Public Sector Economics

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Do increases in public sector wages affect inflation?

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Abstract

After the pressures from rising energy and food prices subsided, wage increases became the primary risk to inflation. Given concerns that substantial wage growth in the public sector during Croatia's 2024 election year could create additional inflationary pressures, this paper estimates the potential impact of public sector wage growth on overall inflation using BVAR models. The analysis finds that while the direct impact of 0.15 pp is negligible, there may be a stronger indirect effect. Depending on the assumed (side) effects of public sector wage growth on aggregate demand and the extent of wage spillover to the private sector, the indirect effect of public sector wage growth on inflation could range from 0.34 to 0.88 percentage points. However, considering the double-digit wage growth, it can be concluded that the estimated total contribution of 0.5 to 1 basis points from public sector wage growth is relatively modest.

Keywords: public sector wage growth, inflation, transmission of wages to inflation, BVAR model, Croatia
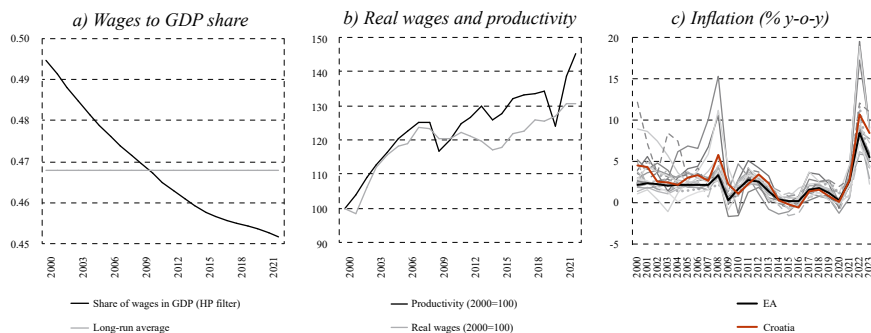
1 INTRODUCTION

After a prolonged period of low and stable inflation, toward the end of 2021 inflationary pressures began to rise globally as well as in Croatia. These pressures, primarily driven by surges in global food, energy, and raw material prices, along with supply chain disruptions, peaked in the second half of 2022, when Croatia's annual inflation rate surpassed 12% – a level not seen since the implementation of the last stabilization program. Although this spike in inflation eroded real wages, they started to recover in 2023, as nominal wage growth began catching up with inflation. While such a recovery often follows a significant decline in real wages, the marked acceleration in wage growth has raised concerns about its potential impact on inflation, especially given that labour costs constitute a substantial portion of total production costs. Consequently, as external inflationary pressures have subsided, the unprecedented rise in nominal wages has emerged as a primary inflation risk (Ivanac, Kunovac and Nadoveza, 2024). This not only poses challenges for economic policymakers, particularly in the realm of monetary policy, but could also have broader social and economic impacts. While some have argued that the recent wage increases were merely compensating for prior losses in real wages[1], given that the share of wages in GDP has long trended below the long-term average (graph 1a) and that real wages have been growing more slowly than labour productivity (graph 1b). However, others were concerned that such a significant rise in wages could further accelerate the already high inflation rate[2], which is among the highest in the euro area (graph 1c).

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[1] For instance Index argued that in 2022 labour costs (nominal wages) were increasing but that simultaneously real wages were decreasing (see Perković, 2022). From the context of the argumentation it is clearly implied that substantial nominal wage growth at the time (7.5% yearly) was not enough to offset inflation, the suggestion being that more nominal wage growth is required.

[2] During the periods of elevated inflation, particularly in the first half of 2023, concerns arose about the potential for a wage-price spiral. For instance, the Croatian Employers' Association cautioned that robust wage growth "raises the risk of a wage and retail price spiral" (---, 2024). This risk was taken seriously amid strong price increases, as reflected in remarks by key central bank figures. Notably, ECB President Christine Lagarde addressed the issue in a 2023 speech (ECB, 2023), and CNB Governor Boris Vujčić noted in 2024 that inflationary pressures had been contained before a wage-price spiral could take hold (CNB, 2024a).

