \alpha U_{XY} = 0$. From this we can conclude that for qualities being "overall complements" the qualities are strategic complements ($X_Y > 0$), for "overall substitutes" the qualities are strategic substitutes ($X_Y < 0$), while for "overall independence" the qualities are strategic independent ($X_Y = 0$).

Using (3), provider *F* at stage 2 faces the following problem:

$$\text{Max } V = \max[\beta U(X,Y) - C(Y) + t_F] \text{ w.r.t. } Y \; s.t. \; X = X(Y; \alpha) \tag{10}$$

The first-order condition for this problem is:

$$\beta U_Y = C_Y - \beta U_X X_Y \tag{11}$$

From (11) we observe that *F*-quality becomes a function of the altruistic preferences of both providers; $Y = Y(\beta; \alpha)$.[12] The expressions for the impacts from altruism on *F*-quality are:

$$Y_\beta = -\frac{U_Y + U_X X_Y}{V_{YY}} \gtreqless 0 \qquad \text{as} \qquad U_Y + U_X X_Y \gtreqless 0 \tag{12a}$$

$$Y_\alpha = -\frac{\beta\left[\left(U_{XX} X_Y + U_{XY}\right) X_\alpha + U_X X_{Y\alpha}\right]}{V_{YY}} \gtreqless 0 \tag{12b}$$

[11] The strategic properties of the two activities depend on (i) how the client's marginal utility from a higher service intensity (quality) provided by a provider, is affected by changes in the quality provided by the chain partner, and (ii) how the marginal production cost of the *L*-provider is affected by changes in the quality provided by the *F*-provider. The case of strategic substitutes will occur when a more continuous GP monitoring of chronic patients (in terms of blood pressure, cholesterol and alcohol consumption) better determines the adequate timing of specialized services, in this way increasing the marginal benefit from specialized services (complements in client utility) as well as decreasing the marginal cost of specialized care (substitutes in costs). The case of strategic complements occurs when more GP services reduce the marginal client utility from specialized services (substitutes in client utility) while the marginal cost of the subsequent specialist treatment plan is either increased or unaffected by the supply of GP services (so that the qualities are complements or independent in costs).

[12] $V_{YY} = \beta[U_{YY} + (2U_{XY} + U_{XX})X_Y + U_X X_{YY}] - C_{YY} < 0$ is the second order condition for problem (10).

It follows from (12a) that a change in the degree of *F*-altruism has both a direct and an indirect effect on *F*-quality. The direct effect follows because the marginal utility from more quality increases, $U_Y > 0$. The indirect effect follows because of the sequential decision-structure. Provider *F*, when choosing own quality, considers the responses of provider *L*. Given a positive (negative) response, i.e., the qualities being strategic complements (strategic substitutes), provider *F* will choose a higher (lower) quality level to induce provider *L* to increase its quality level (relatively to the case of strategic independent qualities). Unless the qualities are overall substitutes to a significant extent, it seems reasonable that the direct effect (measured by U_Y) dominates the indirect effect (measured by $U_X X_Y$), implying that as β increases, provider *F* will find it advantageous to increase its quality, i.e., $Y_\beta > 0$. From (12b) it follows that the weight given by provider *L* to client utility (a higher degree of *L*-altruism) has complex and indeterminate effects on *F*-quality.[13]

The first-order conditions for the global budgets case, *G,* (see 7 and 11) are summarized below:

$$\alpha U_X = k_X \tag{13}$$

$$\beta U_Y = C_Y - \beta U_X X_Y \tag{14}$$

If we now compare these conditions with the welfare-optimal levels (see 5 and 6), it follows from (14) that the cost-externality is not internalized by provider *F* and that provider *F*, in the setting of own quality, pays attention to the effect own quality has on *L*-quality, in this way taking advantage of his chain position. For $X_Y > (<) 0$, a higher (lower) *F*-quality induces provider *L* to increase (decrease) her quality. Hence, the sequential order of moves implies that the behaviour of provider *F* depends on whether X_Y is positive or negative. In the following, the effects working via the response function of the provider *L*, $X = X(Y, \alpha)$, are termed strategic effects.

Given strategic complements, $X_Y > 0$, provider *F*, when deciding on quality, induces provider *L* to raise its quality. This change in *L*-quality comes at no cost for provider *F.* Given strategic substitutes, $X_Y < 0$, provider *F* reduces own quality to increase *L*-quality. By inserting (13), into the last term of (14), we get $\beta U_X X_Y = \beta/\alpha \; k_X X_Y$ thus the strategic effect, *ceteris paribus*, increases with a higher β and a lower α. Hence, the more provider *F* values client utility, and the less provider *L* does, the more significant is the strategic effect.[14]

In the following, we define a coordination problem as a deviation from the welfare-optimal solution. It follows that the following conditions must be fulfilled for the two cases to coincide; $\lambda = 0$; $\alpha = \beta = 1$, $k_Y = 0$ and $X_Y = 0$. Hence, the coordination

[13] It follows that the effect on provider *L* quality from a higher degree of provider *F* altruism is given by $dX/d\beta = X_Y Y_\beta$.

[14] This reasoning does not consider that the qualities are functions of the altruistic parameters.

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problems that arise from the global budgets case occur because of: (i) imperfect agency, (ii) ignorance of funding costs, (iii) non-internalization of cost-externality, and (iv) the presence of strategic effects. The expressions in (13) and (14) define the optimal quality levels termed (X^G, Y^G) while the welfare level stemming from the global budgets case is defined by $W^G = V(X^G, Y^G) - (1 + \lambda)[C(Y^G) + k(X^G, Y^G)]$.

4 CONTRACTIBLE *L*-QUALITY (THE *L*-SCHEME)

In this section, we study the case where *F*-quality is non-contractible while *L*-quality is contractible. Given this, the sponsor can reimburse provider *L* by a linear incentive scheme (absolute rewards), where p is the payment per unit of X (in the following denoted the "price"). The expenses of the sponsor to provider *L* are defined by $t_L = A_L + pX$ where A_L is the fixed budget and pX the performance rewards. Provider *F*, since its quality level, Y, is non-contractible, is reimbursed by a fixed budget alone ($t_F = A_F$).[15] At the first stage, the sponsor decides on A_F, A_L and p. At stage two, provider *F*, for given levels of A_F, A_L and p, decides on Y. At stage three, provider *L*, for the given A_F, A_L, p, and Y decides on X. This game is solved by backward induction.

The maximization problem of provider *L*, at stage 3, now becomes:

$$\text{Max } v(X, Y) = \max [\alpha U(X, Y) - k(X, Y) + pX + A_L] \text{ w.r.t. } X.$$

Solving this yields the following first order condition:

$$\alpha U_X - k_X + p = 0 \tag{15}$$

It follows that optimal *L*-quality, defined by (15), is dependent on Y, p and α, i.e., $X = (Y, p, \alpha)$ and differentiation of (15) with respect to p (the direct price-effect) yields:[16]

$$X_p = -\frac{1}{\alpha U_{XX} - k_{XX}} > 0 \qquad \text{as} \qquad \alpha U_{XX} - k_{XX} < 0 \tag{16}$$

As expected, a higher price, p, increases incentivized quality (*L*-quality).
At stage 2, provider *F* faces the following problem:

$$\text{Max } V(X, Y) = \max [\beta U(X, Y) - C(Y) + A_F] \text{ w.r.t. } Y \qquad s.t.\ X = X(Y,p,\alpha).$$

The first order condition for provider *F* now becomes:

$$\beta U_X X_Y + \beta U_Y - C_Y = 0 \tag{17}$$

[15] The total financial outlays of the sponsor now become $T = t_L + t_F = A_L + pX + A_F$.
[16] The partial effects on X from Y and α are not presented here, being equal to the ones arrived at for the global budgets case (see 8 and 9).

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Equation (17) defines Y as a function of p, β and α, i.e., $Y = Y(p, \beta, \alpha)$, and differentiation of (17) with respect to p, yields:[17,18]

$$Y_p = -\frac{\beta[(U_{XX}X_Y + U_{XY})X_p + U_X X_{Yp}]}{Z} \tag{18a}$$

The effect in (18a) is an indirect price-effect since it is concerned with the impact on non-incentivized quality. This effect is generally indeterminate because $\beta[(U_{XX}X_Y + U_{XY})X_p + U_X X_{Yp}]$ is ambiguous. In the special case in which $\beta \to 0$, it follows that $Y_p \to 0$. This finding follows because the lower the weight the F-provider gives to client utility, the lower the marginal quality returns that follow from a price change. By assuming that all the third derivatives of the utility and cost functions are zero, we get that $X_{Yp} = 0$, thus (18a) can be expressed as:[19]

$$Y_p = -\frac{\beta(U_{XX}X_Y + U_{XY})X_p}{Z} \tag{18b}$$

Now, by inserting the expression for X_Y (see 9) and X_p (see 16), (18b) can be expressed as:

$$Y_p = -\frac{\beta}{Z(\alpha U_{XX} - k_{XX})^2}(U_{XY}k_{XX} - U_{XX}k_{XY}) \tag{18c}$$

As $-\frac{\beta}{Z(\alpha U_{XX} - k_{XX})^2} > 0$, the sign of Y_p has the same sign as $U_{XY}k_{XX} - U_{XX}k_{XY}$ and since $k_{XX} > 0$ and $U_{XX} < 0$, it follows that Y_p is positive (negative) when the qualities are complements (substitutes) in the utility function, i.e., $U_{XY} > (<) 0$ in combination with the marginal cost of L-provider increasing (decreasing) as F-quality becomes higher, i.e., $k_{XY} > (<) 0$. For qualities that are substitutes in client utility, i.e., $U_{XY} < 0$, the first term in the parenthesis of (18c) is negative while the second term is positive or negative depending on the sign of k_{XY}. For a positive second term that always dominates the first term, the indirect price effect becomes positive.

To define the maximization problem of the sponsor, we insert the reaction functions into the welfare function, which yields the following function:[20]

$$W(p) = U[X(Y(p), p), Y(p)] - (1+\lambda)[k[X(Y(p), p), Y(p)] + C(Y(p))]$$

Maximizing (W_p) with regard to p gives the following first-order condition:

[17] $Z = \beta(U_{YY} + U_X X_{YY} + 2U_{XY}X_Y + U_{XX}X_Y^2) - C_{YY} < 0$ in (18ab) is the second order condition for the maximization problem.

[18] The partial effects on Y from α and β are not presented here since they are equal to those arrived at for the global budgets case (see 12ab).

[19] It follows that $X_{Yp} = \frac{X_p}{(\alpha U_{XX} - k_{XX})^2}(k_{XXY} - \alpha U_{XXY})(\alpha U_{XX} - k_{XX}) - (k_{XY} - \alpha U_{XY})(\alpha U_{XXX} - k_{XXX})$, thus a sufficient condition for $X_{Yp} = 0$ is that all third derivatives are zero.

[20] In the following, whenever it creates no confusion, we do not present the response function with α and β as arguments.

$$(U_X - (1+\lambda)k_X)\left(X_p + X_Y Y_p\right) + (U_Y - (1+\lambda)(k_Y + C_Y))Y_p = 0 \qquad (19)$$

By using (15), the optimal price for the *L*-scheme, p^L, can be expressed as follows:

$$p^L = \frac{1-\alpha(1+\lambda)}{1+\lambda}U_X + \varphi\Omega \text{ where } \varphi = \frac{U_Y - (1+\lambda)(C_Y + k_Y)}{1+\lambda}$$
$$\text{and} \qquad \Omega = \frac{Y_p}{\left(X_p + X_Y Y_p\right)} \qquad (20)$$

The optimal price in (20) is determined by two terms. The first term, $\frac{1-\alpha(1+\lambda)}{1+\lambda}U_X$, reflects sponsor concerns for the weight provider *L* attaches to client utility (where $\alpha < 1$ implies imperfect agency) adjusted by the funding cost, λ. The second term, $\varphi\Omega$, is a correction term, reflecting a trade-off between incentivized and non-incentivized quality (spill-over effect). Ω measures the ratio of the price responsiveness of the two qualities, while φ measures the relative change in welfare that follows from the same changes. For the case where non-incentivized quality is unaffected by p ($Y_p = 0 \Rightarrow \Omega = 0$) and for $\beta \to 0 \Rightarrow Y_p \to 0 \Rightarrow \Omega \to 0$), the correction term becomes zero (or close to zero), thus suggesting that the rationale for the correction term lies with the ability of the sponsor to steer *Y* via the price. For $Y_p = 0$, the sponsor is only able to steer one of the qualities, hence trade-off concerns are no longer relevant. We also observe from (20) that a negative optimal price is the outcome if the degree of *L*-altruism, α, is high relative to the funding cost (λ); ($1/\alpha < 1+\lambda$).

By inserting (20) into the condition for incentivized quality (see 15), and by rewriting the condition for non-incentivized quality (see 17), we arrive at the following *L*-scheme conditions:

$$U_X = (1+\lambda)(k_X - \varphi\Omega) \qquad (21)$$

$$\beta U_Y = C_Y - \beta U_X X_Y = C_Y - \beta(1+\lambda)(k_X - \varphi\Omega)X_Y \qquad (22)$$

The expressions in (21) and (22) define optimal *L*-quality and optimal *F*-quality, respectively termed (X^L, Y^L). The condition for incentivized quality (see 21) is not directly dependent on the altruistic parameters – only indirectly by the possible effects α and β might have via the correction term. The condition for non-incentivized quality (see 22), however, is directly affected by the altruistic parameter belonging to the *F*-provider, β. The same condition also contains a strategic effect.[21] This effect differs from that identified for the global budgets case (see 9) since the condition for *L*-quality differs across the two schemes. In (22), the strategic effect is independent of α but it increases with β (ignoring the fact that the qualities are functions of the altruistic parameters). The welfare stemming from the optimal *L*-scheme is in the following termed $W^L = V(X^L, Y^L) - (1+\lambda)[C(Y^L) + k(X^L, Y^L)]$.

[21] Given qualities that are overall independent, i.e., $X_Y = 0$, implying $Y_p = -\frac{\beta(U_{XY}X_p + U_X X_{Yp})}{z}$.

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If we compare the optimal *L*-scheme (21-22), with the welfare-optimal solution (5-6), it follows that the welfare-optimal solution is not achieved because (i) the optimal condition for incentivized quality differs because of the correction term, and (ii) the optimal condition for non-incentivized quality differs because of imperfect agency ($\beta < 1$), because of a non-internalized externality ($k_Y < 0$) and because of the presence of a strategic effect ($X_Y \neq 0$).

A comparison of the *L*-scheme (21-22) with the global budgets case (13-14) makes it clear that the optimal *L*-scheme changes the behaviour of provider *L*. First, because the optimality condition for incentivized quality becomes independent of the altruistic preferences held by provider *L* at the same time as the funding cost and the correction term play a role. Second, the optimality condition for non-incentivized quality now contains a strategic effect that differs from the one that is present for the global budgets case.

5 CONTRACTIBLE *F*-QUALITY (THE *F*-SCHEME)

Here we study the case where *L*-quality is non-contractible (non-incentivized) while *F*-quality is contractible. Now the sponsor can reimburse provider *F* by a linear scheme where *b* is the payment per unit of *Y* (in the following denoted "the bonus"). The sponsor outlays to provider *F* are $t_F = A_F + bY$ where A_F is the fixed budget and bY the performance rewards. At the first stage, the sponsor decides on A_F, A_L and *b*. At stage two, provider *F*, for given levels of A_F, A_L and *b*, decides on *Y*. At stage three, provider *L*, for given A_F, A_L, *b*, and *Y* decides on *X*. The game is solved by backward induction.

The maximization problem of provider *L*, at stage 3, is:[22]

$$\text{Max } v(X, Y) = \max [\alpha U(X, Y) - k(X, Y) + pX + A_L] \text{ w.r.t. } X$$

Solving this yields the following first order condition:

$$\alpha U_X(X, Y) - k_X(X, Y) = 0 \qquad (23)$$

It is seen that optimal *L*-quality, defined by (23), is dependent on *Y* and α, i.e., $X = X(Y,\alpha)$.[23]

At stage 2, provider *F* faces the following problem:

$$\text{Max } V(X, Y) = \max [\beta U(X, Y) - C(Y) + A_L + bY] \text{ w.r.t. } Y \qquad s.t.\ X = X(Y,\alpha).$$

The first order condition becomes:

$$V_Y = \beta U_X X_Y + \beta U_Y - C_Y + b = 0 \qquad (24)$$

[22] The second order condition for this maximization problem is fulfilled from prior assumptions: $\alpha U_{XX} - k_{XX} < 0$.
[23] The partial effects from *Y* and α are not presented since coinciding with the global budgets case (see 8 and 9).

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Equation (24) defines Y as a function of β, α and b, i.e., $Y = Y(b, \beta, \alpha)$, and differentiation of (24) w.r.t. b yields:[24, 25]

$$Y_b = -\frac{1}{z} > 0 \tag{25a}$$

From (25a) it follows that the direct bonus effect is positive. The indirect bonus effect is given by:

$$X_b = X_Y Y_b \geq (<) 0 \quad \text{as} \quad X_Y \geq (<) 0 \tag{25b}$$

The indirect effect is positive when the qualities are strategic complements, zero for strategic independent qualities and negative for strategic substitutes (see the discussion in relation to 7).

To define the maximization problem of the sponsor, we insert the reaction functions into the welfare function which yields the following maximization problem:

$$\text{Max } W(b) = \max \{U[X(Y(b)), Y(b)] - (1+\lambda)[k[X(Y(b)), Y(b)] + C(Y(b))]\} \text{w.r.t. } b$$

which yields the following first order condition:

$$Y_b\left[U_X X_Y + U_Y - (1+\lambda)\left(k_X X_Y + k_Y + C_Y\right)\right] = 0 \tag{26}$$

By using (24) in (26), the optimal bonus, b^F, can be expressed as follows:

$$b^F = \frac{\left(1-\beta(1+\lambda)\right)}{1+\lambda} U_Y - k_Y + \left[\frac{\left(1-\beta(1+\lambda)\right)}{1+\lambda} U_X - k_X\right] X_Y \tag{27}$$

From (27) we observe that the optimal bonus is determined by three terms. The first term, $\frac{1-\beta(1+\lambda)}{1+\lambda} U_Y$, reflects sponsor concerns for the weight that provider F attaches to client utility and this concern is adjusted by the funding cost, λ. The second term, $-k_Y$, implies that the positive externality is fully internalized. The third term, $\left[\frac{\left(1-\beta(1+\lambda)\right)U_X}{1+\lambda} - k_X\right] X_Y$ is a correction term that reflects trade-offs between incentivized and non-incentivized quality (a spill-over effect) in the sense that a change in b induces a change in incentivized quality (F-quality) that has implications for the optimal choice of non-incentivized quality (L-quality).

[24] $Z = \beta\left(U_{YY} + U_X X_{YY} + 2U_{XY} X_Y + U_{XX} X_Y^2\right) - C_{YY} < 0$ is the second order condition for the maximization problem.
[25] The partial effects from β and α are not presented below since they are equal to the global budgets case (see 12ab).

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By inserting (27) into (24), we arrive at the following first-order conditions for the *F*-scheme:

$$\alpha U_X = k_X \tag{28}$$

$$U_Y = (1+\lambda)(C_Y + k_Y) - \left[U_X - (1+\lambda)k_X\right]X_Y \tag{29}$$

The condition for incentivized quality (see 29) is not directly dependent on any of the altruistic parameters – only indirectly by the possible effects α and β might have via the correction term $\left[U_X - (1+\lambda)k_X\right]X_Y$. The condition for non-incentivized quality (see 28), however, is directly affected by the degree of *L*-altruism α. Furthermore, despite strategic independence, the condition for incentivized quality contains a strategic effect confirming that the sponsor utilizes the dependencies that exist between the qualities. By using (28), the last term of (29) can be expressed as follows: $1/\alpha\left[1-\alpha(1+\lambda)\right]k_X X_Y$. In the case of strategic substitutes (complements), i.e., $X_Y < (>)\ 0$, combined with the case where $\alpha < (>) 1/1+\lambda$, the last term becomes negative meaning that the sponsor values an increase in *Y* more than the marginal client utility, U_Y. The optimal levels of *L*-quality and *F*-quality are now termed (X^F, Y^F). The welfare level stemming from the *F*-scheme is termed $W^F = V(X^F, Y^F) - (1+\lambda)[C(Y^F) + k(X^F, Y^F)]$.

To evaluate the impact of the optimal *F*-scheme we compare (28-29) with the welfare-optimal solution (5 and 6) and the global budgets case (13 and 14). The first conclusion is that the optimal *F*-scheme does not produce the welfare-optimal solution because the condition for incentivized quality (see 31) differs from the corresponding welfare-optimal condition (see 6) due to the presence of a correction term. Furthermore, the condition for non-incentivized quality (see 30) differs from the corresponding welfare-optimal condition (see 5) under imperfect agency ($\beta < 1$) and because the funding cost is not internalized. An additional conclusion is that the introduction of the *F*-scheme (28-29), relatively to the global budgets case, does not change the condition for non-incentivized quality (see 13) but it changes the condition for the incentivized quality (see 14) since (i) *Y* becomes independent of the altruistic preferences held by provider *F* (β), (ii) the funding cost and the cost externality become internalized, and (iii) the strategic effect becomes different.

6 CONTRACTIBLE QUALITIES (THE FIRST-BEST P4P SCHEME)

The final P4P scheme to consider is when both qualities are contractible meaning that the sponsor can reimburse both providers. Provider *L* is now reimbursed by a linear incentive scheme where p^W is price (the payment per unit of *Y*) while provider *F* is reimbursed by a linear scheme where b^W is the bonus (the payment per unit of *X*). By following the same procedures as in the preceding sections, we arrive at the following expressions for the two optimal unit payments:

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$$p^w = \frac{1-\alpha(1+\lambda)}{1+\lambda} U_X \tag{30}$$

$$b^w = \frac{1-\beta(1+\lambda)}{1+\lambda} U_Y - k_Y - \beta U_X X_Y \tag{31}$$

The optimal P4P scheme described in (30) and (31) represents a full information case, hence the first-best solution follows per assumption.[26] We observe that both the welfare-optimal price, p^W, and the welfare-optimal bonus, b^W, are adjusted for client productivity, the funding cost and the degree of altruism held by the respective provider. In addition, the optimal welfare-optimal bonus (see 31) is concerned with the internalization of the cost externality as well as addressing the strategic effect.

7 DISCUSSION AND SUMMARY

In this section, we compare and discuss the findings regarding the four schemes considered. To aid our discussions, we present a table that sums up the optimality conditions and the associated optimal unit payments (see table 1). A first observation from table 1 is that the optimal condition for X is similar for the F-scheme (28) and the global budgets case (13), while the optimal condition for Y is similar for the L-scheme (22) and the global budgets case (14). We also observe that the three P4P schemes are characterized by relatively complex optimal unit payments and that both the L-scheme and F-scheme contain correction terms. For the L-scheme the correction term is part of the optimal price while for the F-scheme the correction term is part of the optimal bonus. This finding confirms that the sponsor, in both partial schemes, utilizes the dependencies that exist between the quality variables.

The ranking of the F-scheme and the first-best P4P scheme with respect to the optimal bonus is:

$$b^F > b^W \quad \text{if} \quad X_Y > 0 \quad \text{and} \quad \frac{1}{1+\lambda} > \alpha \quad \text{and if} \quad X_Y < 0 \quad \text{and} \quad \frac{1}{1+\lambda} < \alpha \tag{32}$$

$$b^F < b^W \quad \text{if} \quad X_Y > 0 \quad \text{and} \quad \frac{1}{1+\lambda} < \alpha \quad \text{and if} \quad X_Y < 0 \quad \text{and} \quad \frac{1}{1+\lambda} > \alpha \tag{33}$$

From (32) and (33) it follows that for $1/1+\lambda \neq \alpha$, a bonus level set equal to the first-best bonus level will not be optimal for the F-scheme. For instance, consider the case where $1/1+\lambda > \alpha$ and $X_Y > 0$ characterizing a situation where the degree of L-altruism is insufficient and where the qualities are strategic complements. In this case, the optimal F-scheme suggests a bonus that is higher than the first-best bonus level since F-quality must be raised to induce more L-quality.

[26] This is seen by inserting the equations in (30) and (31) in (15) and (24) respectively, giving us the conditions for the first-best qualities in (5) and (6).

Table 1

The optimal first-order conditions and the associated optimal unit payment (prices and bonuses) under different assumptions about contractability

	Optimality conditions		**Optimal unit payment (price and bonus)**	
The first-best P4P scheme (contractible X and Y)	$U_X = (1+\lambda)k_X$ --------- $U_Y = (1+\lambda)(C_Y + k_Y)$	(5) (6)	$p^w = \dfrac{1-\alpha(1+\lambda)}{1+\lambda}U_X$ --------- $b^w = \dfrac{1-\beta(1+\lambda)}{1+\lambda}U_Y - k_Y - \beta U_X X_Y$	(30) (31)
Global budgets case (non-contractible X and Y)	$\alpha U_X = k_X$ --------- $\beta U_Y = C_Y - \beta U_X X_Y$	(13) (14)	$p^G \equiv 0$ --------- $b^G \equiv 0$	
The optimal L-scheme (contractible X)	$U_X = (1+\lambda)\left[k_X - \left(\dfrac{U_y - (1+\lambda)(C_Y + k_Y)}{(1+\lambda)}\right)\left(\dfrac{Y_p}{X_p + X_Y + Y_p}\right)\right]$ --------- $\beta U_Y = C_Y - \beta U_X X_Y$	(21) (22)	$p^L = \dfrac{1-\alpha(1+\lambda)}{1+\lambda}U_X + \left(\dfrac{U_y - (1+\lambda)(C_Y + k_Y)}{(1+\lambda)}\right)\left(\dfrac{Y_p}{X_p + X_Y Y_p}\right)$ --------- $b^L \equiv 0$	(20)
The optimal F-scheme (contractible Y)	$\alpha U_X = k_X$ --------- $U_Y = (1+\lambda)(C_Y + k_Y) - \left[U_X - (1+\lambda)k_X\right]X_Y$	(28) (29)	$p^F \equiv 0$ --------- $b^F = \dfrac{(1-\beta(1+\lambda))}{1+\lambda}U_Y - k_Y + \left[\dfrac{(1-\beta(1+\lambda))}{1+\lambda}U_X - k_X\right]X_Y$	(27)

The relative size of the optimal L-scheme price and the first-best P4P price can be determined under some specific conditions. For $\frac{1}{1+\lambda} \geq \beta$, in combination with the qualities being "strong" complements, meaning that $(1+\lambda)k_Y < -U_X X_Y$, it follows that $Y^W > Y^L$ which again yields the following ranking:

$$p^L > (<)\, p^W \quad \text{if} \quad Y_P > (<)\, 0 \tag{34}$$

Eq. (34) says that the optimal L-scheme price is higher (lower) than the first-best P4P price, if a higher price increases (decreases) F-quality. This result follows since an L-scheme price set equal to the first-best P4P price becomes too low. A higher L-scheme price will now induce more (less) F-quality, resulting in an optimal L-scheme price that is higher (lower) than the first-best P4P price.

From former sections we know that the effects from the price and the bonus on incentivized quality (the direct effects X_P and Y_b) are strictly positive in the partial P4P schemes (see 16 and 25ab), while the indirect effects (X_b and Y_p) are indeterminate, depending on the signs of the cross partial derivatives of the utility function and the cost functions (see 25ab). For the F-scheme, the sign of the indirect effect is determined by the strategic relationship between the qualities (strategic complements, strategic independent or strategic substitutes; $k_{XY} - \alpha U_{XY} \leq (>)\, 0$. For the L-scheme, the indirect effect is more complex. In this case, for a response function that is independent of the price ($X_{Yp} = 0$), the sign of the indirect effect depends on $U_{XY} k_{XX} - U_{XX} k_{XY}$ and thus we cannot rule out the indirect effect being positive for "overall" substitutes (see the discussion in relation to 7).

Important findings from the theoretical literature on optimal reimbursement for a single health care provider are that the preferred quality level and the optimal contract will depend on the degree of provider altruism (see the references in the introduction). Our multi-provider analysis shows that these conclusions are also relevant from a production chain perspective. We find that a higher degree of altruism typically increases the quality provided by last movers while the effects on the quality provided by first movers are more complex. On the one hand, more intensive client-specific preferences imply a higher outcome valuation, thus pulling in the direction of higher quality. On the other hand, the same change implies that the marginal returns from opportunistic behaviour (free-riding behaviour and the ignorance of cost externalities) become higher, thus pulling in the opposite direction. On the other hand, there is a possibility that pro-social preferences are strongly associated with internalized norms and moral values that make opportunism less likely. If this is the case, one would expect organizational cultures, characterized by strong client-regarding preferences, to abstain from free-riding behaviour and the ignorance of cost externalities.

The three P4P schemes considered are all quite information-intensive, requiring that (at least) some quality dimensions must be contractible; in addition, the determination

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of the optimal unit payments requires detailed information about client productivities, U_X and U_Y, the funding cost, λ, the marginal production costs of provider F, k_Y, and the degree of altruism held by the providers. The informational requirements that matter for the optimal unit payments in our analysis vary to some extent across the schemes. The first-best P4P scheme presupposes information about the degree of F- and L-altruism and the response-function of provider L, X_Y. The optimal F-scheme, however, is less information intensive in the sense that information about L-altruism is not needed. The optimal L-scheme, however, is more information intensive than the other two P4P schemes, although they do not require information about F-altruism and X_Y, since they need information about C_Y, Y_p and X_p. For $U_{XY}\,k_{XX} - U_{XX}\,k_{XY} = 0$, it follows that $X_Y = Y_p = 0$, thus the informational requirements are reduced for all three schemes since information on X_Y and Y_p is not needed. In addition, information about U_X and k_X is not needed for the optimal F-scheme while information on U_Y, k_Y, C_Y and k_X is not needed for the optimal L-scheme.

As concerning quality-related information, significant resources have over time been invested into increases in the number of quality indicators and into improvement of their validity and reliability, thus making the introduction of P4P schemes more likely.[27] Furthermore, various methods are used to collect such information include audits (site-visits), patient surveys (patient reported outcome measures; PROMs and patient-centred outcomes (PCOs)), medical error reports and various automated reports (e.g., electronic journals). Each information source alone is typically associated with informational limitations while the combined use of several sources may improve on the situation. However, a main impression from the literature is still that the quality indicators observed do not cover all the relevant quality dimensions, they are typically chain member-specific, their importance varies across systems and providers, and they typically measure structures (equipment and technology) and processes (episodes of patient care) rather than outcomes (values). The type and number of quality indicators are typically available from case reports,[28] however, information on various types of costs is rarely available. According to Maynard (2012), Y-Ling and Sutton (2014) and Cashin et al. (2014), the costs reported in case studies are primarily the incentive payments (the rewards), while no attempts are made to measure the cost to providers of participating in programs or meeting initial requirements to participate (program costs and administrative costs). It seems to be self-evident that the program costs for P4P schemes are significantly higher than those for global budgets since more information is needed, which typically results in significant program – and administrative costs. However, in some healthcare systems that typically apply global budgets, quality information is sometimes systematically collected since such practices produce data that enable sponsors to evaluate and compare providers (benchmarking).

[27] Mur-Veeman, van Raak and Paulus (2008), Tsiachristas et al. (2013), and Stokes et al. (2018) describe reimbursements' systems implemented to support integrated care. Cameron et al. (2014) review evidence related to joint working in the field of health and social care services, while Mason et al. (2015) review 38 reimbursement schemes from eight countries to understand the role that integrated funding can play in promoting coordinated care.

[28] According to Eijkenaar et al. (2013), reviewing 12 P4P schemes in 9 different countries, the average number of quality indicators is about 30.

Furthermore, despite some publications stressing the importance of the new payment models, including P4P schemes, in promoting care coordination (Cashin et al., 2014; OECD, 2016), actual case reports on P4P schemes seem not to include such a perspective, meaning that there are no practical lessons on the adequate design of P4P schemes in promoting coordination. In this respect, our analysis appears to represent a first step to defining the requirements for designing optimal P4P schemes when improved coordination is a policy objective. Relative to standard schemes, much of the same type of information is needed (quality, degree of altruism and productivity), however now the situation becomes more complex since the wider perspective necessitates such information for more than one provider and since the interlinkages between chain providers and chain-position must also be included (spill-over effects). The resulting increase in informational requirements may pose a challenge, since the informational costs are rising. Hence, it becomes important to consider what types of information can be collected and what the associated costs will be. A situation characterized by incomplete information and/or significant information costs may well represent a situation where global budgets are the preferred payment scheme from a social perspective.

Our analysis finds that complete information on altruistic preferences is important. This assumption is clearly a strong one since it is difficult to fulfil in practice. However, to what extent altruistic preferences exist or not, and if so, how important they are, are issues that have been investigated in the empirical literature concerned with physician altruism and patient-regarding preferences. This literature applies behavioural data from controlled settings (experimental designs). Hennig-Schmidt, Selten and Wiesen (2011) finds that both patient health benefits and payments are of importance. Similar conclusions are found by Henning-Schmidt and Wiesen (2014), Kesternich, Schumacher and Winter (2015), Brosig-Koch et al. (2016, 2017). Godager and Wiesen (2013) and Wang et al. (2020) quantify the degree of altruism by estimating the weight attached to patient benefits. Wang et al. (2020) use a dataset consisting of three subject pools (Chinese medical students, German medical students and Chinese medical doctors) to estimate a measure of the relative weight of patient benefits.[29] Godager and Wiesen (2013) apply a dataset composed of 42 medical students and find that almost all medical students put a positive weight on the benefits to patients. The majority either attaches equal weights to profit and patient benefits (29%) or puts an even higher weight on patient benefits (44%), but there is considerable variation across the laboratory participants.[30] Evidence on variations across firms and organizations (and to what extent such preferences vary across chain members), however, is still lacking. At the individual

[29] Wang et al. (2020) specify a Cobb-Douglas utility function with constant returns to scale of the following type: $U(B, \pi) = B^{\alpha}\pi^{1-\alpha}$ where α is a measure of the relative weight of the patient benefit in the utility function. The estimates of the relative weight of the patient benefit are 0.51 (Chinese medical students), 0.42 (Chinese doctors) and 0.40 (German medical students).

[30] Godager and Wiesen (2013) specify utility as $U(B, \pi) = \alpha B + \gamma\pi$ where B is patients' benefits and π own profits where α and γ are positive constants indicating the valuation of patient benefits and own profit, respectively. Their estimations show a median relative degree of altruism, α/γ, equal to 1.53 (mixed logit regressions) and 2.1 (multi-nominal logit regressions). The relative degree of altruism (the marginal rate of substitution) expresses how many units of profit the physician is willing to give up increasing the patients' health benefits by one unit.

level, altruism appears to be private information, but this is less obvious at organizational levels. Repeated interactions between sponsors and providers and the possibility of sponsors acquiring information about culture and management styles (e.g., patient satisfaction studies, evaluations and audits) suggest that some information can be collected at reasonable costs.

Our analysis shows, for a given production chain, that a varying degree of altruism across chain members and their actual position in production chains, impact the optimal contracts ("one size does not fit all"). This means that treating all chain members as being homogeneous when it comes to preferences will introduce imperfections. In some situations, however, provider differentiation with respect to reimbursement might be difficult to undertake, for example because of fairness considerations among providers ("same rule for all"). If so, the optimal welfare level will typically be unattainable, and under some assumptions the introduction of such schemes might be welfare-reducing relative to global budgets.

To simplify our analysis, each provider is assumed to control a single quality variable (overall quality). This is a strong assumption since providers typically perform several tasks of which some are measured while others are imperfectly measured or not measured at all. On the other hand, the problem of selective payments (the multi-tasking problem) for single decision-makers is already well understood from the literature (Holmström and Milgrom, 1991; Dewatripont, Jewitt and Tirole, 2000). This literature stresses the importance of paying attention to the effects contracts have on non-contractible decisions. A higher P4P price will typically improve incentivized quality but will also have indirect effects since non-incentivized decisions might be downgraded if the decisions are strategic substitutes ("teaching to test") or upgraded if the decisions are strategic complements ("attention reinforcement"). Such indirect price effects are also present in our analysis, but they are somewhat more complex since they involve several decision-makers with different objective functions and since our set-up assumes a sequential production structure.

Below we compare the four schemes in welfare terms. We start out with the case where contract costs are not included. For this case, we know that the two partial P4P schemes (L- and F-scheme) do better in welfare terms than global budgets. To compare the two partial P4P schemes, we start out by assuming that $\alpha = \beta$. Due to the two imperfections (cost-externality and strategic effect), it now follows that the F-scheme will be preferred from a welfare perspective since the sponsor can directly steer the provider that is responsible for the two imperfections. This implies that the degree of coordination is highest for the F-scheme in the sense that moving from a scheme that targets the last mover to a scheme that targets the first mover introduces two additional coordination problems for provider L (imperfect L-agency and funding cost) while eliminating three coordination problems being associated with provider F (imperfect F- agency, funding cost and the cost-externality). However, if the agency problem related to the F-provider is much more significant than the agency

problem related to the *L*-provider, i.e., α deviates much more from $1/1+\gamma$ than β it might be that the *L*-scheme becomes the preferred scheme.

The information intensiveness of P4P schemes suggests that the costs associated with writing, enforcing and monitoring contracts (contract costs) might be significant. In the following we discuss the schemes in welfare terms when contract costs are included (see table 2). Let the contract costs for the global budgets be zero, thus net social welfare becomes equal to the gross welfare level, W^G. For the two partial P4P schemes, W^F and W^L denote the gross welfare level for the *F*-scheme and the *L*-scheme, respectively. Furthermore, let $f > 0$ and $l > 0$ be the contract costs for the *F*-scheme and the *L*-scheme, respectively, thus we arrive at the following expressions for the net welfare level: $W^F - (1 + \lambda)f$ and $W^L - (1 + \lambda)l$. This means that the introduction of the first-best P4P scheme produces contract costs that add up to $f + l$ producing a net welfare for this scheme equal to $W^W - (1 + \lambda)(f + l)$. It seems reasonable to assume that $W^W > W^F > W^L > W^G$.[31]

TABLE 2

Net welfare for the three P4P schemes and the global budgets case

	***L*-quality is contractible** ***l* > 0**	***L*-quality is non-contractible** ***l* = 0**
F-quality is contractible	$W^W - (1 + \lambda)(f + l)$	$W^F - (1 + \lambda)f$
$f > 0$	(The first-best P4P scheme)	(The *F*-scheme)
F-quality is non-contractible	$W^L - (1 + \lambda)l$	W^G
$f = 0$	(The *L*-scheme)	(The global budgets case)

The first-best P4P scheme becomes the preferred scheme if:

- $W^W - W^G > 0$ is higher than the contract costs associated with the first-best scheme, $(1 + \lambda)(f + l)$.
- $W^W - W^L > 0$ is higher than the contract costs associated with the *F*-scheme, $(1 + \lambda)f$.
- $W^W - W^F > 0$ is higher than the contract costs associated with the *L*-scheme, $(1 + \lambda)l$.

The *F*-scheme (iii) becomes the preferred scheme if:

- $W^W - W^F > 0$ is lower than the contract costs associated with the *L*-scheme, $(1 + \lambda)l$.
- $W^F - W^G > 0$ is higher than the contract costs associated with the *F*-scheme, $(1 + \lambda)f$.
- $W^F - W^L > 0$ is higher than the difference in contract costs between the *F*-scheme and the *L*-scheme, $(1 + \lambda)(f - l)$.

[31] As commented on above, the targeting of provider *F*, when information about *Y* is available, means that the strategic effect is eliminated, the cost-externality is internalized, and imperfect agency is corrected for. However, the choice of *X* by the late mover might be based on a very low degree of altruism which again produces a welfare outcome for the *F*-scheme that is worse than the *L*-scheme.

The *L*-scheme (ii) becomes the preferred scheme if:

- $W^L - W^G > 0$ is higher than the contract cost associated with the *L*-scheme, $(1+\lambda)l$.
- $W^F - W^L > 0$ is lower than the difference in contract costs between the *F*-scheme and the *L*-scheme, $(1+\lambda)(f-l)$.
- $W^W - W^L > 0$ is lower than the contract costs associated with the *F*-scheme, $(1+\lambda)f$.

The global budgets case (i) becomes the preferred scheme if:

- $W^W - W^G > 0$ is lower than the contract costs associated with the first-best scheme, $(1+\lambda)(f+l)$.
- $W^L - W^G > 0$ is less than the contract costs associated with the *L*-scheme, $(1+\lambda)l$.
- $W^F - W^G > 0$ is less than the contract costs associated with the *F*-scheme, $(1+\lambda)f$.

The above findings say that the global budgets case typically is the preferred scheme when both f and l are relatively high. The *L*-scheme is the preferred scheme when f is relatively high and l is relatively low, the *F*-scheme is preferred when f is relatively low and l is relatively high, while the first-best scheme is preferred scheme when both f and l are relatively low.

8 CONCLUSION

This study examines the role of pay-for-performance (P4P) schemes in improving coordination between sequentially organized providers. By using a model where two semi-altruistic public providers deliver services in a production chain, we demonstrate that P4P schemes targeting different actors in the production chain influence coordination outcomes differently. While traditional global budget models introduce inefficiencies due to cost externalities, strategic incentives, and imperfect agency, P4P schemes mitigate these issues to varying degrees.

We find, for the case where the quality of one of the providers is contractible, that pay-for-performance schemes will do better than global budgets when it comes to coordination. The pay-for-performance scheme that targets the quality of the last mover enables the sponsor to induce the last mover to choose a quality level that is in accordance with the social preferences (achieving perfect agency). The behaviour of the first mover, however, will still produce coordination imperfections that arise from semi-altruistic preferences, the cost-externality and strategic effects. The pay-for-performance scheme that targets the quality of the first mover enables the sponsor to induce the first mover to behave according to the social preferences because cost externality is internalised and the utilization of its own strategic position is avoided. For this pay-for-performance scheme, however, the behaviour of the last mover remains influenced by own private incentives.

Overall, the number of coordination problems that arise from the scheme targeted at the first mover is lower than the number that arises for the scheme targeting the last mover. This finding suggests that production chains characterized by the quality of the first movers being contractible should be prioritized over production chains where the quality of late movers is contractible. This conclusion becomes even more relevant if the degree of altruism held by first movers is significantly lower than the degree of altruism held by late movers. However, if the opposite is the case, it might be that P4P schemes that target late movers produce better welfare outcomes than schemes that target first movers. Finally, in situations where the implementation of pay-for-performance schemes is costly (information-intensive), simpler payment schemes that require less information, such as global budgets, might do better in welfare terms than P4P schemes.

From a policy perspective, the more information needed for the implementation of a specific pay-for performance-scheme, the greater the professional health bureaucracy required and the higher the administrative costs associated with the actual contract. Additionally, policymakers should be aware of the practical challenges in implementation of P4P. For instance, our results underscore the importance of aligning incentive structures with the specific characteristics of provider interactions. Policymakers should consider not only the theoretical efficiency of payment schemes but also their practical feasibility, given the constraints of information availability and administrative costs. Future research could explore dynamic P4P contracts that adapt to real-time performance data, as well as alternative incentive structures that balance coordination and cost-efficiency in multi-provider settings. Furthermore, future research should focus on the distributional consequences of the use of P4P schemes since such schemes, like other incentive schemes, will probably impact various patient groups differently, One, out of several possible concerns, is that providers may give a higher priority to certain patient groups (selection incentives).

Disclosure statement

The authors have no conflicts of interest to declare.

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Time gap between termination of paid parental leave and eligibility for early childhood education and care services in Croatia

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Abstract

Parental leave is essential for supporting women's participation in the labour market, while accessible and affordable childcare is equally important for their return to work. This study examines the care gap in Croatia, defined as the period between the end of paid parental leave and the start of early childhood education and care (ECEC). Data from an anonymous online survey were analysed using logistic regression to identify predictors of this gap. The results confirm its presence and show that it affects mothers disproportionately, as many adjust their employment during this period. The probability of a care gap is lower in larger local government units (LGUs) and for children born later in the year. These findings highlight the importance of aligning parental leave and ECEC enrolment policies to promote gender equality and support a better work-life balance for families.

Keywords: childcare, parental leave, care gap, gender equality, Croatia

1 INTRODUCTION

Maternity, paternity and parental leave are crucial for helping parents with young children stay in the labour market. These types of leave enable parents to temporarily leave their jobs to take care of their children, without becoming unemployed. Maternity leave is typically taken to preserve the health of both the mother and the newborn immediately before, during and following childbirth. Fathers use paternity leave in the same period as maternity leave. Parental leave follows on from maternity leave and is intended to be used by both parents, often as an alternative to childcare (European Commission, 2016). The primary issue with parental leave from the standpoint of gender equality has been that it is mainly taken by mothers (Ingólfsdóttir and Gíslason, 2016). According to the Annual Report of the Ombudsperson for Gender Equality of the Republic of Croatia (2024) in 2023, only 4.2% of fathers in Croatia exercised their right to parental leave, indicating that society still views women as the primary caregivers.

Given that women are still primarily perceived as caregivers, motherhood increases the amount of unavoidable unpaid work they do, making it harder for them to balance work and private life. Consequently, women with children face a greater risk of unemployment, find it harder to retain a job and find it more challenging to return to the labour market after an absence from the workforce (Gelo, Smolić and Strmota, 2010). An increase in the number of children in a family leads to a widening gap in the employment rate and activity rate between men and women (Mills et al., 2014). Discontinuing employment reduces the economic independence of women and their future social security in retirement (Fultz and Stenhilber, 2004; according to Matković, 2008). These circumstances lead to gender inequality in other social segments, making women more financially dependent on men.

Though leave is essential for keeping women in the labour market, a long-extended leave reduces their job continuity, productivity, salary and the likelihood of

eventually returning to the labour market (Sikirić, 2021). Helping parents, especially mothers, remain in the labour market after parental leave requires the financing and provision of high-quality public services that establish a balance between family and professional life. Particular importance should be ascribed to early childhood education and care (ECEC). Such services reduce the incompatibility of work and motherhood because the care and education of children are entrusted to pre-school childcare institutions as organised systems, and the position of women with pre-school children on the labour market greatly depends on the availability, quality and affordability of ECEC (Sikirić, 2017; Sikirić and Čičak, 2016). Recent research has shown that ECEC services for nursery-age children are a key factor in women being able to gain employment. Also, utilising full-day ECEC services for children younger than three years of age reduces the differences in employment rates between men and women with children younger than six (Sikirić, 2021).

Hence, in terms of gender equality, it is important to align the ECEC system with the parental leave system to prevent a time gap between the end of paid parental leave and the child commencing an ECEC program, commonly referred to in the literature as the care gap. The care gap refers to the period when parents, having exhausted their right to parental leave, must return to the labour market but do not have access to formal childcare. Aligning these systems would primarily benefit women. by reducing the need to extend leave or withdraw from the labour market to provide childcare, as mothers are significantly more likely than fathers to adjust their employment to bridge this gap. Accordingly, the existence of a care gap constitutes an additional obstacle to achieving greater gender equality in the labour market (Dobrotić, 2015, 2021; Ingólfsdóttir and Gíslason, 2016). The aim of this paper is to examine whether a care gap exists in Croatia, to identify its main predictors, and to explore strategies employed to bridge this gap.