GRAPH 1

Wages, productivity and inflation

a) Wages to GDP share *b) Real wages and productivity* *c) Inflation (% y-o-y)*

— Share of wages in GDP (HP filter)   — Productivity (2000=100)   — EA
— Long-run average   — Real wages (2000=100)   — Croatia

Note: Prices are measured by the Harmonized Index of Consumer Prices (HICP). Wages are measured by compensation of employees per employee from national accounts statistics, productivity is calculated as the ratio of real GDP to the number of employees from national accounts. Source: Eurostat.

Before the first estimates of the impact of the sharp rise in total wages on inflation and the inflation differential (which began to ease in late 2023 and early 2024) were published, the decision to implement a substantial wage increase as part of the civil and public service wage reform reignited discussions about the potential inflationary effects of rapid wage growth[3]. According to the government document titled Reform in Numbers (Government of RC, 2024), this reform affects 244,000 state and public service employees, aiming to streamline and equalize job classifications by merging roles of similar complexity based on evaluations and reducing the number of job titles. Of the five phases in this reform, the most relevant here is the 15% wage increase resulting from coefficient adjustments effective from March 2023.

Public sector wage growth can impact inflation through several channels. The direct effect stems from a possible rise in public service prices, driven by higher employee costs, as labour compensation accounts for over 80% of the gross value added (GVA) in the public sector[4], according to Eurostat's national accounts data. This is significantly higher than the average employee compensation share of approximately 50% in other sectors. However, this direct impact is likely small because (a) public sector prices are mostly set outside the market, making the pass-through of wage growth to public service prices lower than in other sectors, and (b) services that consumers purchase directly from the public sector represent a small portion of the overall consumer basket. Nonetheless, substantial wage increases in the public sector may create inflationary pressures indirectly by increasing the aggregate demand of public sector employees and potentially influencing private sector wages. The size of this indirect effect will depend on the proportion of public sector employment within the economy and the degree of wage spillover from the public to the private sector. Thus, a larger public sector could amplify these indirect inflationary effects.

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[3] For instance in Lider (---, 2024b) and HRT (see: Kovaček, 2024).
[4] Which includes public administration and defence services; compulsory social security services (O), education services (P), and human health services (Q).

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This paper seeks to estimate both the direct and the indirect inflationary effects of public sector wage growth using a methodology based on Bayesian VAR models with sign and zero restrictions on impulse response functions, which approximate the standard wage-setting (WS) and price-setting (PS) model. By employing this established approach to analyse the impact of wage growth on prices, the paper contributes to academic literature by introducing a novel framework for identifying and examining the direct and indirect effects of public sector wage growth on inflation. Additionally, the paper adds to the ongoing policy and economic debate regarding the potential inflationary impact of exceptionally high wage increases in the public sector.

Analysis of the results of model estimates based on data for Croatia from 2004 to 2023 shows that wage growth in the public sector has a negligible direct but a relatively strong potential indirect impact on overall inflation. Thus, wage growth in the public sector increases the total inflation rate through the direct channel by approximately 0.15 percentage points. The negligible direct effect is mostly the result of the small share of public sector services in the consumer basket. On the other hand, it is estimated that the total indirect impact on inflation could be relatively strong and amount to between 0.34 and 0.88 percentage points, depending on the assumed contribution of wage growth in the public sector to total aggregate demand and the extent of spillover of wage growth in the public sector to the private sector. However, it is important to emphasize that considering the assumptions about the spillover of wage growth to the private sector and aggregate demand, bearing in mind that this wage growth is in the double digits, we can conclude that the estimated total contribution of wage growth in the public sector of 0.5 pp – 1 pp is relatively low. However, despite the relatively low estimated contribution of wage growth in the public sector to inflation, these results should be interpreted with caution, since empirical assessment of the impact of wage growth on inflation is inherently complex. That is, apart from the fact that the relationship between wages and prices is bidirectional (Conti and Nobili, 2019; Ivanac, Kunovac and Nadoveza, 2024), its strength and direction depend on the nature of the shocks affecting the economy (Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; Ivanac, Kunovac and Nadoveza, 2024), so it is difficult to estimate empirically the real causal effect of wage growth on prices – even without additional assumptions regarding the potential effects of public sector wage growth on aggregate demand and private sector wages.