2 LITERATURE REVIEW

2.1 THEORETICAL PERSPECTIVES

Becker's theory of time allocation and household production has significantly shaped research on childcare and employment gaps between parents, i.e., the father and mother. The theory models households as producers of outputs – such as food and children – by combining goods and time, and suggests that household members specialise in tasks where they have a comparative advantage (Becker, 1973, 1974, 1985; Heckman, 2015). In practice, this often results in women taking on more childcare responsibilities, while men focus on earning income (Dalmia and Sicilian, 2008). Economic resources also play a decisive role: many families cannot afford to live on a single wage, and many women, especially if they are highly skilled, prefer not to take breaks from paid work (Suwada, 2021). Gornick, Meyers and Ross (1998) point out that women's preferences as to the allocation of time between paid and unpaid work are highly individual. The presence of children increases the value of time spent outside the labour market, reducing women's probability of employment and expected work hours (Nakamura and

Nakamura, 1985 according Cleveland, Gunderson and Hyatt, 1996; Connelly, 1991; Leibowitz, Klerman and Waite, 1992). However, the availability of satisfactory ECEC services shifts these preferences toward paid work, resulting in higher female employment rates (Brilli, Del Boca and Pronzato, 2013; De Henau, Meulders and O'Dorchai, 2010; Spansenoska and Fethu-Vehapi, 2011).

2.2 EARLY CHILDHOOD EDUCATION AND CARE AND MATERNAL EMPLOYMENT

The impact of ECEC on female labour supply is multifaceted, involving affordability, availability, and quality. In countries where childcare is mainly private, the price of ECEC services directly affects women's employment decisions and work hours (Connelly, 1992; Powell, 1997; Anderson and Levin, 1999; Baker, Gruber and Milligan, 2005; Viitanen, 2005). Higher costs lower effective income and decrease the likelihood of gaining employment (Connelly, 1992; Han and Waldfogel, 2001; Del Boca, 1993; Del Boca and Vuri, 2006). When ECEC places are limited in number, price becomes less relevant, and availability is the key determinant (Del Boca and Vuri, 2006). Empirical research shows that countries with greater availability of full-day ECEC services have smaller gender gaps in employment among parents of young children (Kreynfeld and Hank, 1999; Sikirić and Čičak, 2016; Sikirić, 2021). Quality also matters: high-quality childcare encourages mothers to increase their working hours, suggesting that policies should address the quantity and quality of ECEC (Parera-Nicolau and Mumford, 2005).

2.3 DESIGNING PARENTAL LEAVE

Compared to ECEC services, parental leave does not facilitate a balance between unpaid and paid work but allows women to temporarily leave their current job to care for a newborn infant without actually losing their job. The relationship between parental leave and female employment is complex and depends on the duration and specific policies of parental leave. While parental leave generally contributes to higher female employment rates, excessively long leave can reduce women's job continuity, productivity, salary, and the likelihood of returning to work (Spansenoska and Fethu-Vehapi, 2011; Gornick, Meyers and Ross, 1996; Misra, Budig and Boeckmann, 2011; De Henau, Meulders and O'Dorchai, 2010; Mikucka, 2008; Thévenon and Solaz, 2013; Sikirić, 2021). Encouraging fathers to utilise parental leave can reduce a woman's absence from the workforce and promote gender equality (Dobrotić and Varga, 2018). Social norms and cultural expectations further influence women's decisions regarding work and childcare (Blau and Ferber, 1992 according Gornick, Meyers and Ross, 1996).

2.4 EVIDENCE OF THE CARE GAP INTERNATIONALLY

The "care gap" is explicitly defined as the period between the end of paid parental leave and when a child becomes eligible for publicly supported ECEC services. It refers to the absence of any guaranteed, available place in formal care for a period of a child's early life. In contrast, affordability and quality refer to the conditions and standards of care once a place becomes available. During this time, families

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may have no entitlement to formal, accessible childcare, forcing them to make difficult decisions such as one parent (typically the mother) leaving the workforce, relying on informal care, or seeking a costly private option. In Iceland, for example, the care gap results in mothers taking longer leave and experiencing reduced income, while fathers use only their permitted leave (Farstad, 2014). Studies from Iceland show that most parents turn to private child-minders, extended family support, or reduced working hours to bridge the care gap, with mothers more likely than fathers to decrease their labour market participation (Ingólfsdóttir, 2013 and Jónsdóttir, 2007 according Ingólfsdóttir and Gíslason, 2016). Similar circumstances are observed in Poland, where the care gap exacerbates gender inequalities (Suwada, 2021).

2.5 RESEARCH GAP

The research described in this paper contributes to existing literature in several ways. First, a considerable body of research explores the impact of childcare services and parental leave on women's employment. This study focuses on the under-researched issue of the care gap – the period between the end of paid parental leave and the point at which accessible, affordable childcare becomes available. Second, the paper aims to raise awareness of the care gap faced by parents in Croatia, particularly by women. In Croatia, parental leave ends before children are universally entitled to a place in ECEC, leaving a period in which many families have no formal, accessible childcare options. Third, it identifies and examines key predictors of the care gap, providing empirical evidence on the factors that influence access to ECEC. Finally, the findings highlight the need to reconsider current parental leave policy and criteria for enrolling children in ECEC programmes.

3 EARLY CHILDHOOD EDUCATION AND CARE AND PARENTAL LEAVE IN CROATIA

The Early Childhood Education and Care Act governs ECEC in Croatia, assigning local self-government units (LGUs) the responsibility for organising services for children from six months of age up to school entry. Although the Act permits enrolment from six months, in practice, most municipalities admit children only after their first birthday and only once per year, typically during an enrolment period in April or May for the following school year beginning on 1 September. This practice creates a significant implementation gap, as children who are not yet six months old at the time of enrolment, or who do not reach the minimum required age by 31 August, must wait until the following year to access formal childcare. Whether parents whose child is not yet one year old as of 31 August will be able to access ECEC programs once the child reaches one year of age – or earlier – depends on the availability of vacant places. Paid parental leave in Croatia lasts six months for the first and second child, or up to 30 months for twins or a third child if only one parent uses the leave, and may be used until the child turns eight (Croatian Health Insurance Fund, 2025). However, the structure of the ECEC system, combined with its restrictive annual enrolments and age requirements, often forces parents to use their leave only up to the child's first birthday, after which

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immediate access to ECEC is not guaranteed. As a result, there is a real possibility that parents will be unable to secure formal childcare immediately after parental leave ends, resulting in a time gap between the end of paid parental leave and the start of entitlement to ECEC. This misalignment is the primary driver of the care gap in Croatia.

In Croatia in 2023, 29.6% of children younger than three years of age attended some form of formal ECEC, while 82.3% of children older than three participated (Eurostat, 2025a). The enrolment rate for children under three was down from the previous year, while the percentage for children over three increased, partly due to a legal amendment prioritising children over four (The Early Childhood Education and Care Act).

Regional differences in availability, quality, and financial accessibility characterise the ECEC system in Croatia. While responsibility for ECEC, including its establishment and financing, lies primarily with LGUs, expecting municipalities and cities with limited fiscal capacity to provide the same level of service as those with greater resources is unrealistic. Larger cities such as Split, Rijeka, Zadar, and Pula are characterised by better fiscal performance and capacity, whereas the majority (80%) of cities and municipalities have fewer than 5,000 inhabitants (Koprić, Musa and Đulabić, 2016) and struggle with their limited financial resources. These circumstances affect their ability to provide public services, including ECEC (Hodžić and Paleka, 2020; Slijepčević, Broz and Rasic, 2024; Dobrotić and Matković, 2023). Coverage is lowest in rural areas and the smallest LGUs, which often lack a sufficient population to organise efficiently sized childcare facilities, especially in economically less developed parts of the country. As a result, the care gap may be more pronounced in these areas. Consequently, children do not have the same right to access ECEC, and parents – especially mothers – may face greater difficulty in reconciling work and family life and re-entering the labour market after parental leave. To address these disparities, inter-territorial fiscal equalisation mechanisms are needed to help redistribute resources more equitably (Dobrotić and Matković, 2023).

Regional differences are also evident in financial accessibility. Public funds from local authorities finance ECEC capacity and partially cover the cost of accommodating children, making services more financially accessible. Parental participation in program costs is determined by the founders of a centre and usually amounts to around 33% of the declared economic price (Eurydice, 2024). Though the level of parental participation does not differ significantly between more or less developed LGUs, the burden relative to average wages is much higher in less developed areas, making childcare programs hardly affordable for parents with lower economic status (Dobrotić, 2013; OECD, 2017).

4 METHODOLOGY

This research aims to examine whether a time gap exists between the end of paid parental leave and the availability of accessible, affordable ECEC for families with young children in Croatia. It also seeks to identify the predictors of this care gap and to explore the strategies parents use to bridge this period. Given that parental leave is mainly taken by mothers who also adjust their participation in the labour market to care for their children more than fathers, the target group studied was women with children under the age of three. They are mothers who, in the subsequent period or recently, have faced problems with the availability of formal childcare after the expiration of paid parental leave. At the time of the study, there were around 170,000 children under the age of three in Croatia (Census, 2021). Determining the size of the target population solely by the number of children is challenging, as women can have multiple children. Nonetheless, this number is valuable in getting an idea of the size of the target population.

A non-probability convenience sample was used. In all, 674 female respondents completed the questionnaire. The data were collected online from an anonymous questionnaire dating back to 2022. The link to access the questionnaire was shared on social media platforms. Participation was voluntary, and no personally identifiable information was collected. In line with institutional guidelines, approval from the ethics board was not required for this study design. Given that the survey was conducted online, the sample did not include many women with low incomes or low digital skills. Although generalisation of the results to a broader population is limited, a suitable sample for this study is not necessarily limiting, as the aim is primarily to determine whether women in Croatia face a care gap that should be considered in the design of future work-life balance policies and strategies.

The questionnaire consists of three groups of questions. The first group of questions consisted of closed-type questions related to the basic characteristics of the respondents, the month of birth and the child's age. The second group comprised questions asking about the intention to use ECEC after finishing parental leave (for respondents with a child younger than 12 months of age) and the use of ECEC (for children older than 12 months of age), including the existence of the time gap between finishing paid parental leave and the possibility of utilising ECEC, and the manner of overcoming the gap. The questions were accompanied by multiple-choice answers and the opportunity to supplement the answers. The third group of questions inquired about the attitudes of respondents regarding the impact of formal ECEC programs on the development of children under three years of age. In some cultures, enrolling children in formal types of childcare as early as possible is desirable; in others, the expectation is that children up to a certain age should remain solely in the family environment. Finally, the respondents were allowed to express their personal experiences and highlight some of the inadequacies within the existing early childhood education and care system in Croatia. The questionnaire underwent face validity testing with five non-expert women. While this confirmed basic clarity, the absence of thorough validation represents a limitation of the study.

Associations between categorical variables (e.g., residence size and care gap occurrence) were examined using the chi-square test. The more significant findings reveal relationships that merit further investigation, but do not establish causality (Bewick, Cheek and Ball, 2003; Maxwell, 1971). Therefore, to identify predictors of care gaps, binary logistic regression was conducted, assessing independent variables such as residence size, the child's birth month, and employment status in relation to the binary outcome of the presence or absence of a care gap (Hosmer, Lemeshow and Sturdivant, 2013).

5 RESULTS AND DISCUSSION

5.1 SAMPLE CHARACTERISTICS

Of the 674 female respondents who completed the questionnaire, one did not answer the questions from the second and third groups, so her answers were excluded from the analysis. The female respondents came from all counties in Croatia, with the most coming from the City of Zagreb (26.7%) and the fewest from Krapina-Zagorje and Požega-Slavonia County (0.7%). With respect to the size of the locations in which the respondents reside, most of them live in towns with more than 100,000 inhabitants (36%) and locations with fewer than 10,000 inhabitants (30.8%), thereby providing a clearer picture of the differences in ECEC services between large towns or cities and smaller locations. In terms of level of education, more than 75% of the female respondents had a tertiary education, and most respondents (91.2%) were employed or self-employed prior to taking parental leave or sick leave due to pregnancy complications. For most respondents, their employment status remained unchanged (86.6%), whereas 90 respondents had undergone a change in their employment status after finishing leave (48 respondents had their employment terminated due to the expiration of their fixed-term employment contract, 22 respondents had their employment terminated by the employer, 12 respondents terminated their employment, and eight respondents gained employment or self-employment). In line with the main characteristics of the respondents, the study mostly included highly educated employed women. This is due to both the suitability of the sample and the fact that the survey was conducted online, which is why many low-income and less digitally literate women were not included.

5.2 CARE GAP

The participants were divided into two groups: (1) respondents with children younger than 12 months of age (N=195) who will encounter the care gap issue in the near future, (2) and respondents with children older than one year (N=478) who have already faced or are facing the care gap issue. Of the 195 respondents with children younger than 12 months, 70.3% (137) planned to utilise ECEC services after their child reached one year. Accordingly, of the 137 respondents who planned to utilise ECEC services, almost half of them had to wait for the following school year to utilise such services. In bridging the existing care gap, the majority of respondents (41.2%) received help from their extended family, but around 26% of mothers decided to adjust their participation in the labour market by taking unpaid

leave (11.8%), annual leave (2.9%), working from home (2.9%), remaining unemployed (5.9%). In all, 14% of respondents stated that the father would adjust his participation in the labour force in one of the above-mentioned ways in order to bridge the care gap. Interestingly, 10.3% of respondents hired a babysitter.

Overall, 333 out of 478 (69.7%) respondents with a child older than 12 months of age expressed their intention to utilise ECEC services, but only 51.7% of them were able to exercise the right to such services upon finishing parental leave, whereas 36.9% had to wait for a new school year, 1.2% decided against it because it was too expensive, and 10.2% were on a waiting list. Due to their inability to access ECEC services after parental leave ended, 43.6% of women received help from their extended family, 35% decided to adapt their professional life to family responsibilities by taking unpaid leave (9.9%), being unemployed (5.5%), using their annual leave (2.2%), quitting their job (1.9%), working from home (1.9%), and only 4.3% stated that fathers did the same. Accordingly, 13.7% respondents hired a babysitter. In 3.4% of cases, women reported that their partners share the caring responsibilities equally in bridging the care gap.

These results show a tendency among parents to divide caregiving in traditional ways, aligning with Becker's theory of household specialisation, which suggests that families maximise utility by allocating tasks to individuals based on their comparative advantages. In the context of caregiving, this often results in mothers assuming primary responsibility for childcare and domestic duties, while fathers focus on staying in the labour force. The data reveals a stark specialisation pattern: among mothers facing the care gap, 26% with infants and 35% with older children adjusted their labour participation (e.g., unpaid leave, unemployment), while paternal adjustments were minimal (14% and 4.3% respectively), and equal care-sharing was rare (3.4%). This situation reflects Becker's core premise of mothers disproportionately absorbing care burdens as a "rational" household efficiency strategy.

5.3 CHI-SQUARE TEST RESULTS

Discrepancies between the end of paid parental leave and access to childcare services were observed in both small and large LGUs. The results of the non-parametric chi-square test of independence indicate an association between the presence of a care gap and the LGU size (Pearson $chi^2 = 6.31$, $p = 0.0974$). Although this association does not reach conventional levels of statistical significance ($p < 0.05$), the result may suggest a possible trend: smaller LGUs, which often have more limited financial resources, may face greater challenges in organising efficient early childhood education and care (ECEC) services, thus increasing the likelihood of a care gap. However, this finding should be interpreted with caution given the p-value, and further research with larger samples may be needed to clarify this relationship.

A total of 671 respondents provided information on the month of their child's birth. Although the highest number of children was born in January, all birth months were

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well represented in the sample. The results of the non-parametric chi-square test of independence indicate a statistically significant association between the month of birth and the likelihood of mothers facing a care gap (Pearson $chi^2 = 39.81$, $p = 0.0000$). Mothers with children born between February and June were most likely to experience a care gap, while those with children born in September had the lowest probability of experiencing a care gap. This pattern is likely explained by the eligibility criteria for early childhood education and care (ECEC) services in Croatia: to apply for ECEC, children must be at least six months old by the end of August, and priority is given to infants who turn one year old by this date. Whether children who meet the minimum age requirement but turn one after August are admitted depends on the availability of places. As a result, children who turn one shortly after August are more likely to secure a childcare place – provided places remain – than those born in the middle of the pedagogic year.

According to the results of the non-parametric chi-square test of independence, there is no statistically significant association between the presence of a care gap and women's employment status (Pearson $chi^2 = 0.21$, $p = 0.6467$). This outcome suggests that, based on the data, whether a woman experiences a care gap appears to be unrelated to her employment status. In other words, employed and unemployed women are equally likely to report experiencing a care gap.

5.4 LOGISTIC REGRESSION RESULTS

In line with these results, a logistic regression model was established to assess the association between the presence of a care gap and the size of place of residence, the month of the child's birth, and the respondent's employment status. The selection of only three variables for the logistic regression model is grounded in both theoretical relevance and the specific policy context of the Croatian ECEC system. The care gap primarily depends on structural and institutional factors – specifically, the timing of parental leave expiration, the child's eligibility for ECEC, both relying on the month of birth of the child, and the enrolment policies of ECEC institutions, which are nearly uniform across all publicly owned facilities in Croatia. Other potential predictors, such as the education or income level of respondents, do not directly determine whether a care gap occurs; instead, they influence the strategies families use to bridge the gap once it arises. Similarly, while ECEC availability is generally lower in smaller local government units (LGUs) due to fiscal constraints, the size of the place of residence serves as a practical proxy for this dimension in the absence of detailed fiscal data. Consequently, the model includes only those variables that are both available in the survey and theoretically justified as direct predictors of the care gap: child's month of birth (to capture the timing of a parental leave expiration and eligibility for ECEC enrolment by the end of August), size of residence (as a proxy for ECEC availability and LGU fiscal capacity), and the parent's employment status (since employed parents are often prioritised for ECEC access when demand exceeds supply). This approach avoids overfitting and multicollinearity, ensures interpretability, and focuses the analysis on the most policy-relevant determinants of the care gap in Croatia.

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The log-odds of experiencing a care gap were modelled as:

$$\log\left(\frac{P(CGAP=1)}{1-P(CGAP=1)}\right) = \beta_0 + \beta_1 RSIZE + \beta_2 CMONTH + \beta_3 EMP \qquad (1)$$

where β_0 is the intercept, i.e., baseline log-odds when all predictors are zero, and β_1, β_2 and β_3 are the coefficients for independent variables. The dependent variable, care gap (CGAP), was coded dichotomously (1 = care gap present, 0 = no care gap). The independent variables included the following:

– The size of place of residence (RSIZE) is an ordinal variable, where 1 = LGU with fewer than 10,000 inhabitants; 2 = LGU with 10,000 to 50,000 inhabitants; 3 = LGU with 50,000 to 100,000 inhabitants; and 4 = LGU with more than 100,000 inhabitants. This variable was included under the assumption that smaller LGUs have a lower fiscal capacity and, consequently, lower availability of ECEC, increasing the probability of the care gap.
– The child's month of birth (CMONTH) is an ordinal variable ranging from 1 (January) to 12 (December). This variable was included because enrolment in ECEC typically occurs once a year, and eligibility is determined by the child's age, making the birth month a relevant predictor of care gap risk.
– The respondent's employment status (EMPL) is a binary variable (1 = employed or self-employed, 0 = unemployed or student). Employment status is often used as a criterion for prioritising ECEC access and was therefore included as a predictor.

Table 1

Logistic regression results – predicting the presence of a care gap

Variables names	Coefficient (b)	Std. error (SE)	z-value	p-value	Odds ratio (OR)	95% CI for OR
Residence size (LGU)	-0.218	0.081	-2.680	0.007	0.804	0.686 – 0.943
Child's month of birth (CMONTH)	-0.116	0.024	-3.900	0.000	0.890	0.840 – 0.944
Employment status (EMPL)	0.292	0.433	0.670	0.500	1.339	0.573 – 3.128
Constant	0.761	0.495	1.740	0.125	2.140	0.810 – 5.651

Note: Number of obs. = 419; Log likelihood = -276.81646; LR chi2(3) = 21.48; Prob > chi2 = 0.0001; Pseudo R2 = 0.0374.

Source: Own calculations using STATE/SE 13.0.

The overall model fit is statistically significant, although the explained proportion of variance remains relatively modest (approximately 3.7%). The negative and statistically significant coefficient for residence size indicates that, controlling for other variables, a larger LGU size is associated with a statistically significant reduction in the log-odds of experiencing a care gap. An odds ratio of approximately 0.804 suggests that, all else being equal, each increase in place of residence size (LGU) is associated with a 21% reduction in the odds of a care gap occurring (95% CI for OR [0.686 – 0.943]).

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Similarly, the negative and statistically significant coefficient for the child's month of birth shows that a later birth month is significantly associated with a reduction in the log-odds of a care gap occurring. The corresponding odds ratio of approximately 0.890 indicates that, all else being equal, for each additional month later in the year a child is born, the odds of a care gap decreasing are approximately 11% (95% CI for OR [0.840 – 0.944]).

Employment status has a positive coefficient, indicating that, all else being equal, employed respondents may have higher odds of experiencing a care gap than non-employed respondents. However, this effect is not statistically significant ($p = 0.500$), providing no evidence of a true association between employment status and the likelihood of experiencing a care gap in the population. This finding can be explained in theory by recognising that the primary drivers of care gaps are systemic issues within the ECEC system, such as limited capacity, inflexible enrolment procedures, and organisational shortcomings, rather than individual parental employment. Although employed parents may receive some priority in the ECEC enrolment process, these advantages are frequently offset by broader structural barriers. Ultimately, the organisation and availability of ECEC, rather than employment status, play a decisive role in whether families experience a care gap.

5.5 THE ATTITUDES OF MOTHERS TOWARDS THE ROLE OF EARLY CHILDHOOD EDUCATION AND CARE SERVICES IN CHILD DEVELOPMENT

The answers from respondents show that in Croatia, ECEC services are recognised as part of the education system, and including children older than 12 months of age in formal types of childcare is considered mostly socially acceptable. From the first group of respondents (with children under 12 months), only 29.7% of respondents did not plan to utilise ECEC services and decided to personally care for their child or use an alternative, relying on grandparents or a babysitter (table A1 in the appendix). In all, 30.3% of respondents with children older than 12 months of age neither utilise nor intend to utilise ECEC services for children younger than three years. Almost 60% of these respondents opted for an alternative form of childcare, such as hiring a babysitter or having a family member care for the child. Overall, 24.1% of respondents decided to care for the child themselves even after the expiration of parental leave, despite 70% of these respondents being employed or self-employed (table A2 in the appendix).

Parental attitudes on the role of ECEC services in child development certainly influence the number of children enrolled in formal programs providing ECEC services for pre-school children. According to these research results, 62.9% of respondents felt that including children younger than three years of age in formal types of childcare had a positive effect on child development. Some respondents pointed out that achieving positive results requires maintaining a high pedagogical standard. Nonetheless, some mothers believe that children younger than three years of age should attend formal types of childcare only after their second year of life, specifically half-day stays and not all-day stays. Overall, 22.7% of respondents believe that enrolling

children under three years of age in ECEC services does not have a positive effect on child development. The remaining 14.4% could not determine whether ECEC services have a positive impact on child development.