The remainder of the paper is organized as follows: section 2 provides a summary of the relevant theoretical and empirical literature. Section 3 outlines the data and methodology used to assess the effects of public sector wage growth on inflation. Section 4 presents the empirical results, and section 5 discusses the main conclusions and limitations of the estimates provided in the paper.

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The impact of wages on inflation is one of the most widely researched topics in economics because of its relevance to economic policymakers and its significant effects on individuals' purchasing power, as well as on companies' production costs. However, studies specifically addressing the influence of public sector wages on inflation are rare. This scarcity likely reflects a common view that the direct impact of public sector wage growth on inflation is small – public sector service prices are largely non-market-based and represent only a small portion of the consumer basket (Whiteley, 2023). Nonetheless, public sector wage increases can indirectly affect inflation through heightened demand from public sector employees and by influencing private sector wages. The latter can lead to a rise in production costs across the economy, potentially increasing the prices of products and services not directly related to public sector wage growth (i.e., cost-push inflation). In such cases, theoretical and methodological tools that analyse the effects of broad wage growth on inflation become useful for examining the potential inflationary impact of public sector wage growth, particularly when such growth is substantial and in economies where the public sector is relatively large. We therefore review theoretical and empirical research that examines economy-wide wage-to-price transmission, while focusing on the effect of public sector wages on economy-wide prices.

2.1 THEORETICAL FRAMEWORK

The mechanism of the transmission of wage growth to inflation is often studied within the framework of macroeconomic theories summarized in various forms of the so-called Phillips curve, which essentially assumes an inverse relationship between the unemployment rate and inflation. According to this framework, a more favourable situation on the labour market, which manifests itself through a lower unemployment rate, leads to an increase in wages that can result in higher production costs that producers are able to pass on to consumers through an increase in the prices of their products and services (see for example Carlin and Soskice, 2014). Thus, in the basic neoclassical model of a closed economy under conditions of perfect competition where prices are set at the level of marginal cost, the prices of products and services grow according to the growth rate of wages minus labour productivity, that is, according to the growth rate of unit labour costs. In such conditions, it can be shown that in the long run the elasticity of price changes to wage changes, which is used to measure the transmission of wages to prices, is equal to the share of labour costs in the total costs.[5]

However, setting aside the empirical challenges of quantifying the causal impact of wage growth on prices – since wage dynamics itself is largely influenced by inflation

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[5] See Deutsche Bundesbank (2019). It is important to note that consumers (and central banks) are primarily interested in the potential pass-through of wage growth to consumer prices measured by the Harmonized Index of Consumer Prices (HICP). In contrast, the conclusions of theoretical models generally refer to prices measured by the GDP deflator, which captures the prices of goods produced within the domestic economy. Since consumers also purchase imported goods and since a significant share of imported intermediates is used in the domestic production of consumer goods, the pass-through of wage growth to consumer prices will not necessarily correspond to the pass-through of wage growth to the prices of goods produced within the domestic economy.

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trends – this theoretical conclusion faces several practical issues. The pass-through of wage growth to prices depends on a range of factors that vary between countries and can shift within a country over time. These include changes in profit margins[6], labour market conditions, the structure of the economy, and how workers formulate wage demands, which are influenced by anticipated inflation, current labour market conditions, and actual or expected productivity growth. As a result, we cannot simply deduce the extent of wage growth pass-through onto prices based solely on the share of labour costs, particularly in the short to medium term.

A formal framework for understanding the joint dynamics of wage and price movements is captured in a basic wage-setting (WS) and price-setting (PS) model, as outlined by Blanchard and Bernanke (2023).

The standard equation that describes the relationship among wage growth, inflation, and labour market conditions is known as the wage-setting (WS) relationship[7]:

$$\Delta w_t = \Delta p^e_t - \alpha\left(u_t - u^*\right) + \Delta a_{Lt} \tag{1}$$

where $\Delta w_t = w_t - w_{t-1}$ is the rate of change of nominal wages in time t, $\Delta p^e_t = p^e_t - p_{t-1}$ is the expected rate of inflation in time t, u_t is the unemployment rate in time t, and u^* is the natural rate of unemployment in time t, Δa_{Lt} is the real (or expected) labour productivity growth rate. Equation (1) indicates that workers' wage demands are driven by their inflation expectations and the current labour market conditions. When the unemployment rate is low, workers have greater bargaining power since employers face challenges in filling vacant positions, allowing workers to negotiate for higher nominal wages.