In the final open-ended question, 394 respondents (58.5%) shared their personal experiences and expressed their satisfaction or dissatisfaction with the current ECEC system in Croatia. Qualitative analysis was conducted manually by a single researcher using an inductive coding approach, meaning that thematic areas and codes emerged organically from the responses of participants, without reliance on predefined categories or theoretical frameworks. The researcher began by thoroughly reading all collected responses to gain a comprehensive understanding of the content, then identified and marked key concepts, patterns, and themes present in their statements. These codes were subsequently grouped into broader thematic areas that reflected the most significant aspects and experiences described in the data. This approach allowed the analysis to remain open to new meanings and unexpected patterns, thereby enhancing the credibility and depth of the qualitative findings. The responses reveal a nuanced picture, with a strong emphasis on systemic challenges alongside a few positive experiences. Table 2 presents the main themes and their frequency in the responses of participants.

Table 2

Main themes and their frequency in the responses of participants

Themes	Number of participants
Insufficient capacity and long waiting lists	103
Overcrowded groups and staff shortages	96
Inflexible and unfair enrolment policies	44
Positive experiences	35
Mismatch with parental work schedules	20
High costs	19
Reliance on informal care	17
Quality of care and dedication of staff	14
Impact on child and family well-being	12

Source: Author's calculation.

Insufficient capacity and long waiting lists: Many parents highlighted the lack of vacancies in nurseries and kindergartens, especially in certain regions. The waiting lists are long, and some parents are unable to secure a place for their child when needed. These circumstances are particularly problematic for unemployed parents, who are often excluded from enrolment, making it even more difficult for them to seek employment.

"Extremely useful, but unfortunately a mission impossible to get a place. Build new childcare facilities and enable working mothers to return to work." (R13)

"It is terrible that 300 children are not enrolled in ECEC in Rijeka every year." (R48)

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Overcrowded groups and staff shortages: Respondents frequently mentioned that the childcare groups are too large and there are too few caregivers per child. This overcrowding is seen as reducing the quality of care and negatively impacting child development.

"Too little space, too many children, too few child carers. Not organised for or geared towards the children at all." (R4)

Inflexible and unfair enrolment policies*:* Parents expressed frustration with the annual enrolment policy and existing care gap, which means that children born after the cut-off date must wait almost a year to enter the system. This situation places additional stress on families, forcing them to seek expensive private care or rely on their extended family.

"For example, my third child was not admitted because it was born on 1 September." (R28)

"The situation is that you have to plan your fertile days so that your child is born between June and September, so that you can get a place at the nursery when your parental leave ends." (R72)

Mismatch with parental work schedules: Many parents reported that ECEC operating hours do not align with shift work or summer employment, particularly in regions where tourism is a major part of the local economy. During holidays, groups of children are combined and staff numbers are reduced, further lowering quality and increasing the spread of illness.

"Many parents work two or even three shifts... and we have no right to a two-shift kindergarten because we don't live in the city." (R27)

High costs: The cost of ECEC services is a major concern, especially for families without high incomes. Some noted that fees are not adjusted to household incomes, and additional costs for supplies further strain budgets.

"The price is also too high. There is no income-based price adjustment, which I think there should be, as in Zagreb." (R105)

Reliance on informal care: Due to limited availability and inflexible policies, families are forced to rely on grandparents or hire private babysitters, resources that are not always affordable or sustainable.

"We were lucky enough to have a 'granny service', but we hope she can go to a day centre as soon as possible because granny is quite old." (R25)

Impact on child and family well-being: Some parents noted the negative effects of frequent illness due to large groups, as well as the financial strain of taking sick leave. The sick leave allowance is often much lower than regular wages, increasing the financial burden on families. Sick leave allowance for a child up to three years of age amounts to 100% of the base salary and is paid by the Croatian Health Insurance Fund, which at that time, amounts to a maximum of EUR 565.04 (HRK 4,257.28) for the entire month at the time of conducting this study. When taking into account that the average monthly net wage for an employee in legal entities in Croatia for 2022 amounted to EUR 1,016.33 (HRK 7,653) (CBS, 2023), the maximum allowance is exceptionally low and certainly less than the wage for a large number of mothers, whereas the amount for parental participation in the cost of a nursery program has not necessarily decreased, thereby putting an additional burden on household budgets. The forthcoming legislative amendments on increasing these maximum amounts are therefore a step forward in this matter.

"The only disadvantage or fear is that the child will catch all sorts of diseases and viruses and often get sick, which can be avoided by keeping it at home." (R569)

Quality of care and dedication of staff: Despite systemic issues, many respondents praised the dedication and professionalism of caregivers, noting that staff commitment is the greatest strength of the system.

"Caregivers are a miracle." (R23)

"Caregivers are underpaid and neglected by the system, and the whole pre-school education system relies on the enthusiasm of individuals." (R136)

Positive experiences: A minority of parents, particularly those with children in private nurseries or with access to supportive family networks, reported high satisfaction with the quality of care and the developmental benefits for their children.

"Personally, as the mother of a nursery school child and a child in the older group, I am satisfied and we have not had any unpleasant experiences." (R102)

In summary, while a small number of parents are satisfied with the Croatian ECEC system, the majority report significant challenges related to insufficient capacity, overcrowding, inflexible enrolment policies, high costs, and a lack of alignment with parental work schedules. The dedication of ECEC staff is widely recognised, but parents overwhelmingly call for systemic improvements to ensure accessible, affordable, and high-quality care for all children.

6 CONCLUSION

Parenthood significantly increases the amount of unpaid and mental labour for women, making work-life balance more challenging, particularly during the early years of a child's life. Maternity and paid parental leave allow one parent, typically the mother, to temporarily step away from paid employment without suffering major economic repercussions. However, the problem arises at the end of paid parental leave. Research findings reveal a misalignment between Croatia's parental leave system and the availability of institutional ECEC. Specifically, when paid parental leave ends, many families encounter difficulties securing a nursery place for their one-year-old child. Among the 470 respondents who used or planned to use ECEC services, nearly 45% had to wait for the start of the next school year. This care gap poses a significant organisational challenge for parents, particularly mothers, as many women are unable to return to work due to a lack of access to ECEC. To effectively address the care gap, in the short term, local and central authorities should focus on expanding ECEC capacities, particularly in smaller LGUs where families face the highest risk of the care gap. Immediate measures should also include revising enrolment criteria to ensure fairness – such as implementing continuous enrolment throughout the school year – so that all children who reach the minimum age requirement have access to services as soon as they are eligible. In the medium term, policymakers should work to align the end of paid parental leave with the availability of ECEC places, thereby preventing care gaps that disproportionately affect women who want to return to the workforce. However, excessively long leaves should be avoided, as it can reinforce gender inequality and hinder career advancement for women. A long-term, structural reform that invests in universal, high-quality ECEC should become a strategic priority, recognising its foundational role in both early education and gender equality. Strengthening governance and coordination between family policy, parental leave, and ECEC systems will further ensure that reforms are effective and sustainable. By clustering recommendations in this way, policymakers can implement immediate solutions while laying the groundwork for systemic change.

Although the results of this study offer valuable insights into the care gap in Croatia, a major limitation is that the research was conducted using an online questionnaire distributed to a convenience sample, i.e., not representative of the entire population. Consequently, mothers living in poorer material conditions and those with lower digital literacy, many of whom lack internet access or the necessary technical means, were underrepresented. This limitation should be considered when interpreting the findings, as it restricts the generalizability of the results to the broader population and probably leads to an underestimation of the scale and severity of the care gap in Croatia. Nonetheless, the findings clearly demonstrate the existence of a care gap, which has a tangible impact on work-life balance and compels some women to adjust their labour market participation to bridge the gap. To overcome these limitations, future studies should utilise stratified sampling by region and socioeconomic status to ensure adequate representation of rural populations and disadvantaged groups. Linking survey responses to administrative

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data, such as ECEC enrolment records or employment histories, would allow for more precise measurement of the impact of the care gap on the participation rate of women in the labour market and their reliance on alternative care arrangements. Additionally, longitudinal research could capture the long-term effects of care gaps on the career trajectories and economic security of women. Expanding the focus to include the experiences of fathers, other caregivers, and families in remote or underserved areas would further guide targeted and equitable policy interventions.

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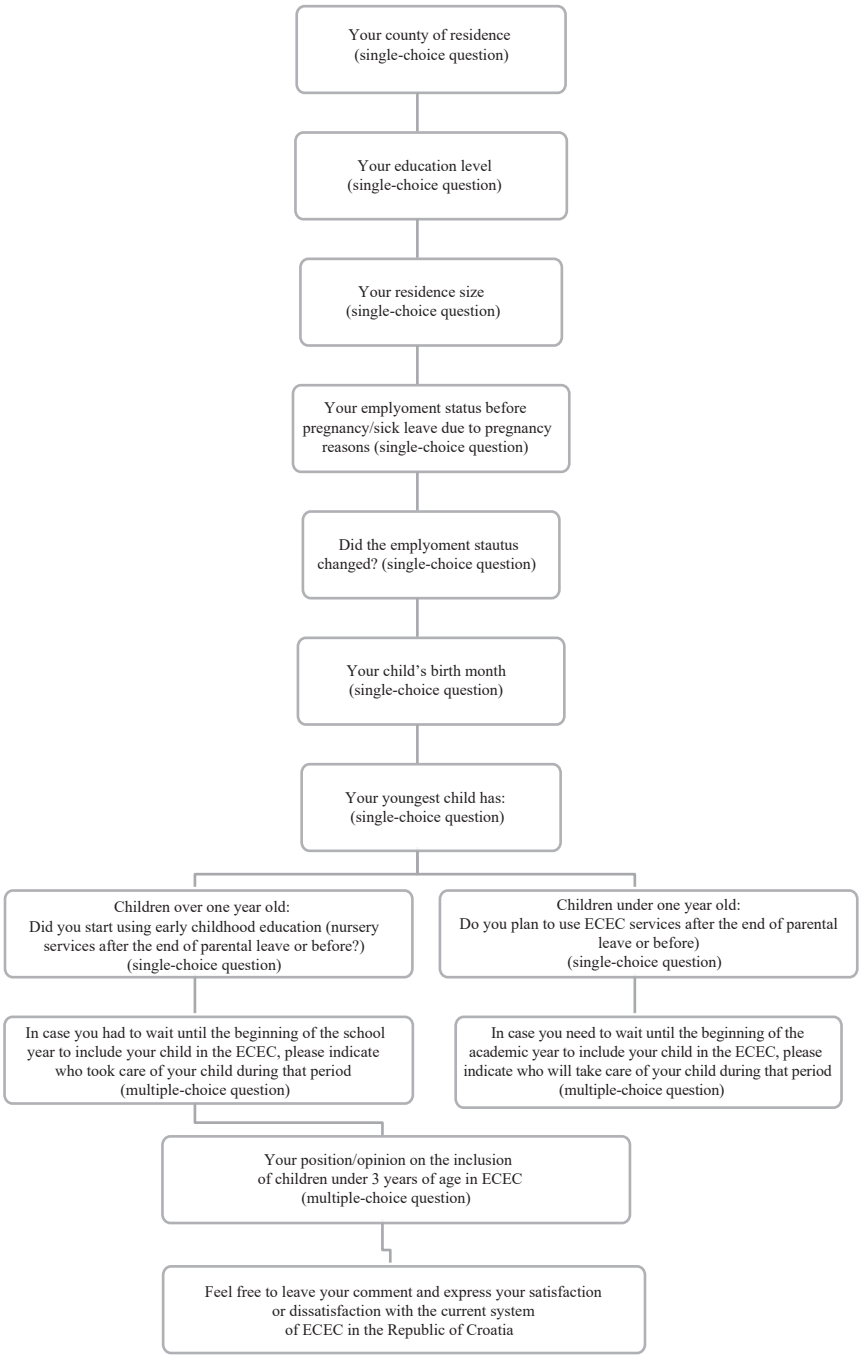
APPENDIX

FIGURE A1

Structure of questionnaire



Source: Author.

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Table A1

Intention to utilise ECEC services by respondents with children younger than 12 months

Do you plan to utilise early childhood education and care services after finishing parental leave?	**Yes**		**No**		
	f	**%**	**f**	**%**	
Yes	63	46.0	18	31.0	No, because I choose to look after the child myself
Yes, but I have to wait for the start of the new pedagogic year (beginning of September)	68	49.6	39	67.2	No, because I have alternatives (e.g., grandparents, hired lady)
Yes, but I am not able to due to other reasons	6	4.4	1	1.7	No, due to other reasons
Total	**137**	**100**	**58**	**100**	

Source: Author.

Table A2

Utilisation of ECEC services by respondents with children older than 12 months of age

Do you utilise early childhood education and care services?	**Yes**		**No**		
	f	**%**	**f**	**%**	
Yes, after finishing parental leave	172	51.7	35	24.1	No, because I choose to look after the child myself
Yes, but I had to wait for the start of the new pedagogic year (beginning of September)	123	36.9	19	13.1	No, because I was on sick leave to look after my pregnancy or was on extended parental leave
I had planned to do so, but it was too expensive	4	1.2	85	58.6	No, because I have alternatives (e.g., grandparents, hired lady)
I had planned to do so, but we are currently on the waiting list (or we were)	34	10.2	6	4.1	No, due to other reasons
Total	**333**	**100**	**145**	**100**	

Source: Author.

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Table A3

Results of the Chi-Square Test of Independence for different categorical variables

Tabulation of CMONTH CGAP, RSIZE CGAP and EMPL CGAP

CMONTH – Child's month of birth	**CGAP (Care gap)**		
	0 – no care gap	**1 – care gap present**	**Total**
1 – January	23	17	40
2 – February	19	18	37
3 – March	15	15	30
4 – April	12	27	39
5 – May	10	20	30
6 – June	11	22	33
7 – July	26	16	42
8 – August	26	12	38
9 – September	23	6	29
10 – October	24	12	36
11 – November	23	9	32
12 – December	22	11	33
Total	234	185	419
Pearson Chi2 = 39.81 Prob = 0.0000			
RSIZE – Residence size		**CGAP(Care gap)**	
	0	**1**	**Total**
1 – up to 10.000 citizens	64	70	134
2 – 10.000 to 50.000 citizens	55	46	101
3 – 50.000 to 100.000 citizens	24	15	39
4 – more than 100.000 citizens	91	56	147
Total	234	187	421
Pearson Chi2 = 6.31, Prob = 0.0974			
EMPL – Employment status		**CGAP (Care gap)**	
	0	**1**	**Total**
0	15	10	25
1	219	177	396
Total	234	187	421
Pearson Chi2 = 0.21, Prob = 0.6467			

Source: Author's calculations using STATE/SE 13. 0.

The influence of education on social mobility in Croatia and Greece: a comparative analysis

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Article**
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Abstract

This paper explores social mobility in Greece and Croatia among individuals born between 1950-2000, focusing on the role of education in occupational and educational mobility. We draw information on both dimensions from the European Union Statistics on Income and Living Conditions (EU-SILC) survey. When intergenerational educational mobility is examined our findings show a downward trend of upward mobility with the outcomes being better for women in both countries. They also suggest that individuals whose parents have a low level of education are significantly less likely to complete tertiary education than those whose parents have higher levels of education. Exploring intergenerational occupational mobility as an indicator of relative mobility reveals a growing persistence of the influence of parental occupational status on children's outcomes. Although the influence of education is slightly stronger in Greece, higher educational levels increase the probability of upward occupational mobility in both countries.

Keywords: social mobility, educational mobility, intergenerational occupational mobility, human capital, Croatia, Greece

1 INTRODUCTION

Social mobility is movement within the social hierarchy as people have the possibility to change their class. Groups can be defined according to income or occupational/educational/social status. An open society provides opportunities for its citizens to move upward, while social mobility can also lead in the opposite direction for those who lack the capabilities to maintain their status. Intergenerational mobility is often defined by the degree to which the status of parents is transmitted to their descendants. It is an indicator of equality in opportunities for success in a society (Aydemir and Yazici, 2019; Wilkinson and Pickett, 2010). According to Council of Europe (2012) social mobility is linked to social cohesion. The expectations and aspirations of different generations that their life's outcomes are associated not only with the socio-economic background but, and mainly, with their efforts and merit, can reinforce the sense of justice in a state (Fields and Ok, 1999; Yang and Qiu, 2016). The prospects of social mobility, which affect economic and political evolution, are hidden behind the salient pattern of intergenerational educational attainments (Torul and Oztunali, 2017).

A researcher into social mobility must clarify the question: social mobility in terms of what? Research into social mobility over time includes economic, educational and occupational elements. To understand the real opportunities and barriers to mobility in a country, it is essential to study these data historically. It is also important to investigate the different dimensions of mobility, for two reasons. Firstly, they may show different trends in social mobility depending on which element the researcher is taking into account while individuals experience absolute and relative changes subjectively. Secondly, in order to prevent the social reproduction of inequalities of opportunities in all dimensions, it is necessary to present the whole picture of social mobility. Each dimension of social mobility can reveal

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different aspects of this issue within a country and lead to analogous conclusions and policy suggestions. Eurofound (2017) underlines the necessity of considering additional indicators of social mobility beyond income to better measure equality of opportunity. To our knowledge, limited research has been conducted regarding these topics in the countries of Southeast Europe.

Motivated by the lack of evidence on intergenerational mobility in Greece and Croatia, we investigate the situation in both countries for birth cohorts after 1950. Over the past decades, both countries have undergone tremendous changes, including their integration into the European Union. Exploring social mobility in Greece and Croatia simultaneously could be valuable for several reasons. The two countries transitioned from different political and economic systems (Greece from a state-interventionist democracy to a Western-style economy, Croatia from the Yugoslav socialist economy to a mixed economy) and faced significant restructuring. Comparing them could reveal insights into how different paths affected social mobility and provide a comparative analysis of post-transition economies. Both countries are EU members but joined at different times (Greece in 1981, Croatia in 2013). In addition, they have struggled with similar challenges in economic development (high unemployment, reliance on tourism, and slow industrial growth). In terms of mobility and the role of education, Croatia and Greece have strong educational traditions but suffer from brain drain. Cultural and social structures like family networks and informal support systems play a big role in the opportunities of the citizens in Balkan countries. Finally, both countries experience significant internal regional disparities (Athens vs. rural Greece; coastal vs. inland Croatia). Studying social mobility in these contexts could reveal patterns and opportunities related to it.

The aim of this study is to investigate the social mobility in Southeast Europe by comparing Croatia and Greece (going back in the past as far as reliable data sources allow). The major research questions are to examine how educational attainment impacts two dimensions of social mobility (intergenerational educational and occupational mobility) and what lessons can be drawn from these findings for similar countries. In addition, in what ways have educational policies in Croatia and Greece influenced social mobility patterns over the previous decades? The intention is to explore whether social mobility follows specific patterns across these dimensions and to identify the barriers to social mobility. We employ three rounds of the European Union Statistics on Income and Living Conditions (EU-SILC) household survey conducted by Eurostat in 2011, 2019 and 2023.

The rest of the paper is organised as follows. In section 2, we review the literature on the measures of mobility, the challenges in measuring it, and its determinants. In section 3 we describe the educational background and occupational changes in both countries. Sections 4 and 5 discuss the data and methodology used in our analysis. Section 6 presents the main findings for all dimensions. Section 7 provides discussion before the main findings are concluded.

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2 RELATED LITERATURE

Intragenerational mobility indicates changes in an individual's social class within the span of their lifetime, while intergenerational mobility compares their status to that of their parents, reflecting changes between two generations. Both types of studies require at least two observations over time. The most common standard measure of income mobility is intergenerational earnings elasticity – IGE (Björklund and Jäntti, 1997; Blanden, 2015; Corak, Lindquist and Mazumder, 2014). Comparing the earnings of parents and children allows us to compute the extent to which the latter's income depends on that of the first. However, the challenges/restrictions in the measurement of IGE make the other dimensions (educational and occupational mobility) more reliable in terms of unbiased estimations.

Educational mobility is defined as an improvement in educational achievements during the lifetime of a person or among different cohorts due to the explosion of education. Intergenerational mobility/persistence in education corresponds to the trajectories from the preceding generation to the next generation. It is seen in the transmission of parental educational attainment to their offspring (Symeonaki, Stamatopoulou and Michalopoulou, 2016). High mobility in education indicates that everyone, regardless of their family background, has a fair chance of attaining a high level of education. In addition, educational attainment is the main predictor of income inequality (De Gregorio and Jong-Wha, 2003), as well as non-pecuniary outcomes such as health (Ross and Wu, 1995) and crime (Lochner, 2004). Affluent parents can invest more in the education of their offspring. As a result, educational attainment can maintain the status quo in society (Hout and DiPrete, 2006). Therefore, understanding this mobility and its mechanisms helps us to design policies that achieve greater income equality and success (Wilson, Timothy and Haveman, 2008). An open and mobile society should set itself the target of an egalitarian system in education (Daouli, Demoussis and Giannakopoulos, 2010). Moreover, certain occupations require specific qualifications. A person who as a result of low educational mobility does not receive an education similar to or better than that of his (her) parents has little opportunity to move up the occupational ladder.

Measures of educational attainment are often questioned. Essentially, we can measure attainment either by the number of years of schooling or the highest degree (or qualifications). Both present pros and cons. The former can be treated as a continuous variable which is useful in the regression analysis. However, the return on each year spent in school differs. It is important to precisely measure the impact of each additional year on returns to education. Measurement based on degrees obtained is a categorical variable, but it has its own problems due to the large heterogeneity across different degrees in terms of cost, duration, and prestige. It also cannot distinguish between qualifications of the same level that require different years of schooling (Aydemir and Yazici, 2019). For instance, a bachelor's degree in medicine requires at least 6 years of studying in Greece, compared to 4

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years for a bachelor's degree in economics or 5 years for architecture. Similarly in Croatia, it takes at least 6 years of studying to become a doctor of medicine followed by many more years of education in order to specialize in a specific field of medicine, compared to 3 years of studying to earn a bachelor's degree and 5 years to complete a master's degree in economics. These merits motivated academics to use both when all information can be extracted from a database. Different segments along the educational distribution may present different degrees of persistence because coefficients summarize the dependence on average. Marital sorting and the highest level of schooling in a couple as an indicator of family origin is often used for determining the background of a child (Wilson, Timothy and Haveman, 2008). Educational measures of intergenerational mobility are more reliable and comparable than income-based approaches. Therefore, research in this field can follow commonly accepted methodological standards.

Intergenerational occupational mobility presents the occupational class of children compared to that of their parents. It is important to check whether it is obtained through personal efforts, skills and achievements or inherited from the occupational background of their family (OECD, 2018). Gender differences play an important role in this aspect of mobility, as they inform us about the extent to which societies provide equal opportunities for men and women and assess whether women are able to achieve upward mobility in their careers. The economic impact of these disparities is the utilization of the full human capital potential, because if women face barriers to upward mobility, it can hinder growth and lead to economic inefficiencies. The variation of mobility between sons and daughters in the same country emerges from the hypothesis that parents make different decisions about individual children and these affect the educational investments or support. A general pattern among the OECD countries shows a slightly higher absolute mobility for sons.

In order to obtain results that are comparable with similar studies and other countries, it is essential to follow a detailed occupational classification and avoid restrictions of differentiating codes. This approach typically reveals that the majority of people end up in a different occupational class than their parents but in similar skill levels, while immobility is predominant. Cross-country studies have shown that there is a deviation in socio-economic advantage with Nordic countries presenting the highest mobility indicators (Pohlig, 2021). OECD (2018) found greater persistence at the top of the occupational distribution and notable gender differences, with daughters being more influenced by their parents and exhibiting lower mobility. One disadvantage of other approaches to measuring social mobility, which consider levels of earnings and education, is the difficulty in making robust comparisons between countries and over time due to the high dependence on the timing of data collection. Intergenerational occupational mobility seems to be more stable indicator.