Also, when workers expect higher inflation, they demand higher wages to prevent real wages from falling. The way in which workers form inflation expectations can be described as follows:

$$\Delta p^e_t = \lambda \Delta p^*_t - (1 - \lambda)\Delta p_{t-1} \tag{2}$$

Here, Δp^*_t represents the long-term expected inflation rate, typically aligned with the central bank's target inflation rate. It is assumed that long-term inflation expectations are shaped by last year's long-term inflation and the inflation rate from the previous period.

$$\Delta p^*_t = \delta \Delta p^*_{t-1} - (1 - \delta)\Delta p_{t-1} \tag{3}$$

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[6] Markets are often not perfectly competitive, allowing companies to set prices above marginal costs, meaning they can charge markups. These markups do not necessarily remain constant, so companies can adjust them to mitigate (or amplify) the pass-through of higher wages to prices by reducing (or increasing) their markups.
[7] In describing the model, we abstract from the effect of so-called aspiration wages, which Blanchard and Bernanke (2023) consider in their highly influential paper. Specifically, while standard WS-PS models typically do not include aspiration wages (see, for example, Carlin and Soskice, 2014), integrating the concept of aspiration wages explicitly into the methodological approach underlying the empirical estimation would be challenging.

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The parameter λ in equation (2) indicates the anchoring of short-term expectations, and the parameter δ in equation (3) indicates the anchoring of long-term expectations. When expectations are fully anchored, both parameters are equal to 1, and when expectations are completely unanchored, they are equal to 0[8].

In addition to expected inflation and labour market conditions, nominal wage growth described by equation (1) is also influenced by factors such as the actual or anticipated growth rate of labour productivity (Δa_{Lt}). In theory, prices increase according to the growth rate of unit labour costs rather than wages alone. Consequently, any changes or adjustments that affect labour productivity can mitigate the impact of wage growth on prices. For instance, companies may respond to wage increase demands by reducing their workforce, which might increase labour productivity. With higher labour productivity, unit labour costs may rise more slowly than wages, thereby reducing the sensitivity of prices to wage changes. Additionally, if layoffs lead to higher unemployment, total demand may decrease, potentially exerting downward pressure on prices.

The approach producers take to set prices is generally described by the price-setting (PS) relationship:

$$\Delta p_t = \Delta w_t - \Delta a_{Lt} + \Delta z_t \qquad (4)$$

In equation (4), z_t represents all factors that influence pricing beyond unit labour costs – defined as wage growth (w) minus labour productivity growth (α_L). These factors include mark-ups and costs of intermediates, such as the prices of energy, food, and other raw materials. Together, these relationships form the basis of the standard Phillips curve, which is commonly used to analyse the mechanism through which wage increases translate into price changes.

$$\Delta p_t = \lambda \Delta p^*_t - (1 - \lambda) \Delta p_{t-1} - \alpha \left(u_t - u^* \right) + \Delta z_t \qquad (5)$$

The Phillips curve describes aggregate supply, illustrating how price levels move based on expected inflation, labour market conditions, and other factors. Assuming the Phillips relationship holds, equation (5) suggests that price dynamics are influenced by the anchoring of inflation expectations, labour market conditions which affect wage demands, and fluctuations in mark-ups and prices of important intermediates, such as energy and other raw materials.

A significant empirical challenge in assessing the impact of wages on prices (especially in the short and medium term) arises from the simultaneous determination of wages and prices, as evident in the WS-PS model (Conti and Nobili, 2019). The wage-price relationship is bidirectional, making it difficult to pinpoint and quantify

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[8] In the empirical model, expectations are not explicitly modelled because the time series of short-term and long-term inflation expectations published by Consensus Economics for Croatia is too short and only available at a semi-annual frequency.

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the causal impact of wages on prices. The co-movement of prices and wages can be driven by (a) demand shocks, (b) supply shocks, or (c) the attempts of workers or producers to increase their share in income distribution (Blanchard, 1986). The strength of the wage-price link depends on the nature of the shock. For instance, research shows that under a positive aggregate demand shock, the connection between wages and prices is much stronger than in the case of a supply shock[9].

A positive aggregate demand shock is characterized by rising prices and income, leading to increased demand for labour and a drop in the unemployment rate below its natural level. Companies respond to heightened demand for products by raising prices (demand-push), while workers, in response to increased demand for labour, push for higher wages. Wage growth raises production costs (cost-push), prompting further price increases unless mark-ups or input costs change. This cycle of rising prices and wages continues until income stabilizes at its potential level, or until unemployment returns to a level that does not accelerate inflation[10], as seen in equations (1) and (5).

Conversely, a negative aggregate supply shock is marked by rising prices alongside declining income. When such an inflationary shock occurs, workers seek wage increases to maintain their real purchasing power. However, a negative supply shock also raises the natural unemployment rate (or lowers the potential output), thereby weakening workers' bargaining power due to the availability of the involuntarily unemployed labour force in the market. As the economy adjusts to a higher equilibrium unemployment rate and lower potential output, aggregate demand declines, which puts a downward pressure on prices. Thus, in the case of a supply shock, wage growth impacts prices mainly through the cost-push channel, and this effect is mitigated (or even offset) by the reduction in aggregate demand.

2.2 EMPIRICAL FRAMEWORK

Due to its importance in economic theory and policy, numerous empirical studies examine the relationship and transmission of wage growth to inflation. The direction and significance of this relationship are often analysed using Granger causality tests (e.g., Hu and Toussaint-Comeau, 2010; Bidder, 2015) and by assessing the importance of wages in inflation forecasts (e.g., Stock and Watson, 2008; Knotek and Zaman, 2014; Jarocinski and Mackowiak, 2017) or through Phillips curve estimations (e.g., Stock and Watson, 2008; Tatierska, 2010; Galí and Gambetti, 2019). However, due to the simultaneity, these methods typically only reveal joint dynamics or correlation between wages and prices but generally inadequate for isolating the causal effect of wage growth on prices. While these approaches do not identify or quantify causation, they can be highly informative – particularly in the context of a potential wage-price spiral. On the other hand, analyses that try to quantify the pass-through of wage growth to inflation often use vector autoregressive (VAR) models (e.g., Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; Hahn, 2020; Ivanac, Kunovac and Nadoveza, 2024),

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[9] For instance, Gumiel and Elke (2018), Bobeica, Ciccarelli and Vansteenkiste (2019, 2021).

[10] The potential output is assumed to be the level of income achieved at the natural rate of unemployment, that is, the unemployment rate that does not accelerate inflation (Non-Accelerating Inflation Rate of Unemployment, NAIRU).

error correction models (e.g., Chang and Emery, 1996) or simultaneous equations (e.g., Blanchard and Bernanke, 2023; Arce et al., 2024).

The findings of various studies offer different assessments of the wage-to-price pass-through. While most research suggests a weak or partial transmission of wage increases to prices (Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; Hahn, 2020; Blanchard and Bernanke, 2023; Arce et al., 2024), where only a portion of wage increases is passed on to prices due to competitiveness gains and changes in mark-ups (see, for instance, Deutsche Bundesbank, 2019; Bobeica, Ciccarelli and Vansteenkiste, 2019), some studies indicate that the extent of transmission varies across sectors and countries (Bobeica, Ciccarelli and Vansteenkiste, 2019).