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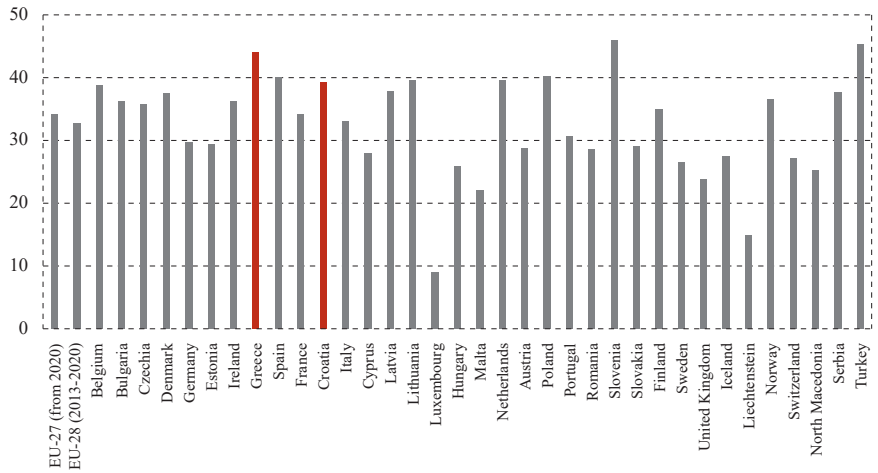
3 THE BACKGROUND OF EDUCATION IN BOTH COUNTRIES AND THE OCCUPATIONAL CHANGES

From the mid-60s, in Greece education was the key mechanism through which policymakers tried to achieve greater social mobility and fairness. Educational equality was introduced in the 1964 reform, when free education was extended to many levels. Unfortunately, the dictatorship put an end to the reforms in 1967. After the stabilization of democracy in 1974, the nine-year compulsory education was voted in again, accompanied by the increase in the number of university departments in all regions, this expansion really taking off in the 80s. Upper secondary education remained optional. Moreover, the division of secondary into general and vocational was introduced (Symeonaki, Stamatopoulou and Michalopoulou, 2016). It was clear that these reforms had a significant impact on our respondents born from 1960 to 1980. Unprecedented enrolments in tertiary education nearly doubled after the 80s. The country, as an EU member, signed the Lisbon Strategy launched by the European Council in 2000, committing to an increase in the opportunities for participating in all levels of education for all citizens.

The education system in Croatia begins with nurseries and preschools, with preschool being compulsory for children a year before they start school, ever since 2014. At the age of six and a half or over, children must take part in compulsory elementary education lasting for eight years since the 1958 reform. After completing elementary education, they may continue to non-obligatory secondary education choosing either gymnasiums, vocational or art schools. Both elementary and secondary education are free in Croatia. In order to enter the higher education system, since 2010, it has been necessary to pass the state graduation exams, similarly to Greece. Higher education is provided through universities and professional studies, both which are aligned with the requirements of the Bologna process that was introduced in 2005 (Ministry of Science, Education and Youth, 2005).

FIGURE 1

Students in tertiary education (share of population aged 20-24)



Source: UNESCO Institute for Statistics (uis.unesco.org). Data as of September 2020.

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As education is the main mechanism of social mobility, it is essential to identify some similarities between Greece and Croatia. Based on the European Commission's report (Canzonieri and Giamboni, 2024) on efficiency of public expenditure in education, European Union countries have increased their efficiency in the recent years. Greece and Croatia stand out as top performers in the EU. Efficiency scores related to tertiary educational attainment and tertiary education expenditure per student show improvements in both countries, scoring above 90% in Croatia and above 100% in Greece in 2022, compared to around 50% in both countries in 2008. Overall changes in the efficiency of education spending in the period 2006-2022, according to the Malmquist index, place Croatia and Greece among the seven EU countries that have improved their efficiency the most. As reported by UNESCO Institute for Statistics[1], Greece shows the highest gross enrolment ratio in tertiary education (142%). The average ratio in the EU is 71% and only 39% worldwide. Along similar lines, Croatia shows a gross enrolment ratio in tertiary education of 81%, which is above the EU average. In the last two decades, Greece and Croatia show constantly higher enrolment rates in tertiary education than other European countries (figure 1).

The post-modernization era created different compositions of occupations. For instance, Greece witnessed a decline of 29% in the number of farmers from previous generations and an increase in heavy industry jobs. The delay in industrialization suggests that Greece was not corresponding through all the cycles of modernization. Economic activity has been transferred from the primary sector to services. This expansion, particularly after Greece joined the EU, combined with urbanization, facilitated the absorption of women into tertiary employment, replacing many services formerly provided within the household (Anastasiadou, Batiou and Valkanos, 2015; Nicolitsas, 2006). Over the past three decades, Croatia has undergone several major transitions that have led to significant changes in its social, political, and economic landscape. These changes started happening after the Homeland War, followed by a period of transition characterized by a process of social diversification, resulting in even deeper social stratification and the virtual disappearance of a middle class. The transition process also included a transformation from social to private ownership and from a one-party to a multi-party-political system (Doolan, Puzić and Baranović, 2018) as well as a change from an agrarian to an industrial society followed by urbanization and changes in the structure of households (Potočnik, 2012). This caused a transfer of workforce from manual to non-manual occupations, leading to an increased employment in secondary and tertiary sectors. It meant that the share of employment in agriculture decreased (from 20% to 7%) as well as in the industrial sector, while it grew in the service sector from 50% to around 70%. Since the 1990s, Croatian women's participation in the labour force also grew with greater involvement in the service sector and rising educational attainment. The most recent changes Croatia has gone through include entering the European Union (2013) and the Eurozone (2023).

[1] According to UNESCO the definition of Gross enrolment ratio is "the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Differences between the gross enrollment ratio and the net enrollment rate show the incidence of over-age and under-age enrollments."

External shocks like a crisis, or political decisions like accession to the European Union, may change the trends of social mobility through the new policies applied. The way in which economic and political shocks are reflected in the process of intergenerational social mobility depends on the individual characteristic of a country. Cross-national evidence indicates that higher intergenerational mobility is positively associated with both stronger institutional quality and higher GDP per capita, suggesting that the promotion of mobility is not only socially but also economically advantageous (Bešić, 2023). This supports the view that improving social mobility is not merely an equity issue, but a structural driver of long-term economic performance and democratic stability.

4 DATA AND LIMITATIONS

Our analysis is based on three special ad-hoc modules (2011, 2019, and 2023) on the intergenerational transmission of disadvantages from the European Union Statistics on Income and Living Conditions (EU-SILC) household survey, compiled by Eurostat. These ad-hoc modules provide data on the respondents and their parents as well as retrospective information about the respondents at the age of 14. We restrict the sample to people over the age of 30 with information about parental education. Our assumption is that people have completed tertiary education or the highest level of education at the age of 30 and have started establishing their career. After removing the respondents with missing parental information, our final sample consists of 52,406 parent-child pairs for the educational dimension and 36,496 observations for the occupational approach. The descriptive statistics and national distributions of respondents and their parents across the three modules are exhibited in tables A1 and A2 in the appendix.

The EU-SILC dataset used the International Standard Classification of Occupations (ISCO-08) to describe the occupation of the respondents and their family members. The nine occupational classes are shown below (table 1). Our purpose is to exploit all the available information of the survey so as to compile a hierarchical occupational classification. Following the group definitions of International Labor Office, they arrange occupations in skilled groups[2] as the second column in table 1 presents (ILO, 2012). Hospitality managers belong in skill level 3, while other types of managers belong in skill level 4. In terms of mobility, this interprets mobility from managers to technicians and associates as "downward" and mobility from hospitality managers to professionals as "immobility". Regarding the armed forces, we chose to exclude them. Pohlig (2021) coded all soldiers as skill level 1 as there are fewer officers than ordinary soldiers and this likely produces fewer classification errors. To keep the educational attainments consistent between the generations, we create a dummy variable for educational background corresponding to 3 educational levels: primary or lower education; lower and upper secondary education; tertiary education[3].

[2] Definition of skill levels: "The nature of the work performed in an occupation with respect to the characteristic tasks and duties defined for each ISCO-08 level. The level of formal education required for the competent execution of the relevant tasks. The amount of informal on-the-job training and/or prior experience in a related position necessary for the competent performance of duties."

[3] EU-SILC survey provides information for 3 educational levels regarding the parental educational background.

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Table 1

Mapping of ISCO-08 groups to skill levels and skill levels to education

ISCO-08 major groups	Skill level	Levels of education (ISCED-97)
1. Managers, senior officials and legislators	3-4	Second stage of tertiary (leading to an advanced research qualification) First stage of tertiary, first degree (medium duration)
2. Professionals		
3. Technicians and associate professionals	3	First stage of tertiary education (short or medium duration)
4. Clerks	2	Post-secondary, non-tertiary education Upper secondary level Lower secondary level
5. Service and sales workers		
6. Skilled agricultural and fishery workers		
7. Craft and related trades workers		
8. Plant and machine operators, and assemblers		
9. Elementary occupations	1	Primary level

Source: Prepared by the authors based on ILO, 2012.

Although it seems inevitable that some kind of classification error will be made, the key is consistency in coding the data over time when studying mobility. To address the problem of life-cycle fluctuations, we consider the occupation and highest educational level of a person when she/he is in her/his productive years. In both countries, we keep adults between 30-60 years old for both dimensions.

5 METHODOLOGY

5.1 EDUCATIONAL MOBILITY

To examine whether educational mobility changes over time in Greece and Croatia, absolute measures will be used. Due to the lack of information about the years of schooling, the highest level of attainment for parents and offspring will be the base of our analysis, imposing analogous measurement approaches (Symeonaki, Stamatopoulou and Michalopoulou, 2016). Absolute mobility indices measure the total number of children who surpass the educational level of their parents (upward mobility) or show lower educational attainments (downward mobility) or reach the same educational outcome (immobility). The sum of the previous ratios is equal to one.

In order to explore potential changes in educational inequalities over a long period, we estimate **conditional probability ratio** (as the educational opportunities reflected in the probability of completing a specific educational level). Equality of educational opportunity is estimated by the probability that descendants born into families with less educated parents (1st or 2nd educational category) will attain tertiary education, compared to the probability of those with the highest parental background (tertiary education) reaching the same level. The conditional probability ratio chosen to determine the inequalities in Croatia and Greece for tertiary education is:

$$Ratio = Pr(ChEd=3|P=3)/Pr(ChEd=3|P\neq 3) \quad (1)$$

A higher number indicates unequal opportunities, while a number close to 1 suggests equal chances regardless of their family's educational background.

5.2 INTERGENERATIONAL OCCUPATIONAL MOBILITY

We use an ordered logit model[4] to explore the effect of parental skill level on children's skill level of occupation. It is an index model for a single latent variable y^* (which is unobservable, we only know when it crosses thresholds). In this model, the outcome is determined by the propensity y^* (Plewis and Bartley, 2014).

$$y^* = \beta^* X + u \quad (2)$$

The dependent variable has 4 categories/alternatives: skill levels of children. The explanatory variables are the highest skill level of the parents, the gender and the age of the offspring. There will be one set of coefficients with three intercepts. There will be four sets of marginal effects, one for each occupational category.

Finally, we aim to capture the determinants of intergenerational occupational mobility and the influence of education on that dimension of mobility. We estimate a multinomial logit model in regards to upward and downward mobility. We define three possible states: not mobile, upwardly (if Skill level of child > Skill level of parent) and downwardly mobile (if Skill level of child < Skill level of parent) following a model suggested by Ruiz (2016).

As a multiple logit thus ignoring the ordering using mlogit in STATA:

$$\log[\frac{\pi_m}{\pi_M}]\, m = 1. . .M-1 \quad (3)$$

We consider five groups of explanatory variables: socio-demographic characteristics (gender, age, nationality, marital status, siblings), human capital (educational attainment level), labour law effects (born after 70s), and additional regional variables (urbanization).

6 RESULTS

6.1 INTERGENERATIONAL EDUCATIONAL MOBILITY

Table 2 outlines the educational mobility rates, showing the percentage of children with educational level higher (upwardly mobile), lower (downwardly mobile) than or the same (immobile) as the educational level of their parents. In both countries, there is a downward trend in upward mobility, especially noticeable in Croatia. 70.8% of individuals born between 1950-1959 in Croatia and 59.5% of the ones born in Greece, achieved a higher level of education than to their parents, while for the youngest

[4] An ordered logit $\log[\sum_{i=1}^{m} \frac{\pi_i}{(1-\sum_{i=1}^{m}\pi_i)}]$, m = 1. . .M − 1 (1). M is the highest category (M = 4) and π is the probability of being in category i.

cohort studied, only 40.7% of individuals in Croatia and 47.9% in Greece managed to surpass their parents. The highest percentage of upward mobility in Greece was observed for the birth cohorts 1970-1979, which can be explained by the significant efforts of policymakers in the mid-60s, who used education as a means of increasing social mobility. A possible explanation for the decrease in upward mobility in Croatia is that older generations experienced significant social and economic changes, which resulted in them surpassing the educational levels of their parents. This left less room for their children to move up, resulting in lower percentages of upward mobility as well as the higher immobility rates among younger generations. If the available data allow for a more granular classification of educational attainment, the observed trends – particularly concerning the lower upward mobility of younger cohorts – may slightly differ from the previous patterns. Nevertheless, upward mobility rates are significantly higher than downward mobility rates, which have slightly increased in both countries.

Comparing mobility rates between men and women (tables A3 and A4 in appendix) in Croatia, the trend in educational mobility is similar for both genders. Specifically, there has been an increase in immobility and downward mobility rates, alongside a decrease in upward mobility for both men and women. However, the changes over time are more favourable for women, as upward mobility rates have been higher for women starting with the 1960s birth cohort. On the other hand, in a comparison of genders in Greece, while men's mobility rates follow a similar trend to those observed in Croatia, female patterns differ – particularly in terms of immobility and upward mobility. Since the 1970s birth cohort, women's upward mobility rates have been higher than men's.

Table 2

Absolute mobility indices

Birth cohorts of children	Immobility	Upward	Downward	Observations
		Croatia		
1950-1959	0.269	0.708	0.024	2,438
1960-1969	0.273	0.700	0.028	7,262
1970-1979	0.403	0.547	0.050	6,308
1980-1989	0.492	0.450	0.059	4,353
1990-1999	0.516	0.407	0.077	1,855
		Greece		
1950-1959	0.386	0.595	0.020	1,931
1960-1969	0.310	0.659	0.031	9,880
1970-1979	0.287	0.674	0.039	9,615
1980-1989	0.339	0.615	0.046	6,477
1990-1999	0.440	0.479	0.081	2,287

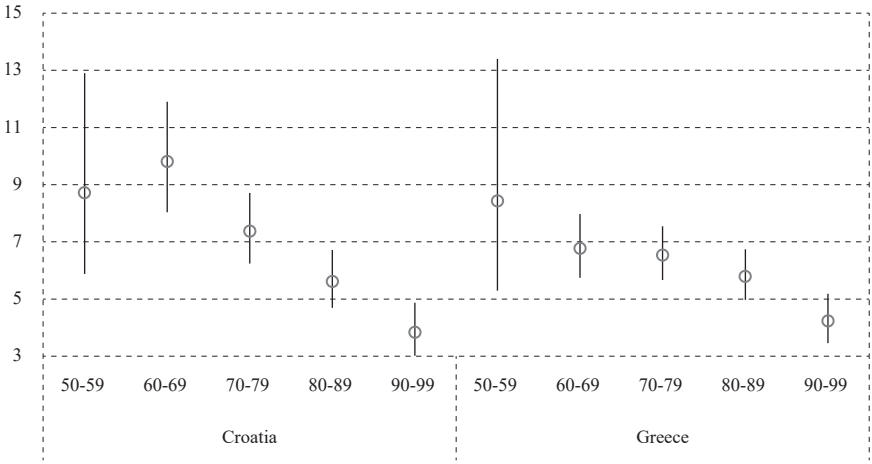
Source: Authors' own calculations based on the EU-SILC data.

Table A5 in the appendix and figure 2 present the probability ratios of completing tertiary education. In Croatia, older birth cohorts show higher odds ratios, indicating greater inequality in educational opportunities among those cohorts. In the

youngest cohort, a child whose parent has a tertiary degree has 3.83 times greater chances of attaining that level of education than a child whose parent has a primary or lower level of education, whereas for individuals born in the 1960s those chances are 9.81. The trend is the same in Greece, with the highest ratio of 8.43 for people born in the 50s and the lowest ratio of 4.23 for the youngest cohort. A gender-based comparison may indicate greater gender equality in Greece compared to Croatia, given that in Croatia, women exhibit higher odds ratios than men in all but the youngest cohort, while the reverse pattern is seen in Greece. Therefore, these results confirm that the changes have been more favourable for women, as in the youngest cohort in both countries, women are more likely to attend tertiary education regardless of the family educational background.

FIGURE 2

Probability ratios (with 95% confidence intervals) of educational inequalities by birth cohort

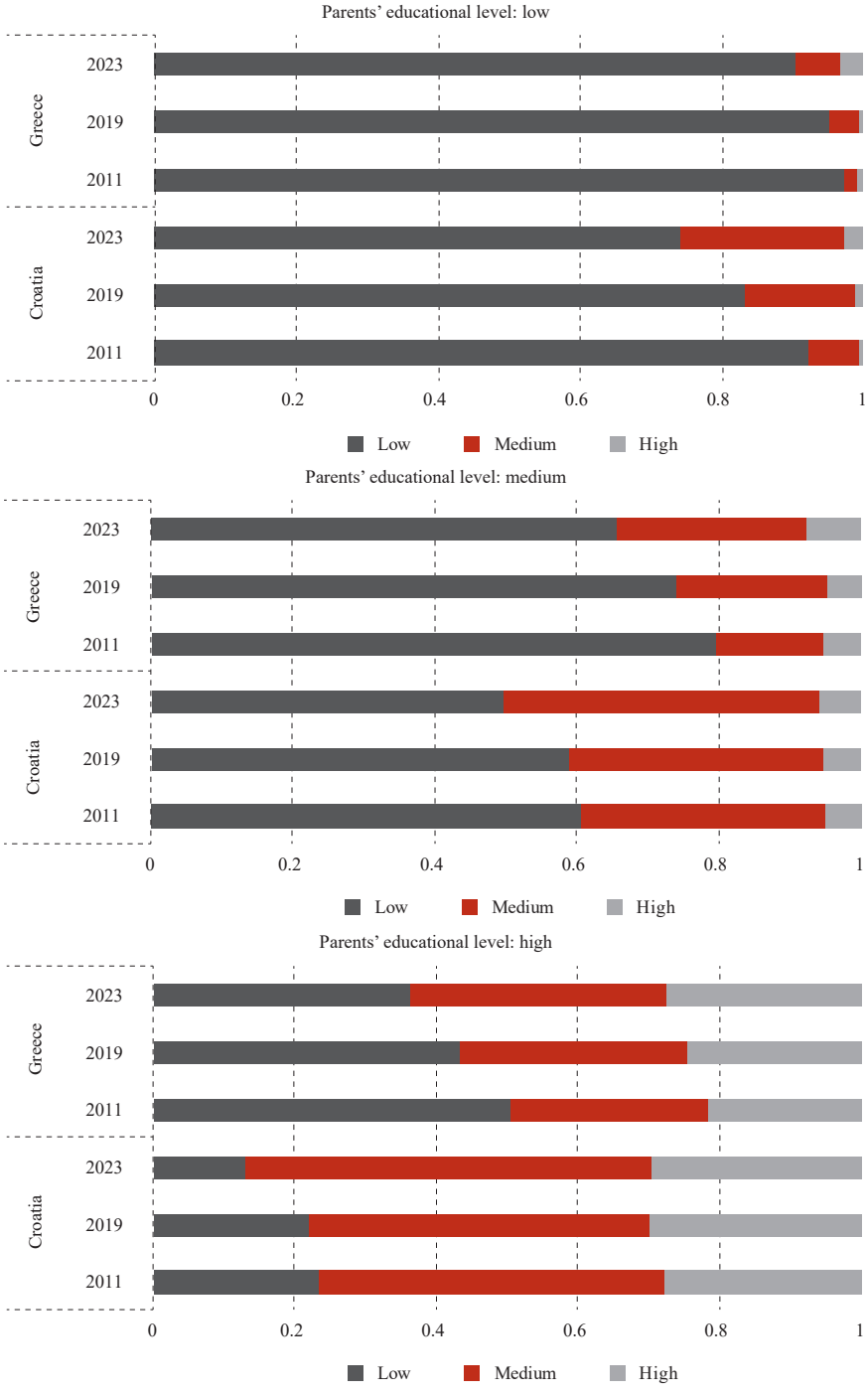


Source: Prepared by authors based on the EU-SILC data.

As a robustness check, tables A6 and A7 in the appendix present the absolute mobility indices per ad-hoc module to verify that the reported results are not influenced by differences across the observed surveys. The results can be interpreted as reflecting average movements in transition matrices and average mobility rates as well as odds ratios among birth cohorts in both Croatia and Greece. The absolute mobility indices and corresponding odds ratios are very similar across all ad-hoc modules. Both countries show a slight downward trend in upward mobility, accompanied by an opposite trend in downward mobility and immobility rates. The lowest odds ratios occur in the most recent ad-hoc module, suggesting an improvement in the equality of educational opportunities in both countries. Figure 3 provides an overview of the transition probabilities of individuals based on their parents' educational background. It is evident that individuals whose parents have a low level of education are significantly less likely to complete tertiary education than those whose parents have a medium or high level of education. In both countries, there has been an improvement in the equality of access to tertiary education.

FIGURE 3

The transition probabilities of people from different educational backgrounds, by country and ad-hoc module



Source: Prepared by authors based on the EU-SILC data.

6.2 INTERGENERATIONAL OCCUPATIONAL MOBILITY

6.2.1 The impact of parent's class on children's class

Tables 3 and 4 present the effects of parental occupational class on their children's class, controlling for the children's age and gender. The marginal effects demonstrate a strong and positive association between parents' and children's occupational skill levels. For the earliest birth cohort (1950-1959) in Croatia, children whose parents belong to the highest occupational skill level are 27.1% more likely to attain the same level themselves, 15.3% more likely to reach level 3, 30.5% less likely to end up in level 2, and 12% less likely to be in level 1 than the reference category (children whose parents worked in skill level 1 occupations). A similar pattern is observed in Greece, where children with parents in level 4 are 22.7% more likely to attain that level, 11.3% more likely to reach level 3, and 22.1% and 11.8% less likely to fall into levels 2 and 1, respectively. This pattern remains consistent across all birth cohorts in both countries.

When comparing the probability of attaining the highest occupational skill level, children of parents in level 4 are far more likely to reach the same level than those whose parents are in the lowest skill group. In Croatia, for example, the likelihood of a child attaining level 4 is 27.1% higher when the parent also belongs to that level, as against only 4.4% when the parent is in level 2 in relation to the reference category. The same trend is evident in Greece. These findings confirm that a higher parental occupational skill level is associated with a greater likelihood of children attaining levels 3 and 4, and a lower likelihood of ending up in levels 1 and 2. Figure 4 shows the trend in occupational mobility in Croatia and Greece. A comparison between the earliest (1950s) and the most recent (1980s) birth cohorts in both countries reveals an increased likelihood that children of parents in the highest occupational skill level also attain the highest level themselves. This suggests growing persistence, as it indicates that the influence of parental occupational status on children's outcomes has strengthened over time.

The effect of gender on children's occupational outcomes appears to be consistent in Croatia and Greece. Women born in the 1950s were more likely to be employed in occupations classified within skill levels 1 and 2. A similar pattern is observed among women born in the 1960s in Croatia. However, for the 1980s cohort, women were more likely to be employed in occupations at skill levels 3 and 4 in both countries, with an additional increase in representation at skill level 2 in Croatia (statistically significant for the 1950s and 1980s birth cohorts in both countries, as well as for the 1960s cohort in Croatia). The effect of age is not statistically significant in most cases, with the exception of the youngest birth cohort in Greece, in which age has a positive effect on the likelihood of being in the highest occupational skill levels, possibly attributed to greater work experience accumulated over time.