More recent research typically analyses the wage-price nexus using structural VAR models similar to the approach taken in this paper. These models are able to account for shock-dependent wage-to-price relationship[11] (e.g., Gumiel and Hahn, 2018; Galí and Gambetti, 2019; Conti and Nobili, 2019; Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Hahn, 2020), and offer a reasonable approximation of the WS-PS model. The results of these studies generally show that the wage-price relationship is strongest during aggregate demand shocks, but weaker during labour market shocks, and even negative in the case of aggregate supply shocks. Furthermore, Bobeica, Ciccarelli and Vansteenkiste (2019, 2021), and Ivanac, Kunovac and Nadoveza (2024) investigate the role of wages in transmission of various structural shocks to prices using a counterfactual scenario within a VAR framework[12]. These studies find that wages significantly amplify the effects of aggregate demand shocks on inflation, suggesting that, without wage growth, inflation would be considerably lower during aggregate demand shocks. In contrast, the role of wages in transmitting aggregate supply shocks to prices is much less significant.

In addition to the VAR model, Blanchard and Bernanke (2023) present a simple dynamic model of wages, prices (WS-PS), and short- and long-term inflation expectations, which was later replicated for the euro area by Arce et al. (2024). Their findings suggest that wage growth had a relatively low impact on inflation during the period of heightened inflation that began in late 2021 and that the surge in inflation during this period was primarily driven by shocks in raw material prices.

While this paper draws heavily on the literature that combines zero and sign restrictions on impulse response functions within the VAR framework to analyse the relationship between wages and prices, it makes two notable contributions. First, in addition to examining the conditional correlation between wages and

[11] The idea that the pass-through of wages to prices can vary depending on the shocks affecting an economy originates from the literature on exchange rate pass-through to inflation, as discussed in the papers of Kunovac and Communale (2017), and Forbes, Hjortsoe and Nenova (2018).

[12] The authors adopt the idea of identifying the effects of specific shocks using a hypothetical scenario from the literature related to isolating the role of confidence in the transmission of government spending shocks (Bachmann and Sims, 2012) and isolating the role of the credit channel in the transmission of monetary shocks (Ciccarelli, Maddaloni and Peydró, 2015).

prices under various structural shocks (wage-to-price multipliers), the paper explores time-varying correlations between wages and prices in both the public sector and in the overall economy. As in Ivanac, Kunovac and Nadoveza (2024) this analysis shows how the dynamics of wages and prices evolves over time even without a time-varying parameter. Second, the paper identifies the potential role of public sector wages in the transmission of various shocks to inflation, both across the economy and within the public sector, by using wage-to-price multipliers (Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; Ivanac, Kunovac and Nadoveza, 2024). This approach is rarely applied in the literature on wage-price transmission but has proven to be a valuable tool for quantifying the indirect effects of public sector wage growth on overall inflation. Lastly, the paper makes a significant professional contribution by using the standard methodology in an analysis of the wage-price relationship in the public sector – a relatively large and crucial sector in most countries – in which no studies have attempted to quantify the transmission of wages to prices.

3 METHODOLOGY AND DATA

To examine the relationship between wage dynamics, consumer prices, and the transmission of wage growth to inflation, we approximate the WS-PS model using a standard Bayesian VAR model, applying zero and sign restrictions on the impulse response functions (see table 1)[13]. We estimate two models: one focused on the public sector, which evaluates the direct impact of public sector wage growth on public service price inflation, and another for the overall economy, which assesses the potential indirect effects of public sector wage growth on headline inflation.

Prices and wages in both the public sector and the overall economy that are used in the empirical analysis are illustrated in graph 2[14]. The graph shows that wage trends in the public and private sectors are generally synchronised (graph 2a), with wage growth during the high inflation period of 2022 and 2023 (graph 3a) being exceptionally high. This surge can largely be attributed to the wage catch-up process aimed at preventing a significant decline in real wages during the high inflation period. On the other hand, inflation measured by the constructed HICP for public sector services (see appendix) did not always follow the dynamics of overall price growth, which is partly due to the role of administered prices in the price setting process for public sector services. The most notable divergence between total inflation and inflation in public sector services occurred in 2009, largely due to healthcare system reform, which introduced a new system of co-payments and supplementary health care insurance. Since, according to tables available in Cai and Vandyck (2020), healthcare spending accounts for a significant share (33.7%) of total consumer expenditure on public sector services, this reform had a marked impact on the constructed price index for public sector services.