TABLE 3

Ordered logit model marginal effects (cohorts 1950-1989) – Croatia

Birth cohort	**1950-1959**				**1960-1969**				**1970-1979**				**1980-1989**			
Skill levels																
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Female	0.015*	0.020*	-0.017*	-0.018*	0.021***	0.017***	-0.016***	-0.021***	0.005	0.008	-0.006	-0.008	-0.038***	0.078***	0.043***	0.073***
	(0.007)	(0.009)	(0.008)	(0.008)	(0.006)	(0.001)	(0.005)	(0.006)	(0.001)	(0.008)	(0.006)	(0.008)	(0.007)	(0.015)	(0.008)	(0.014)
Age	0.001	0.002	-0.002	-0.002	0.001	0.001	-0.001	-0.001	-0.001	-0.001	0.001	0.001	0.001	0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Parental class																
2	-0.058***	-0.034***	0.048***	0.044***	-0.069***	-0.018***	0.042***	0.045***	-0.078***	-0.031***	0.054***	0.055***	-0.075***	-0.036***	0.052***	0.060***
	(0.011)	(0.007)	(0.008)	(0.007)	(0.010)	(0.003)	(0.005)	(0.006)	(0.013)	(0.005)	(0.007)	(0.007)	(0.021)	(0.008)	(0.012)	(0.013)
3	-0.103***	-0.168***	0.121***	0.150***	-0.126***	-0.102***	0.096***	0.132***	-0.128***	-0.137***	0.113***	0.152***	-0.130***	-0.174***	0.114***	0.191***
	(0.012)	(0.029)	(0.014)	(0.024)	(0.011)	(0.016)	(0.009)	(0.016)	(0.013)	(0.020)	(0.011)	(0.018)	(0.021)	(0.027)	(0.015)	(0.027)
4	-0.120***	-0.305***	0.153***	0.271***	-0.168***	-0.271***	0.130***	0.310***	-0.157***	-0.289***	0.143***	0.304***	-0.149***	-0.283***	0.129***	0.304***
	(0.011)	(0.035)	(0.012)	(0.034)	(0.009)	(0.020)	(0.007)	(0.023)	(0.013)	(0.019)	(0.009)	(0.021)	(0.021)	(0.024)	(0.014)	(0.026)
Obs.	2,018				4,436				3,287				1,544			

Source: Authors' own calculations based on the EU-SILC data.

TABLE 4

Ordered logit model marginal effects (cohorts 1950-1989) – Greece

Birth cohort	**1950-1959**				**1960-1969**				**1970-1979**				**1980-1989**			
Skill levels																
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Female	0.044***	0.064***	-0.043***	-0.066***	-0.002	-0.003	0.001	0.004	-0.002	-0.004	0.002	0.004	-0.022***	-0.047***	0.017***	0.052***
	(0.080)	(0.010)	(0.007)	(0.010)	(0.003)	(0.006)	(0.002)	(0.007)	(0.003)	(0.006)	(0.002)	(0.006)	(0.004)	(0.009)	(0.003)	(0.009)
Age	-0.001	-0.001	0.001	0.001	0.001	0.001	-0.001	-0.001	-0.001	-0.001*	0.001	0.001*	-0.001***	-0.003***	0.001***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Parental class																
2	-0.058	-0.026***	0.037*	0.047**	-0.059***	-0.035***	0.030***	0.064***	-0.061***	-0.036***	0.034***	0.063***	-0.109***	-0.037***	0.047***	0.099***
	(0.038)	(0.004)	(0.018)	(0.020)	(0.015)	(0.003)	(0.006)	(0.011)	(0.014)	(0.003)	(0.006)	(0.010)	(0.027)	(0.008)	(0.007)	(0.013)
3	-0.134***	-0.382***	0.118***	0.398***	-0.120***	-0.235***	0.076***	0.278***	-0.119***	-0.211***	0.084***	0.246***	-0.162***	0.212***	0.088***	0.285***
	(0.038)	(0.073)	(0.021)	(0.089)	(0.016)	(0.038)	(0.007)	(0.043)	(0.015)	(0.003)	(0.007)	(0.035)	(0.027)	(0.036)	(0.009)	(0.039)
4	-0.118***	-0.221***	0.113***	0.227***	-0.127***	-0.291***	0.077***	0.340***	-0.129***	- 0.285***	0.088***	0.326***	-0.171***	-0.287***	0.090***	0.368***
	(0.038)	(0.034)	(0.020)	(0.037)	(0.015)	(0.016)	(0.006)	(0.020)	(0.014)	(0.015)	(0.007)	(0.018)	(0.027)	(0.019)	(0.008)	(0.022)
Obs.	1,954				7,945				7,736				4,561			

Source: Authors' own calculations based on the EU-SILC data.

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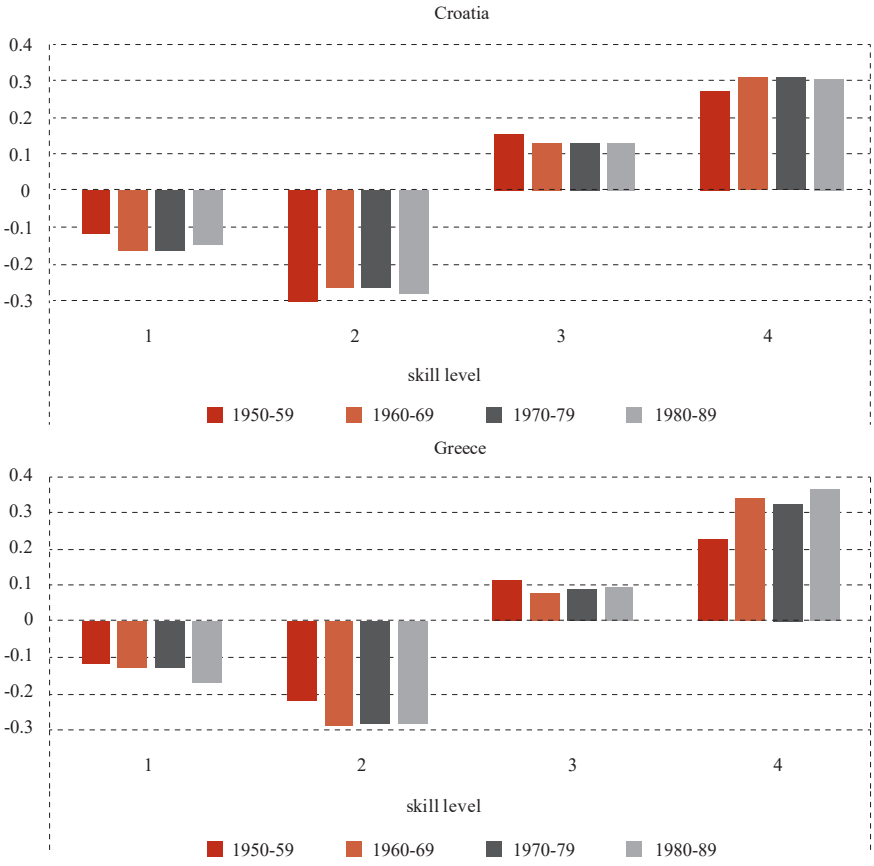
FIGURE 4

The marginal effects of highest parental class on the offspring's class



Source: Prepared by authors based on the EU-SILC data.

6.2.2 Determinants of intergenerational mobility and the role of education

Table 5 presents the possibilities of upward and downward intergenerational occupational movements for the entire sample in both countries. Starting with education, it is evident that higher educational levels increase the probability of upward occupational mobility. Upper secondary education reduces the chance of downward mobility compared to primary education in both countries, while it increases the probabilities for upward mobility but not significantly so in Croatia. Its effect on immobility is small and statistically insignificant in Greece, but slightly positive in Croatia indicating an increasing immobility. Tertiary education has a much stronger impact, positively affecting upward mobility and reducing the chances of experiencing immobility or downward mobility. A university graduate is 34.2% more likely in Croatia and 43% more likely in Greece to experience upward mobility relative to their family occupational background, compared to the reference category of individuals with only primary education. The influence of education is slightly stronger

in Greece, as it increases the likelihood of upward mobility and reduces the probability of immobility to a greater extent than in Croatia.

The ways in which mobility patterns are shaped in relation to gender differ between the countries. In both, women have higher chances of experiencing downward occupational mobility, even though the result is statistically insignificant in Croatia. Females show higher probabilities for immobility than men in Croatia, while in Greece the opposite pattern has been noted. Contrasting results have also been found when looking at upward mobility, where females are more likely to experience it in Greece than men, with the opposite happening in Croatia. In both countries, age increases the probability of experiencing upward mobility and decreases the likelihood of downward mobility, possibly due to the longer work experience.

TABLE 5

Estimates of the marginal effects corresponding to the multinomial logit model

	Croatia			Greece		
	Downward	**Immobility**	**Upward**	**Downward**	**Immobility**	**Upward**
Age	-0.003***	-0.002*	0.005***	-0.001*	-0.003***	0.004**
	(0.0001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Gender (female)	0.120	0.029*	-0.041***	0.054***	-0.067***	0.013
	(0.010)	(0.012)	(0.012)	(0.005)	(0.009)	(0.008)
Educational level						
Upper secondary education	-0.186*	0.092	0.094	-0.095***	-0.005	0.100***
	(0.089)	(0.086)	(0.070)	(0.011)	(0.013)	(0.008)
Higher education	-0.275***	-0.067	0.342***	-0.142***	-0.287***	0.430***
	(0.089)	(0.087)	(0.071)	(0.012)	(0.015)	(0.011)
Marital status (married)	-0.068***	-0.005	0.074***	0.034***	-0.001	0.035***
	(0.011)	(0.014)	(0.014)	(0.060)	(0.010)	(0.009)
Citizenship (Native)	-0.021	0.458	-0.023	-0.106***	0.033	0.073***
	(0.069)	(0.088)	(0.084)	(0.010)	(0.022)	(0.022)
Birth cohorts after 70s	-0.015	0.001	0.015	0.011	-0.036*	0.024
	(0.019)	(0.020)	(0.023)	(0.011)	(0.016)	(0.015)
Number of siblings	-0.070	0.007	0.001	0.003	0.010*	-0.014***
	(0.004)	(0.005)	(0.001)	(0.002)	(0.004)	(0.004)
Urbanization (cities)	0.055***	0.026*	-0.081***	0.017**	-0.030***	0.012
	(0.130)	(0.017)	(0.017)	(0.007)	(0.010)	(0.009)
Obs.		6,156			11,734	

*Note: The symbols *, ** and *** denote statistical significance at 10%, 5% and 1%. Robust standard errors are in parentheses.*

Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

The results emphasize other key attributes, such as marital status, number of siblings, citizenship and level of urbanization. Being married increases the likelihood of experiencing upward mobility in both countries. It reduces the chances for downward mobility in Croatia but has the opposite effect in Greece. Citizenship or

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number of siblings do not have a significant effect in Croatia. In Greece on the other hand, people whose parents are native show higher probabilities for upward mobility, while the number of siblings reduces that likelihood. Living in a city increases the possibility of downward mobility in both countries. However, its impact on immobility and upward mobility differs between them. In Croatia, higher levels of urbanization are associated with increased chances of immobility and reduced opportunities for upward mobility. In contrast, in Greece, urbanization appears to promote upward mobility and reduce immobility.

7 DISCUSSION

This section contextualizes our findings in relation to the existing literature, comparable empirical studies, and relevant statistical evidence. According to our findings, both countries exhibit a downward trend in upward educational mobility, a pattern that has also been observed in many other countries over the past 30 years, according to OECD estimations (2018) with the average upward mobility rate in these countries being 39%. Upward mobility rates in Greece and Croatia are above the OECD average and are also higher than rates in most of the countries included, where only a few of them surpassed 50%. International comparisons about educational mobility revealed higher persistence for South American countries, lower persistence for western European countries, while the USA tends to be in the middle. Mediterranean countries indicated lower educational persistence for birth cohorts until 1985, the opposite to the post-communist bloc, while Nordic countries follow a U-shaped trend. The rest of the European countries follow a similar pattern to the Mediterranean ones, with moderate downward persistence (Torul and Oztunali, 2017).

In both Croatia and Greece, the changes over time are more favourable for women. In Croatia, upward mobility rates have been higher for women starting with the 1960s birth cohort. Population censuses also show an increase in the percentage of women that have completed higher education, growing from only 0.8% in 1961 to 25.7% in 2021. Additionally, the percentage of women with a degree has surpassed the percentage of men that have completed higher education in 2011 and has remained higher ever since (CBS, 2021). In Greece, since the 1970s birth cohort, women's upward mobility rates have been higher than men's. According to Eurostat, women show a higher ratio in tertiary education than men (33.6% compared to 30.2%). The estimated odd-ratios around 3-5 for the younger cohorts in both countries indicate that educational inequalities, even though still present, are not too high compared to other countries. Trends in the likelihood of educational attainment if neither parent has attained the level of higher education vary across OECD countries**.** Stamatopoulou and Symeonaki (2023) found that in post-socialist countries, like Hungary and Slovakia, individuals whose fathers have a high level of education are approximately nine times more likely to complete tertiary education than those whose fathers have low educational attainment, and three times more likely than those with moderately educated fathers. In contrast, Nordic countries demonstrate significantly greater equality in access to higher education.

The educational explosion after the Second World War in the majority of the countries encouraged debate on whether previous reforms have affected the opportunities for children from different socioeconomic backgrounds, especially the transition from secondary education to university. According to Keller and Róbert (2016), the effect of father's education on respondents' socioeconomic class and education declined over the decades of the 70s and 80s. Contrarily, Bar-Haim, Blank and Shavit (2013) contend that the educational explosion does not necessarily secure the decline of educational inequalities. There is often a probability that the beneficiaries belong to the same groups, and the losers also come from similar socioeconomic backgrounds. Despite widespread expansion in higher education across Europe, institutional stratification and parental background remain persistent determinants of educational attainment, with stronger effects in Southern and Eastern Europe (Andreou and Koutsampelas, 2015; Sianou-Kyrgiou, 2010; D'Hombres et al., 2024). Finally, Doolan et al. (2018) find that Croatian students from families with higher educational backgrounds and better socio-economic status, remain disproportionately overrepresented in universities.

Regarding occupational mobility, our findings indicate that the influence of parental occupational status on children's outcomes has strengthened over time. The intergenerational transmission of highly skilled jobs and high prestige occupations can be explained by the sectoral composition of these classes (Anastasiadou, Batiou and Valkanos, 2015; Nicolitsas, 2006). The persistence in occupations such as doctors, lawyers, etc. reveals that privileged backgrounds not only create favourable conditions and social networks but also guide their children into these roles (Doolan, Puzić and Baranović, 2018; Patrinos, 1997). OECD (2018) found that there is more persistence at the top of the occupational distribution. The institutional differences among states tend to be crucial for the occupational mobility in Mediterranean countries, considering mixed market economies. The structural features and stricter employment protections in these countries, the significant number of public servants and bureaucratic constraints, and legislation for dismissals can explain the occupational persistence over time (Bisello, Maccarrone and Fernández-Macías, 2020; Pohlig, 2021). In the countries of Southern Europe, the rudimentary welfare state is along similar lines, family bonds and networks being formerly more important factors for transitions to employment. The contemporary notion poses the intensity of the network as an extremely useful tool for workers seeking opportunities in other organizations that require similar skill levels.

In cases of greater occupational mobility, the role of education is prominent. In Croatia and Greece, all levels of education increase the likelihood of experiencing upward intergenerational mobility, with higher education having the strongest impact. Higher education also reduces the likelihood of downward movement and immobility in both countries. Our findings are consistent with those of Ruiz (2016), who found that in Spain, all levels of education increase the likelihood of upward occupational mobility, with the highest education level also having the strongest effect. Education also reduces the likelihood of downward mobility and

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immobility. According to his research, in the birth cohort 1969-1986, higher education increases the likelihood of upward mobility by 25.8%, while for the 1952-1968 cohort, the increase is 26.9%. Therefore, the influence of education is stronger in Croatia and Greece, where a higher level of education increases the chances of upward mobility by 34.2% and 43%. OECD (2018) investigated education as a "mediating" factor of occupational mobility. Countries that experienced an expansion of education and reduced educational attainment gaps between children from different social classes have seen a weakening of the influence of parental background. Lower occupational persistence of educated individuals means that the origin does not shape the destination and this works as an extra motivation for acquiring greater education for everybody in this society.

The ways in which mobility patterns are shaped in relation to gender differ in Croatia and Greece. Women are less likely to experience downward occupational mobility in both countries, which aligns with the findings of Ruiz (2016), as in Spain, men have higher chances of downward mobility. Differences emerge when it comes to upward occupational mobility. In Greece, women show higher probabilities of upward mobility (as in Eurofound's research in 2017), as well as in Spain across all birth cohorts. In contrast, women have lower chances of upward mobility in Croatia. Previous empirical literature invokes family beliefs and social norms as a dominant transmission channel of female labour market behaviour and educational attainment across the generations. Men's cultural models of gender roles have, to some extent, influenced women's increased motivation to invest in their education and human capital in recent decades (Papapetrou and Tsalaporta, 2017). In addition, the decision to quit and emigrate has become more individualized, differing between partners. In earlier decades, such decisions were typically based on the husband's professional opportunities, with wives often acting as "tied movers" and experiencing occupational deterioration. As a result, they had fewer opportunities to build professional networks and demonstrated lower job search intensity, both of which are crucial for securing employment or advancing in their careers. Nevertheless, this incidence does not apply for women in top occupational positions, engaged in gendered jobs like nursing-care specialists, education, or even clerical positions in administration (Crespo, Simoes and Moreira, 2013). Gender-based research on mobility has shown a small association of results across countries. The variation of mobility between sons and daughters in the same country emerges from the hypothesis that parents make different decisions about their individual children and these affect the educational investments or support. A general pattern among the OECD countries is a slightly higher mobility for sons than for daughters.

We also found that being born into younger cohorts penalizes upward mobility without affecting the results of downward mobility. It is important to note that younger generations have more educated parents who found a job after the modernization of the economy. Consequently, it is more difficult to experience upward intergenerational mobility. Marital status influences occupational mobility, as

being married increases the likelihood of experiencing upward mobility. This evidence agrees with the argument that marital sorting can increase the informal social network of the couple helping them find jobs better suited to their needs and skills. The controversial effect in the two countries regarding the effect of marital status in downward mobility could be explained by cultural reasons such as the decreased importance of the large-family mindset, as family commitments are highly correlated with occupational persistence (Crespo, Simoes and Moreira, 2013; Nicolitsas, 2006).

Finally, we acknowledge that family background not only reflects financial resources, social and cultural capital, but may also be correlated with innate abilities and cognitive skills, which can partly explain educational outcomes. Another issue raised in the literature is whether the expansion of higher education leads to overeducation and the erosion of standards (Kitsoleris and Luong, 2025). We recognize this debate and emphasize that future reforms must ensure that broader access does not come at the expense of quality. Strengthening vocational and professional pathways, improving quality assurance in universities, and aligning curricula with labour market demands are critical steps for Croatia and Greece.

8 CONCLUSION

Our analysis revealed a declining trend in upward educational mobility in both Croatia and Greece. Research into intergenerational occupational mobility has investigated high occupational persistence between generations when focusing on skill levels. This is problematic because family background determines whether children end up in well-paying or low-paying jobs. The significance of education is further underscored: individuals with more highly educated parents are more likely to complete tertiary education and achieve upward occupational mobility. Although educational inequalities in access to tertiary education have decreased in both countries, they remain present. However, in both countries completing tertiary education significantly increases the likelihood of a person experiencing better occupational status than the previous generation.

This study suggests that the expansion of formal public education is not capable of reducing inequalities if it is unaccompanied by policies offsetting the families' background deficits. Such measures include longer school days (to support families in which both parents are in the labour market), smaller class sizes (in order to ensure quality), and financial aid supporting the education of disadvantaged groups (covering costs for accommodation, transportation and study materials). Even though education is free in both countries, households are still required to invest heavily in their children's education. Families are often faced with lack of funds, restricting their ability to experience upward mobility. Household educational investments are thus an important parameter of social mobility and it is the state's responsibility to reduce barriers for those who receive less support from the educational system. In order to lessen the influence of parental income on educational achievement and promote greater mobility, the states need to adopt policies

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ensuring equal opportunities, starting from the early stages (additional support for parents) and continuing to all stages of education. Universal access to individual tutoring and support seem to be essential for the prevention of the stratification of the advantages of access to and success in higher educational levels and programs.

Furthermore, to achieve this goal, from a policy perspective, it is important to emphasize the need to compensate for the impact of a family's financial background on access to prestigious educational opportunities, and to eliminate barriers to entry into certain occupations. Discretionary expenses on education targeting disadvantaged households may be the appropriate policy. The most realistic scenario for increasing social mobility is through the institutions of pilot and experimental schools, already operating in Greece and other countries. In our opinion, these are not operating appropriately: socio-economic criteria are not taken into consideration in enrolment, resulting in the underrepresentation of vulnerable groups. These schools are units of secondary public education that aim to cultivate and promote excellence within the education system. They employ teachers with advanced formal qualifications and teaching experience. Admission requires annual entrance exams, and many parents invest significant resources in preparing their children for these tests. As a result, the process mirrors the inequalities seen in university entrance exams, another issue that should be addressed. The schools could select their students in a different way in order to mitigate the educational inequalities that our research revealed and give opportunities to students from vulnerable groups.

Finally, future research should extend the current analysis by: (i) employing longitudinal data to capture multi-generational patterns in more southern European countries, (ii) exploring regional disparities (urban-rural, coastal-inland) in mobility, (iii) combining quantitative evidence with qualitative studies of family networks and cultural capital, and (iv) assessing the impact of overeducation on graduate underemployment and skill mismatch in these countries. These directions would provide a more comprehensive understanding of social mobility in Southeast Europe.

Disclosure statement

The authors have no conflicts of interest to declare.

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APPENDIX

Table A1

Descriptive statistics of education mobility (%)

Variables	Croatia	Greece
Gender		
Male	49.47	48.52
Female	50.53	51.48
Age		
30-39	18.6	22.25
40-49	29.79	31.00
50-60	41.07	39.07
Highest level of education for children		
Primary	1.61	13.27
Secondary	78.03	56.33
Tertiary	20.36	30.41
Highest level of parental education		
Primary	49.17	66.23
Secondary	40.68	22.76
Tertiary	10.15	11.01
Number of observations by ad-hoc module		
2011	6,701	5,642
2019	7,771	15,473
2023	7,744	9,075
Total number of observations	**22,216**	**30,190**

Source: Authors' own calculations based on the EU-SILC data.

Table A2

Descriptive statistics of occupational mobility (%)

Variables	Croatia	Greece
Gender		
Male	51.41	53.85
Female	48.59	46.15
Age		
30-39	20.24	22.49
40-49	30.85	32.22
50-60	40.79	38.57
Highest level of occupation for children		
1	11.10	8.65
2	58.24	61.19
3	15.28	10.92
4	15.38	19.25
Highest level of parental occupation		
1	24.04	5.32
2	53.63	81.15
3	9.93	1.80
4	12.40	11.72
Total number of observations	**12,282**	**24,214**

Source: Authors' own calculations based on the EU-SILC data.

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Table A3

Absolute mobility indices for sons

Sons	Immobility	Upward	Downward	Observations
		Croatia		
1950-1959	0.246	0.730	0.024	1,159
1960-1969	0.271	0.698	0.031	3,483
1970-1979	0.410	0.532	0.058	3,092
1980-1989	0.523	0.401	0.076	2,236
1990-1999	0.554	0.354	0.092	1,020
		Greece		
1950-1959	0.323	0.660	0.016	913
1960-1969	0.298	0.674	0.028	4,679
1970-1979	0.292	0.671	0.038	4,640
1980-1989	0.354	0.589	0.056	3,222
1990-1999	0.484	0.423	0.093	1,195

Source: Authors' own calculations based on the EU-SILC data.

Table A4

Absolute mobility indices for daughters

Daughters	Immobility	Upward	Downward	Observations
		Croatia		
1950-1959	0.289	0.687	0.023	1,279
1960-1969	0.274	0.701	0.025	3,779
1970-1979	0.396	0.561	0.043	3,216
1980-1989	0.459	0.502	0.040	2,117
1990-1999	0.471	0.472	0.057	835
		Greece		
1950-1959	0.442	0.535	0.023	1,018
1960-1969	0.322	0.646	0.033	5,201
1970-1979	0.283	0.677	0.040	4,975
1980-1989	0.324	0.641	0.035	3,255
1990-1999	0.392	0.539	0.069	1,092

Source: Authors' own calculations based on the EU-SILC data.

Table A5

Odds ratios for the whole sample and per gender

		Odds ratios for both genders	Confidence intervals (95%)	Odds ratios for sons	Odds ratios for daughters
Croatia	1950-59	8.72	5.87 – 12.95	8.26	9.19
	1960-69	9.81	8.03 – 11.98	8.22	11.5
	1970-79	7.37	6.25 – 8.71	6.85	8.12
	1980-89	5.61	4.7 – 6.71	5.83	6.42
	1990-99	3.83	3.01 – 4.88	4.51	3.64
Greece	1950-59	8.43	5.3 – 13.44	12.3	6.89
	1960-69	6.77	5.75 – 7.97	7.59	6.13
	1970-79	6.53	5.67 – 7.54	7.46	5.81
	1980-89	5.79	4.98 – 6.75	5.82	6.27
	1990-99	4.23	3.46 – 5.19	4.82	3.85

Source: Authors' own calculations based on the EU-SILC data.

Table A6

Absolute mobility indices per ad-hoc module – Croatia

Module		Parental education			UM	DM	IM	Odds ratios
		1	2	3				
2011	Child's education 1	0.921	0.073	0.004	0.605	0.042	0.353	7.74
	2	0.605	0.345	0.048				
	3	0.233	0.489	0.276				
2019	1	0.831	0.156	0.012	0.605	0.044	0.351	7.67
	2	0.589	0.357	0.053				
	3	0.222	0.478	0.300				
2023	1	0.742	0.228	0.028	0.543	0.045	0.411	6.92
	2	0.497	0.445	0.057				
	3	0.131	0.572	0.296				

Source: Authors' own calculations based on the EU-SILC data.

Table A7

Absolute mobility indices per ad-hoc module – Greece

Module		Parental education			UM	DM	IM	Odds ratios
		1	2	3				
2011	Child's education 1	0.972	0.019	0.008	0.661	0.033	0.306	6.41
	2	0.796	0.151	0.051				
	3	0.503	0.278	0.218				
2019	1	0.950	0.042	0.007	0.640	0.034	0.326	7.82
	2	0.741	0.210	0.048				
	3	0.431	0.323	0.245				
2023	1	0.903	0.062	0.033	0.616	0.053	0.331	5.01
	2	0.656	0.267	0.076				
	3	0.364	0.361	0.274				

Source: Authors' own calculations based on the EU-SILC data.

Determinants of tax morale among university students in Croatia

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Abstract

This study aims to identify the main determinants of tax morale among university students in Croatia. The partial least squares structural equation modelling (PLS-SEM) approach has been used, and the results show that trust in institutions, religious principles and tax knowledge positively influence the tax morale of university students. Contrary, politics, social norms, and financial knowledge negatively influence tax morale. Higher financial knowledge lowers tax morale, while students who believe that the state should have a greater influence on the economy have higher tax morale. Moreover, there are some differences in attitudes towards tax morale according to gender, age and place of birth. The research shows a general lack of tax knowledge among students, indicating a need for improved tax education initiatives. By incorporating these findings into policy and curriculum design, governments can cultivate a culture of compliance among future taxpayers, ultimately contributing to more effective and equitable tax systems.

Keywords: tax morale, university students, Croatia, PLS-SEM approach

1 INTRODUCTION

The research gap identified in this study is related to the limited research on tax morale specifically among university students, particularly in the Croatian context. Tax morale refers to the intrinsic motivation of individuals to fulfil their tax obligations and contribute to the common good. In general, tax morale is influenced by a number of factors including demographic factors (gender, age, employment status, religious beliefs, etc.), cultural and social norms, trust in institutions (government and state institutions), perceptions of fairness, tax rates and complexity, etc., which influence individuals' attitudes towards paying taxes. High tax morale is associated with greater voluntary compliance and lower tax evasion. Therefore, tax morale is an important aspect of tax policy. While the existing literature has extensively examined tax morale with respect to various demographic and institutional characteristics, there is remarkably little research that focuses on the attitudes and perceptions of young adults who are about to become taxpayers (Cummings et al., 2009; Molero and Pujol, 2012; Goksu and Sahpaz, 2015; Pratama, 2017; McGee and Shopovski, 2018; Batrancea et al., 2019; Yasa et al., 2021).

While previous studies have examined the determinants of tax morale, including sociodemographic factors, institutional trust, and perceptions of fairness, there is insufficient research that integrates these determinants into the specific context of university students, most of whom are not taxpayers. Most studies have focused on established taxpayers, so there is a gap in understanding how early exposure to tax concepts and education influences future compliance behaviour. University students represent the future generation of taxpayers, professionals and decision makers, so their attitudes towards taxation are very important in shaping long-term tax compliance behaviour. Their time in higher education is a formative period, when civic values such as fairness, trust and social responsibility are still developing and therefore easier to influence. In addition, students, especially

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those studying economics, gain foundational knowledge that shapes their understanding of the tax system and its role in society. Understanding their perspectives provides valuable insights into how future citizens will interact with tax systems, both as individuals and as institutional actors.

In addition, this study introduces tax knowledge as a critical variable in assessing students' tax compliance behaviour, an area that has received little attention in previous research (Sarasa and Sarasa-Pérez, 2016). The inclusion of financial and tax knowledge not only addresses an important aspect of the preparation of students for future tax obligations but also highlights the need for targeted educational initiatives to promote a culture of tax honesty from an early age.

As a post-socialist country, Croatia has undergone significant economic institutional changes that influence public attitudes towards the state and taxation. Trust in institutions is often weakened by perceived corruption and inefficiency, so it is crucial to understand how such factors affect tax morale, especially among the young. Furthermore, a large shadow economy exposes young people to non-compliant practices, highlighting the importance of examining their tax-related beliefs and behaviours.

Since the determinants of tax morale are numerous, this paper focuses on some of them. Specifically, we test the importance of selected demographic factors: gender, religion, household financial situation, and place of birth; and two theories: the state reciprocity theory through perceptions of fairness and trust in institutions and the moral alignment theory through political orientation (Robbins and Kiser, 2020). In addition, we add tax knowledge as an important variable. Since our sample consists of students from faculties of economics, who are expected to be financially literate, this study examines the aspect of tax knowledge within financial literacy itself in more detail.

Tax morale or related tax issues in Croatia have already been examined in several studies (Bejaković, 2009; Gadžo and Klemenčić, 2014; Blažić and Štambuk, 2019; Cristea et al., 2019; Bejaković and Bezeredi, 2019; Paleka, Badulescu and Karanović, 2022; Paleka and Vitezić, 2023), but this work is, to our knowledge, the first to analyse university students' views on taxes. Furthermore, it includes two additional factors that have not yet been studied in Croatia, especially not among university students, financial and tax knowledge. Our findings could lead to policy recommendations aimed at combating tax evasion and improving students' tax honesty and ethical awareness. By analysing students' attitudes towards tax morale, this work contributes to the literature on tax compliance, helping tax authorities to better understand and predict taxpayers' motivations and behaviour.

By applying the partial least squares structural equation modelling (PLS-SEM) approach, this study also enhances the research methodology in the area of tax morale as PLS-SEM is used to assess both unobserved and observed variables

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while allowing the simultaneous assessment of the relationship between construct and measures as well as between constructs. This study therefore examines a number of dependency relationships simultaneously and brings a higher-level perspective to the discussion of tax morale.

To summarize, the study of the determinants of tax morale among university students in Croatia provides up-to-date insights for public policy. It enables policy makers to better understand how tax knowledge, institutional trust and perceived fairness influence tax compliance intentions in a post-transition society. These insights can inform the design of targeted tax education programs and ultimately contribute to the development of a stronger tax culture based on trust and voluntary compliance.

The paper is structured as follows. The introduction is followed by a literature review on the determinants of tax morale in section 2. Section 3 provides an overview of the empirical research and describes the data and methodology. The fourth section presents the research findings, which are discussed in the fifth section. The final section concludes.

2 LITERATURE REVIEW

2.1 TAX MORALE DETERMINANTS

The above remarks are followed by a corresponding overview of the literature. Crnogorac and Lago-Peñas (2020), using survey data from the 2008 European Values Study as well as fiscal and economic macro data, found that tax morale is positively influenced by trust in institutions. In addition, the authors found that contextual variables such as a higher tax burden negatively influence tax morale, particularly through direct taxes, while greater economic freedom positively influences tax morale. Perceptions of the fairness of the tax system and the equitable use of tax revenues by the government are also important for tax morale. If people believe that the tax system is fair and that their contributions are used effectively for the common good, they are more willing to pay taxes (Torgler and Schalategger, 2005; Luttmer and Singhal, 2014; Sá, Martins and Gomes, 2015; Owusu et al., 2022). Alm and Torgler (2006) pointed out that key factors influencing tax morale include perceptions of fairness, trust in government institutions, and the nature of the fiscal exchange between taxpayers and the government. Similarly, Torgler (2004) emphasized the importance of trust, satisfaction with government institutions and perception of fairness in shaping tax morale in transition countries. Robbins and Kiser (2020) examined the role of state reciprocity in relation to income tax evasion. State reciprocity states that the provision of public goods by the state creates a social contract in which citizens meet their tax obligations in return for the benefits and services provided by the government. Reciprocity is often seen as an important component of tax morale. It reflects the idea that individuals' willingness to pay taxes is influenced by their perception of a social contract with the government. Taxpayers view tax payments as a reciprocal exchange for the public goods and services provided by the state, leading to a sense of

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obligation to contribute to the common good. Furthermore, reciprocity is related to perception of fairness, trust in government institutions and the legitimacy of the tax system. When taxpayers believe that their contributions are used fairly and efficiently, they are more likely to view their tax obligations as reciprocal and have trust in the government's ability to manage public resources effectively (Luttmer and Singhal, 2014). Nevertheless, Robbins and Kiser (2020) did not find strong support for the role of government reciprocity in income tax evasion. Moral attitudes are explained by two important moral mechanisms of tax compliance: moral imperatives and moral alignment (Robbins and Kiser, 2020). Consistent with state reciprocity theory, this paper assumes that there are statistical differences in attitudes toward tax morale among students with different levels of perceptions of fairness and trust in institutions.

Robbins and Kiser (2020) also examined the role of moral alignment in relation to income tax evasion. Moral alignment is the individual's psychological attachment to a political party or authority in which they recognize their values and morals in the values of those in power. This alignment can influence tax compliance behaviour, as individuals are more likely to comply with tax laws if they identify with the political actors who control the state. Robbins and Kiser (2020), using a factorial survey experiment on income tax evasion, found that moral alignment has a strong influence on tax compliance. In line with the theory of moral alignment, this paper examines whether there are statistical differences in attitudes towards tax morale among students with different political orientations.

Hauptman, Žmuk and Pavić (2024) uncovered gender differences in taxpayers' attitudes towards tax compliance in Slovenia, with women more likely to feel guilty if they do not pay their taxes in full and to disapprove of doing cash work without paying taxes. Similarly, Crnogorac and Lago-Peñas (2020) found that women have higher tax morale than men, while Bejaković and Bezeredi (2019) point out that women are more risk averse and therefore more compliant than men. According to McGee and Shopovski (2018), male students are also more tolerant of tax evasion than their female peers. This paper examines whether there are significant differences in attitudes towards tax morale between male and female students.

Tax morale is also influenced by religious principles. Religion has a direct effect on tax morale and an indirect impact on trust in institutions, political participation and trust in others (Sá, Martins and Gomes, 2015). Torgler (2005) shows a positive correlation between tax morale and religious feeling. Research by Islam et al. (2020) has shown that religion can shape social norms and influence individuals' tax compliance behaviour. The results of the study suggest that higher levels of religious belief lead to higher tax morale among taxpayers and ultimately reduce the propensity to evade taxes. Göksu and Sahpaz (2015) found that religious beliefs shape attitudes towards tax evasion, with a significantly higher percentage of participants from Sakarya University (Turkey) believing that tax evasion is a sin due to their religious beliefs than participants from Zaragoza University

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(Spain). Orumwense and Aiwoho (2021) show that individuals who describe themselves as religious have a more positive attitude towards paying taxes because they believe that tax evasion is a sin according to their religion. Highly religious people strive to lead a moral life and view tax evasion as unethical and against their religion. This paper aims to investigate whether religiousness influences tax morale in Croatia.

Educated people generally have a better understanding of what the state provides and how it spends the tax money it collects. There are studies that have found a positive relationship between tax knowledge and tax awareness. Tax morale is thus higher among educated people, which leads to better tax compliance. According to Sanusi et al. (2021), higher tax knowledge primarily leads to a positive attitude towards the tax system. Thus, with greater tax knowledge and understanding of tax policy, taxpayers become more aware and conscientious. Similarly, the paper of Alexander and Balavac-Orlic (2022) suggests that financial and tax knowledge enhances the effect of fairness on tax morale by increasing the influence of perceived fairness. For individuals with high financial and tax literacy, the perception of a fair tax system significantly increases tax morale. Conversely, perceived fairness has only a minor influence on tax morale among people with lower financial literacy. An improvement in tax and financial literacy can therefore have a positive effect on tax morale. This paper examines the influence of financial and tax knowledge on tax morale. Although financial knowledge has been extensively studied in the literature, tax knowledge has rarely been investigated.

Several works deal with tax evasion and tax morale in Croatia. Bejaković (2009) emphasized that tax evasion is a major challenge for transition countries such as Croatia. The author pointed out that a culture of tax morale and compliance among taxpayers is essential for effective tax collection. He considers strengthening the rule of law, improving the institutional framework and promoting transparency to be the most important steps in combating tax evasion, building trust and increasing tax morale. Blažić and Štambuk (2019) used data from a survey in which 352 people took part in 2016 to present the views of Croatian citizens on various aspects of the tax system and compared them with the opinions of tax experts. In general, the authors concluded that there are differences in opinion between citizens and tax experts regarding the tax system, with citizens showing stronger support for certain tax measures based on personal interests. Bejaković and Bezeredi (2019) collected data in 2,000 personal interviews between August 20 and October 9, 2015 and showed that in Croatia, factors such as gender, age, financial standing, region of residence and involvement in informal economic activities have a significant influence on individuals' attitudes towards paying taxes. The study found that women, older people and people who are not in financial difficulties tend to have higher tax morale.

Paleka, Badulescu and Karanović (2022) examined the determinants of tax compliance in Croatia in an empirical study of 862 Croatian taxpayers. They

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confirmed the crucial role of tax morale in tax compliance and recommended focusing efforts on improving taxpayers' tax morale as a preventive measure and an integral part of a tax strategy. In addition, specific economic and political factors in Croatia, such as the low efficiency of the public sector and the lack of trust in the government, were identified as important factors in reducing tax evasion. The authors suggested that educating citizens about the importance and function of taxes in society would be an effective starting point from which to minimize tax avoidance and evasion. In addition, strong social norms were found to have an impact on tax compliance, suggesting that robust subjective norms can have a positive impact on compliance. Finally, high tax complexity was identified as a contributing factor to taxpayer noncompliance, and suggestions were made for better education and simplification of tax laws to address this issue. Finally, Paleka and Vitezić (2023) conducted a study using 299 valid questionnaires in Croatia from April to May 2021 to identify different clusters of taxpayers based on factors such as tax audits, tax rates, complexity of the tax system, tax morale, social norms and perception of fairness. These clusters were categorized as "extrinsically motivated", "morally committed", "financially motivated" and "socially committed" taxpayers, illustrating the different motivations for tax compliance. The results show that taxpayers are not a homogeneous group and are driven by different mechanisms to fulfil their tax obligations, mainly by factors such as economic considerations and psychological factors.

2.2 DETERMINANTS OF STUDENTS' TAX MORALE

The study of tax morale and tax evasion among university students can reveal the influence of various factors on tax attitudes and help address specific tax morale issues to promote positive attitudes toward tax obligations among future taxpayers. There are several papers that have examined the determinants of tax morale in students. Cummings et al. (2009) focused on the effects of cultural norms and social factors on tax compliance behaviour using artifactual field experiments, survey data, and laboratory experiments. The authors examined how the quality of governance and cultural differences influence tax compliance decisions in different countries, particularly in Botswana and South Africa. Approximately 30 percent of the sample were members of the university, either staff or students. The study found that tax compliance behaviour is influenced by individual perceptions of good governance, with tax morale playing an important role in improving compliance. Molero and Pujol (2012) found that grievance factors, such as perceived high tax pressure and inefficiency of public sector administration, significantly influence individuals' justifications of tax evasion. However, control variables such as gender and parental education level showed no clear relationships with tax morale in relation to tax evasion justification. Their sample consisted of 617 undergraduate students from the University of Navarra. Göksu and Sahpaz (2015) investigated the effects of education on tax morale among students at Sakarya University in Turkey and the University of Zaragoza in Spain. They found that religious beliefs played a role in shaping attitudes towards tax evasion, with a significantly higher percentage of participants at Sakarya University believing in line with their religious convictions that tax

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evasion was a sin. It was also found that opinions on the fairness of the tax system and the justification of tax evasion differed. While a higher percentage of participants at the University of Zaragoza believed that tax evasion is justified if the tax system is unfair, a lower percentage of participants at the University of Sakarya shared this opinion. Furthermore, the majority of students at both universities consider tax evasion to be a form of theft. Sarasa and Sarasa-Pérez (2016) find that gender has no significant influence on attitudes towards tax honesty among university students in Spain. Instead, the study emphasizes that knowledge of the tax system plays a key role in shaping students' tax awareness and tax compliance. Both male and female students were found to have similar levels of tax knowledge, which has a direct impact on their tax morale.

McGee and Shopovski (2018) examined the ethics of tax avoidance based on a survey of 107 law and economics students in the Republic of Macedonia. Their results show that a significant proportion of students (45.3%) do not justify tax evasion in any of the 18 cases presented, suggesting that Macedonian students do not tolerate tax evasion and perceive it as unethical behaviour. Nevertheless, 54.7% justify tax evasion to some extent, which suggests that a significant proportion of students approve of tax evasion to varying degrees depending on the situation. In addition, the study found that there are differences in attitudes towards tax evasion depending on gender and field of study. Male students were more tolerant of tax evasion than their female peers, and law students were more supportive of tax evasion than economics students.

Batrancea et al. (2019) investigated the role of trust and the power of authorities in influencing tax compliance behaviour. The study included 14,509 undergraduate and graduate students from 44 countries on five continents. Most of the students were studying Economics and Business Administration and were between 18 and 25 years old. The study found that trust in authorities and the power of authorities significantly influence tax compliance behaviour worldwide. High levels of trust and power lead to higher levels of compliance and lower levels of tax evasion, with trustworthy authorities encouraging voluntary compliance. According to the authors, the interaction between trust and power plays a crucial role, suggesting that the influence of power on compliance is stronger in high-trust situations.

Cirman, Pahor and Starček (2021) concluded that short educational programmes have a significant impact on increasing tax morale and tax compliance among young taxpayers, especially primary and secondary school pupils. They also found that tax morale decreases slightly with age, while background factors such as household wealth and parental employment status, especially if parents are self-employed, negatively affect tax compliance. Ciziceno (2024) concludes that the determinants of tax morale differ significantly between generations Y and Z, with factors such as gender, education, religion and trust in public institutions playing a different role in these cohorts.

3 DATA AND METHODOLOGY

3.1 RESEARCH INSTRUMENT AND DATA

A structured questionnaire was created for university students in the field of economics. It consisted of several sections focusing on personal attitudes towards taxes, i.e., tax morale, trust in institutions, perceptions of the fairness of the tax system and basic demographic questions. Participation was voluntary and anonymous. The questionnaire was distributed online to Croatian students of economics from January to February 2025. The sample consisted of 770 students. Their demographic information is given in table 1.

Table 1

Demographic information

Item	Frequency (N=770)	Percentage
Gender		
Male	242	31.4
Female	528	68.6
Place of birth		
City	323	41.9
Municipalities on the coast	321	41.7
Municipalities inland	126	16.4
Region		
Zagreb and Northern Croatia	69	9.0
Slavonia	120	15.6
Gorski Kotar, Istria and Primorje	45	5.8
Dalmatia	473	61.4
Lika and Banovina	8	1.0
Outside Croatia	55	7.1
Type of studies		
Undergraduate	574	74.5
Graduate	174	22.6
Integrated	16	2.1
Postgraduate	6	0.8
Household income		
< 1,500 €	134	17.4
1,501 € – 2,500 €	309	40.1
2,501 € – 3,500 €	182	23.6
> 3,500 €	145	18.8
Financial knowledge		
Low	445	57.8
Good	118	15.5
Very good	114	14.8
Excellent	93	12.1
Tax knowledge		
Low	577	75.0
Good	108	14.0
Very good	77	10.0
Excellent	8	1.0

Source: Author's calculations.

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TABLE 2

Multi-items and single-items in the model

Tax moral (TMO)		**Mean**	**St. dev.**
TMO1	It is important to me to pay my fair share of taxes.	3.83	1.13
TMO2	I would feel guilty if I evaded taxes.	3.51	1.41
TMO3	I think paying taxes is a civic duty.	1.02	1.11
TMO4	I do not consider it acceptable that small businesses, in order to survive, pay their workers part or all of their wages in cash, i.e., without paying taxes and contributions.	3.15	1.28
TMO5	I have never knowingly participated in any form of tax evasion (such as receiving part of my salary in cash, undeclared work, smuggling, or paying without a receipt).	3.51	1.52
Religiosity (REL)			
REL1	How important is religion in your life?	3.75	1.32
REL2	How religious are you?	3.56	1.25
REL3	How important is God in your life?	4.00	1.31
REL4	Except for weddings and funerals, how often do you go to church?	2.87	1.23
Politics (POL)			
POL1	What is your political orientation? (1-left, 5-right)	3.08	1.07
POL2	What kind of a role does the government have in the economy? (1-big, 5-small)	2.66	1.14
POL3	Do you support the current Croatian government?	2.33	1.11
POL4	I don't support the right to abortion.	2.68	1.57
Trust in institutions (TRUST)			
TRUST1	I trust the national government to responsibly manage public funds.	2.26	1.01
TRUST2	I trust public institutions in Croatia.	2.51	1.01
TRUST3	I believe that my tax money is effectively used for public services (e.g., health, education, infrastructure)	2.37	1.06
TRUST4	Corruption rate in Croatia is low.	2.05	1.23
Perception of the fairness of the tax system (FAIR)			
FAIR1	I think the tax system in Croatia is fair.	2.36	0.95
FAIR2	I think that the tax burden is fairly distributed among all citizens.	2.23	0.94
FAIR3	I think wealthy individuals and large corporations pay their fair share of taxes.	2.28	1.00
FAIR4	Current tax rates are not too high for me/my family.	2.52	1.08
Social norms (SNO)			
SNO1	It is acceptable for people to evade taxes if they have the opportunity.	2.12	1.27
SNO2	People in my community often avoid paying taxes.	2.40	1.23
SNO3	I don't feel pressure in my environment to comply with tax laws.	2.82	1.17
SNO4	I don't believe others would report someone who evades taxes.	3.21	1.24
Single-items			
FIN	Financial knowledge (0-7)	3.73	2.24
TAX	Tax knowledge (0-7)	3.01	1.88

Source: Author's calculations.

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It is important to emphasize that the results of financial and tax knowledge were disappointing. Financial and tax knowledge were tested with 7 separate questions each. For each correct answer, students receive one point, meaning that the possible score for each domain ranged from 0 to 7 points. 57.8% of economics students have relatively poor financial knowledge, i.e., 0 to 4 points, 15.3% have good, 14.8% very good and only 12.1% excellent financial knowledge. Students' tax knowledge is even worse. 75% of economics students have relatively low tax knowledge, i.e., 0 to 4 points, 14% have good tax knowledge, 10% have very good tax knowledge and only 1% of them have excellent tax knowledge.

The main part of the questions relates to the factors that influence students' tax morale. The questions were presented in the form of statements measuring students' attitudes towards taxes, i.e., tax morale (TMO), politics (POL), trust in institutions (TRUST), perception of the fairness of the tax system (FAIR), social norms (SNO) and religious feeling (REL), mostly on a 5-point Likert scale (1= strongly disagree, 5= strongly agree). In addition, financial and tax knowledge are included in the model as individual items representing the students' knowledge, i.e., the correct answers to financial and tax questions. They represent the items for further structural modelling and are listed in table 2.

3.2 METHODOLOGY

First, the preliminary assessment of the scales was carried out using exploratory factor analysis for all items in order to interpret the factor structure in IBM SPSS. Bartlett's test ($\chi 2 = 7706.24$, p-value < 0.00) and the Keiser-Meyer-Olkin measure of sampling adequacy (0.853) supported the factorability of the item set and indicated sampling adequacy. Principal component analysis and the Varimax rotation with Kaiser normalization technique were used to identify the underlying dimensions of the constructs (Perica, 2021). The Kaiser rule was used to identify six factors corresponding to tax morale (TMO), politics (POL), trust in institutions (TRUST), perception of fairness of the tax system (FAIR), social norms (SNO), and religiosity (REL). The solution explained 59.39% of the variance in the data. All items loaded on the corresponding factors with factor loadings greater than 0.5.

The PLS-SEM model is further estimated in R Studio with the package "SEMinR" (Hair et al., 2021). The advantages of using the PLS-SEM model are: the assumption of multivariate normality of data is not required; it can effectively handle both larger and smaller samples; it has the ability to treat constructs with only one item; it provides greater statistical power, making it suitable for theory development in exploratory research (Vuković, 2024). In the first step, the measurement model is examined, including model fit measures, analysis of convergent validity using average variance extracted (AVE), and reliability using Cronbach's alpha and composite reliability (Hair et al., 2019). Discriminant validity is assessed using the Fornell and Larcker (FL) criterion and the heterotrait-monotrait (HTMT) ratio of correlations. In the FL criterion, the correlations between the constructs are compared with the square root of the AVE for each construct. This is because a construct should explain the variance of its own indicators better than that of the

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indicators of other constructs (Hair et al., 2019; Vuković and Pivac, 2021). The HTMT, on the other hand, calculates "the ratio of correlations between traits to correlations within traits" (Hair et al., 2017), i.e., it compares the correlations of indicators measuring different constructs with the correlations of indicators measuring the same construct. Therefore, lower HTMT values are preferable.

In the second step, the structural model is evaluated, i.e., the strength, direction and significance of the structural paths. To determine the significance of the paths, PLS-SEM requires a bootstrapping procedure (Hair et al., 2021). Bootstrapping is performed with 1,000 subsamples and a seed is set to 1 to obtain reproducible results.

4 RESULTS

The number of iterations required for the PLS-SEM algorithm to converge is 6. The results in table 3 show the validity and reliability analysis of the model.

TABLE 3

Validity and reliability analysis of the model

	Loading	Cronbach's α	rho_c	AVE	rho_A
REL1	0.945	0.933	0.952	0.832	0.945
REL2	0.941				
REL3	0.906				
REL4	0.855				
POL2	1	1	1	1	1
TRUST1	0.890	0.862	0.916	0.784	0.863
TRUST2	0.887				
TRUST3	0.879				
FAIR1	0.904	0.783	0.902	0.822	0.786
FAIR2	0.910				
SNO1	1	1	1	1	1
TMO1	0.856	0.777	0.870	0.691	0.780
TMO2	0.829				
TMO3	0.809				
FIN	1	1	1	1	1
TAX	1	1	1	1	1

Note: Since the loadings for TRUST4, FAIR3, FAIR4, TMO4, TMO5 were lower than 0.708, they were excluded from the model. Namely, as indicated in Hair et al. (2021), "indicator loadings above 0.708 are recommended, since they indicate that the construct explains more than 50 percent of the indicator's variance, thus providing acceptable indicator reliability." Additionally, only POL2 and SNO1 are selected since the constructs' reliability was not sufficient.

Source: Author's calculations in R.

All indicator loadings of the reflectively measured constructs REL, TRUST, FAIR and TMO are above the threshold value of 0.708 (Hair et al., 2019). To assess the composite reliability of the construct measures, rho_A. rho_c and Cronbach's α are calculated. To be considered reliable, they should be above 0.7. All reflectively measured constructs have a high internal consistency reliability, as their rho_A is greater than 0.7. Similarly, the results for Cronbach's α and composite reliability

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rho$_c$ are above the threshold of 0.70 (Hair et al., 2019), indicating that all construct measures are reliable. Internal consistency reliability values of 1 for POL2, SNO1, FIN and TAX cannot be interpreted as an indication of perfect reliability. This is because these are single items, so that their internal consistency reliability is 1 by definition. The assessment of convergent validity is based on the values of the average variance extracted (AVE), which should be above 0.5. In this example, the AVE values of REL (0.832), TRUST (0.784), FAIR (0.822) and TMO (0.691) are above the required minimum value of 0.5. In summary, the measures of the four reflectively measured constructs have a high degree of convergent validity.

Table 4
Fornell-Larcker criterion

	REL	POL	TRUST	FAIR	SNO	FIN	TAX	TMO
REL	0.912							
POL	0.065	1						
TRUST	0.194	-0.004	0.885					
FAIR	0.146	-0.008	0.566	0.907				
SNO	0.006	0.084	-0.029	-0.001	1			
FIN	-0.087	-0.053	-0.101	0.005	0.013	1		
TAX	-0.035	-0.014	-0.058	0.031	-0.046	0.568	1	
TMO	0.120	-0.115	0.192	0.117	-0.424	-0.067	0.030	0.831

Source: Author's calculations in R.

Table 5
HTMT criterion

	REL	POL	TRUST	FAIR	SNO	FIN	TAX	TMO
REL								
POL	0.069							
TRUST	0.215	0.020						
FAIR	0.165	0.010	0.689					
SNO	0.020	0.084	0.032	0.022				
FIN	0.089	0.053	0.108	0.052	0.013			
TAX	0.045	0.014	0.063	0.041	0.046	0.567		
TMO	0.136	0.133	0.233	0.152	0.481	0.086	0.035	

Source: Author's calculations in R.

In order to assess the discriminant validity, the Fornell-Larcker (FL) criterion in table 4 is examined first. Accordingly, the square root of the AVE of each reflectively measured construct, i.e., REL (0.912), TRUST (0.885), FAIR (0.907), and TMO (0.831), are all higher than the correlations of these constructs with other latent variables in the PLS-SEM path model. Second, as the FL criterion performs poorly in detecting discriminant validity issues (Hair et al., 2019), the HTMT criterion is still used. All HTMT values (table 5) are significantly lower than the more conservative threshold value of 0.85. A less conservative threshold value would be 0.9. As all important requirements for validity and reliability are met, this reflective measurement model is suitable for further PLS-SEM analyses.

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To analyse the significance and relevance of the indicator weights, a bootstrapping procedure is required next. The bootstrapped PLS-SEM model is shown in figure 1, while the structural weights are listed in table 6. All loadings of the indicators are higher than 0.705. Therefore, all reflective and formative constructs have satisfactory levels of measurement quality and we can proceed with the evaluation of the structural model.

All path coefficients are statistically significant (table 6, figure 1), with the exception of perceived fairness (FAIR). Trust in institutions (TRUST) and social norms (SNO) are statistically significant at a 1% significance level, while politics (POL) and religion (REL) are significant at a 5% significance level. Financial knowledge (FIN) and tax knowledge (TAX) are statistically significant at a significance level of 10%. Religion (REL), trust in institutions (TRUST) and tax knowledge (TAX) have a positive influence on tax morale (TMO). This means that higher trust in institutions (TRUST), higher religious sentiment (REL) and higher tax knowledge (TAX) of students positively influence tax morale among them. The path coefficient for trust in institutions (0.148) indicates that, *ceteris paribus*, tax morale increases by 0.148 standard deviation units when trust in institutions increases by one standard deviation unit.

Table 6

Bootstrapped structural paths

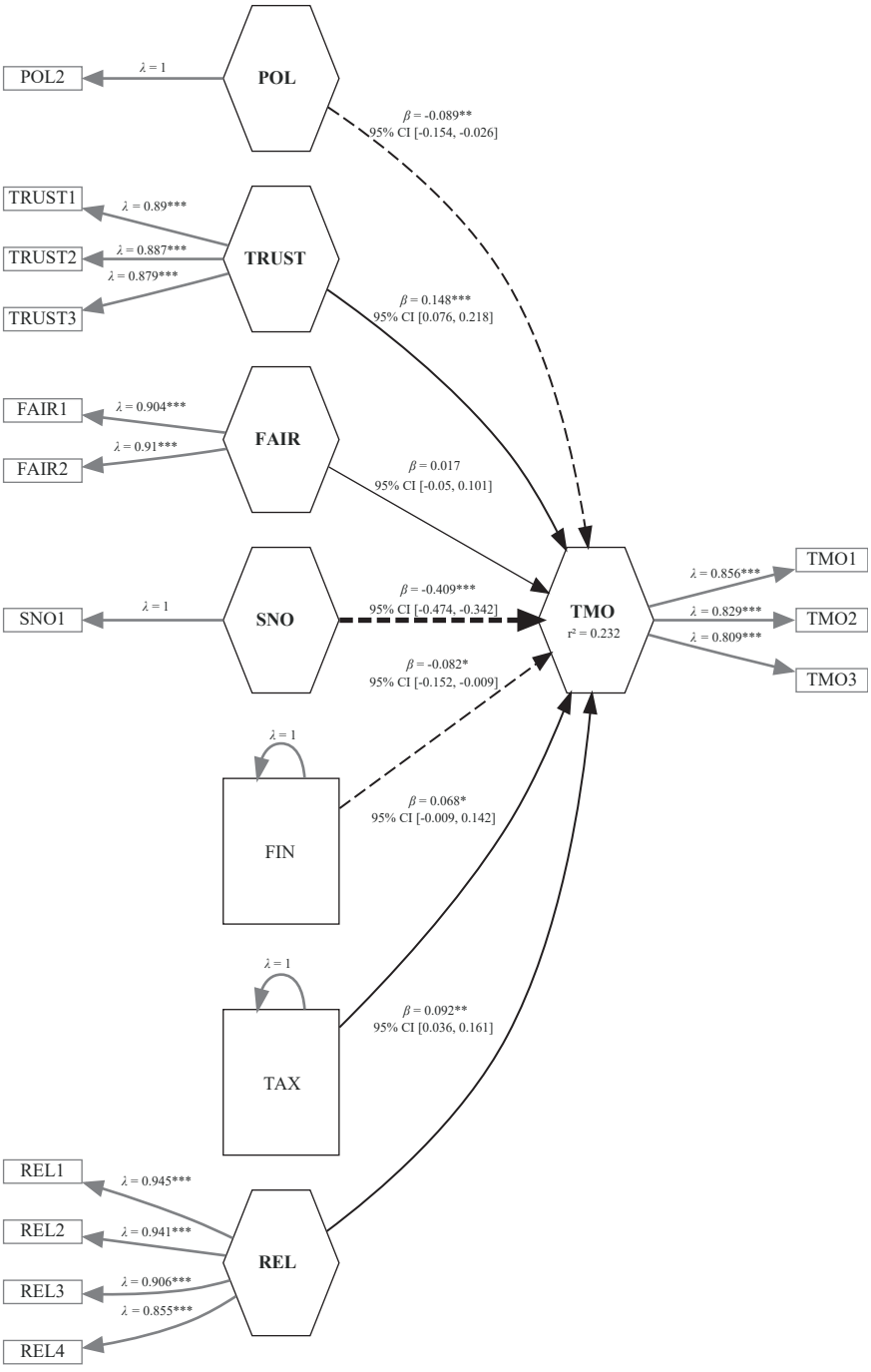
TMO	Path coefficient	t-statistics	Effect size	VIF
REL	0.092**	2.939	0.011	1.051
POL	-0.089**	-2.610	0.010	1.015
TRUST	0.148***	3.980	0.019	1.552
FAIR	0.017	0.447	0.001	1.486
SNO	-0.409***	-11.966	0.214	1.013
FIN	-0.082*	-2.210	0.004	1.504
TAX	0.068*	1.707	0.001	1.487

*Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Source: Author's calculations in R.

In contrast, politics (POL), social norms (SNO) and financial knowledge (FIN) have a negative influence on tax morale. However, this should be elaborated more thoroughly. If the student believes that the government should play a smaller role in the economy, he or she will have a lower tax morale, while if the student believes that the government should play a larger role in the economy, he or she will have a higher tax morale. In addition, social norms (SNO) in this case indicate that students who believe that it is acceptable to evade taxes if they have the opportunity to do so will have lower tax morale and vice versa. On the other hand, financial knowledge has a negative impact on tax morale, i.e., if financial knowledge increases by one standard deviation unit, tax morale decreases by 0.082 standard deviation units, *ceteris paribus*. The effect sizes in table 6 show that social norms, religion, trust and politics have the greatest influence on tax morale. In addition, the construct scores of the predictor constructs in each regression of the structural model are used to calculate the values of the variance inflation factor (VIF). All values are below the threshold of 5 and the more conservative threshold of 3, indicating that there is no multicollinearity problem in the structural model.

FIGURE 1
Bootstrapped PLS-SEM model



Note: Using bootstrapping with 1,000 subsamples.
Source: Author's calculations in R.

Table 7

PLS multigroup (MGA) analysis

	N	REL	POL	TRUST	FAIR	SNO	FIN	TAX
Gender								
Male	242	0.074	-0.088	0.111	0.062	-0.403	-0.004	0.091
Female	528	0.107	-0.088	0.165	-0.007	-0.402	-0.131	0.067
Significance							*	
Revenue								
High	145	0.051	-0.025	0.241	-0.093	-0.482	-0.200	0.116
Low	625	0.105	-0.101	0.130	0.034	-0.388	-0.061	0.064
Significance								
Age (>=23)								
Older	217	0.083	-0.036	0.133	0.119	-0.504	-0.105	0.100
Younger	553	0.105	-0.121	0.157	-0.022	-0.362	-0.073	0.035
Significance					**			
Place of birth								
Bigger town	323	0.135	-0.084	0.091	0.021	-0.308	-0.133	0.043
Municipality or smaller town	447	0.071	-0.081	0.175	0.027	-0.483	-0.049	0.078
Significance						***		
Region								
Dalmatia	473	0.112	-0.092	0.184	0.031	-0.377	-0.055	-0.008
Other	297	0.087	-0.084	0.085	0.011	-0.446	-0.112	0.164
Significance								
Region								
Zagreb and North Croatia	69	-0.064	0.177	0.335	0.027	-0.434	-0.067	0.301
Other	701	0.091	-0.111	0.165	-0.002	-0.403	-0.084	0.044
Significance			**					**
Do you support the current Croatian government?								
Yes	95	0.119	-0.164	0.267	0.051	-0.212	-0.056	0.129
No	675	0.095	-0.074	0.122	0.013	-0.436	-0.081	0.055
Significance				*		**		
What is your political orientation?								
Right	209	0.083	-0.127	0.151	0.042	-0.449	-0.144	0.046
Left and centre	561	0.103	-0.071	0.141	0.002	-0.386	-0.047	0.078
Significance								

*Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Source: Author's calculations in R.

To estimate the influence of other demographic characteristics on tax morale, a PLS multigroup analysis (MGA) is performed in R (table 7). Gender (1-male, 2-female), family income (1-high, 2-low), age (1-older, 2-younger), place of birth (1-large city, 2-municipality of smaller town), regions (Dalmatia vs. other, Zagreb and Northern Croatia vs. other), support for the current government (1-Yes, 2-No) and political orientation (1-Right, 2-Left and Centre) are taken into account. Dummy variables are initially created for all variables except for gender. PLS-MGA is performed to report significance of path differences between two sub-groups of data.

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The results show that there is no statistically significant difference in the path coefficients among students of different income classes, in terms of their political orientation and taking into account the region in which they were born and raised. The path coefficient for female students is significantly lower than the male coefficient only for financial knowledge, while older students exhibit a significantly higher influence of perceived fairness on tax morale. For students born and raised in municipalities and smaller cities, the influence of social norms on tax morale is significantly higher. Students from Zagreb and Northern Croatia have a positive path coefficient for politics, i.e., the greater the role of the government in the economy, the higher the tax morale. They also show a much higher positive influence of tax knowledge on tax morale than those from the rest of the country. Although there is no significant difference between the path coefficients for students' political orientation, students who support the current Croatian government show a much lower influence of social norms on tax morale, while on the other hand they exhibit a much higher influence of trust on tax morale.

5 DISCUSSION

The sample of university students used in this study can be considered broadly representative of the Croatian student population due to following factors. First, the sample includes students from different institutions, thus capturing differences in educational background, socioeconomic status and geographical origin. This diversity reflects the structural composition of the national student body, which is spread across a network of public universities and faculties. Second, the sample includes students from different years of study, ensuring that attitudes are not limited to a single level of education, but span different levels of academic maturity and exposure to institutional knowledge.

To interpret the results of this study, we reconcile them with the theoretical framework underlying tax morale. In particular, we draw on state reciprocity theory, moral alignment theory, and the influence of demographic, institutional, and educational factors on tax morale.

This study found that trust in institutions positively influences the tax morale of university students. This finding is consistent with state reciprocity theory, which says that trust in government institutions strengthens the perceived social contract (Robbins and Kiser, 2020). Students who believe that public funds are managed responsibly exhibit higher tax morale, as shown by the positive path coefficient for institutional trust. Interestingly, the perceived fairness of the tax system did not have a statistically significant impact on tax morale. This is in contrast to previous research (e.g., Torgler and Schaltegger, 2005; Luttmer and Singhal, 2014), which emphasises fairness as a crucial determinant of tax morale. One possible explanation is that university students, many of whom are not yet taxpayers, may not have direct experience of taxation and therefore have limited perceptions of fairness.

The study also found that political orientation influences tax morale (Robbins and Kiser, 2020). In particular, students who favour a greater role for the state in economic affairs exhibit higher tax morale. This finding is consistent with moral

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alignment theory, which states that individuals who are ideologically aligned with government policy are more likely to comply with tax norms. Regional differences were also found, with students from Zagreb and Northern Croatia showing a strong positive influence of political orientation on tax morale compared to other regions. This variation could reflect differences in local government structures or political ideologies (Bejaković and Bezeredi, 2019).

Consistent with previous research (e.g., Göksu and Sahpaz, 2015; Islam et al., 2020), religion was found to positively influence tax morale. Religious beliefs often promote ethical behaviour and discourage actions such as tax evasion, which could explain this relationship.

The study found mixed effects of financial and tax knowledge. While tax knowledge was positively associated with tax morale, financial knowledge showed a negative influence. One possible explanation for this is that financially literate students are more aware of inefficiencies or loopholes in the tax system, leading to scepticism about compliance (Alexander and Balavac, 2022). Those students with higher levels of financial knowledge tend to be more sensitive about how public money is spent and are more critical of government inefficiencies, corruption or perceived misuse of taxpayers' money. Therefore, if students believe that their tax money is not being used effectively, their trust in public institutions, and therefore their intrinsic motivation to comply, may be undermined. Another possible explanation is that greater financial knowledge is associated with a rational cost benefit analysis in relation to tax compliance. This may lead to a more calculated approach where the perceived risks and penalties of non-compliance are weighed against the potential gains, thereby reducing the influence of normative obligations to tax compliance. These findings highlight the importance of targeted educational initiatives that improve both technical knowledge and ethical awareness in relation to taxation.

Social norms were found to have a seemingly negative sign of influence; however, a closer analysis revealed a positive influence on tax morale. In particular, students who believed that tax evasion is unacceptable showed higher tax morale. This highlights the importance of promoting strong societal norms against tax evasion through education and public awareness campaigns. In addition, students from smaller cities showed greater sensitivity to social norms than students from larger cities, which may be due to the greater social cohesion in smaller communities.

In summary, the study's findings are consistent with key theoretical frameworks while providing nuanced insights into the demographic, institutional, and educational factors that influence university students' tax morale. By incorporating these findings into policy and curriculum design, governments can foster a culture of compliance among future taxpayers, ultimately contributing to more effective and equitable tax systems.

To support these goals, it is important to improve tax education through a comprehensive approach. Tax education should be integrated into formal curricula, particularly in secondary and higher education, to ensure early and consistent

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exposure to these concepts (Cirman, Pahor and Starček, 2021; Ciziceno, 2024). In addition, it is crucial to focus on trust and transparency by clearly explaining how tax revenues are used and involving tax authorities in educational efforts, thus strengthening the credibility of institutions. For example, collaboration between the Ministry of Finance, schools, and the academic community can provide age-appropriate tax education. Such a program would not only improve technical understanding, but also emphasize civic engagement and trust in public institutions and help foster a strong culture of voluntary tax compliance from an early age.

6 CONCLUSION

The aim of this study was to identify the most important determinants of tax morale among university students in Croatia. Demographic factors, trust in government institutions, perceived fairness of the tax system, political and religious views, and financial and tax knowledge were taken into account. Using a partial least squares structural equation modelling (PLS-SEM) approach, our results reveal several important findings. Trust in institutions, religious background, and tax knowledge positively influence students' tax morale. In contrast, politics, social norms, and financial knowledge negatively influence tax morale. Higher financial knowledge lowers tax morale, while students who believe that the state should have a greater influence on the economy have higher tax morale. Additionally, social norms in this case indicate that students who believe that it is acceptable to evade taxes if they have the opportunity to do so have lower tax morale and vice versa. A general lack of tax knowledge among students was found, highlighting the need for initiatives to improve tax education. These findings contribute to the existing literature on tax morale and offer several policy implications. Enhancing institutional trust and improving perceptions of fairness in the tax system could significantly increase the tax morale of future taxpayers. Targeted tax education programs should be developed that focus on both technical aspects of taxation and ethical considerations. Policy makers should consider regional and demographic differences when developing strategies to improve tax morale. The government should demonstrate responsible and transparent budget spending to foster a sense of civic duty and fidelity to the law among students as future taxpayers. To effectively improve tax morale, it is critical that the government demonstrate rational and responsible behaviour in its budget spending. Students who see that their future tax contributions will be spent wisely and efficiently on quality public services are more likely to develop a strong sense of civic duty and compliance with the law. This research underscores the multifaceted nature of tax morale and the importance of considering both structural aspects of the tax system and taxpayer behaviours. By focusing on transparency, fairness and effective public service delivery, governments can promote a culture of compliance that ultimately benefits society as a whole. Future research could examine the long-term effects of tax education on tax morale as students become tax-paying adults, and the impact of evolving digital technologies on younger generations' attitudes towards tax honesty.

Disclosure statement

The authors have no conflicts of interest to declare.

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