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[13] The identification scheme relies on sign restrictions on impulse response functions proposed by Canova and De Nicolò (2002), and Uhlig (2005), and further refined by Rubio-Ramírez, Waggoner and Zha (2010), and Arias, Rubio- Ramirez and Waggoner (2014).

[14] Data, data sources and their modifications are available in table A1.

GRAPH 2

Annual wage growth and HICP inflation in the public sector and the overall economy (%)

a) Wages *b) HICP inflation*
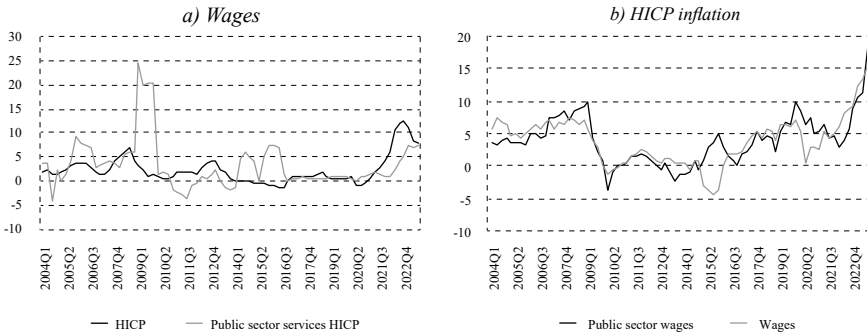
Source: CBS, Eurostat.

The model used to estimate the impact of wage growth (in the public sector) on inflation (of public sector services) includes five key variables for the period from 2004Q1 to 2023Q4: real GVA and GDP (with GVA from the services sector covering O-Q sections[15]), HICP inflation[16] (of public sector services, calculated using the CPA to COICOP conversion tables developed by Cai and Vandyck, 2020[17]), average wages (in the public sector)[18], labour productivity[19] and employment (in sections O-Q), and the unemployment rate. All variables are seasonally adjusted and expressed in quarterly growth rates, except for the unemployment rate, which is expressed in quarterly differences.

3.1 IDENTIFICATION OF THE EFFECTS OF PUBLIC SECTOR WAGE GROWTH ON INFLATION

The identification strategy we employ is outlined in table 1 and is primarily based on conventional macroeconomic theory and recent empirical literature. Aggregate demand and aggregate supply shocks are identified using standard sign restrictions found in the existing literature, while labour supply shocks are distinguished from wage mark-up shocks using the sign restrictions proposed by Foroni, Furlanetto and Lepetit (2018) and applied by Conti and Nobili (2019), as well as Bobeica, Ciccarelli and Vansteenkiste (2019, 2021) and Ivanac, Kunovac and Nadoveza (2024). The identification of shocks in the models for the overall economy and the

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[15] According to the statistical classification of products by activity (CPA) section O includes public administration and defence services; compulsory social security services, section P includes education services, and section Q includes human health and social work services.

[16] Harmonised index of consumer prices.

[17] The HICP for public sector services is calculated as the share of consumption of a specific product by activity (CPA) in the public sector which is linked in the conversion tables to the corresponding category of consumption by purpose (COICOP) and the corresponding HICP index by purpose of consumption (COICOP). See explanation for table A2 and graph A1 for details.

[18] Calculated using Croatian Bureau of Statistics (CBS) data collected through regular monthly surveys on net and gross wages according to the classification of economic activities in the European community (NACE).

[19] Calculated as the ratio of GVA (gross value added of the O-Q sections) and the number of employees (in the O-Q sections).

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public sector – used to assess both the direct and indirect effects of public sector wage growth on inflation – is presented outside the parentheses. The identification using the unemployment rate, which is applicable only for the entire economy and which serves as a robustness check, is shown in parentheses. Namely, the existing literature usually uses the unemployment rate to identify shocks. Still, since there is no analogous indicator for the unemployment rate at the sectoral level, employment in the public sector is used as a proxy for the unemployment rate when identifying shocks within the public services sector. To ensure comparability, the model using employment and GVA is considered the baseline model for the overall economy. Models that use the unemployment rate and GDP to identify shocks are employed to test the robustness of the baseline model. This approach also aims to assess whether replacing the unemployment rate with employment is appropriate for the public sector, given that public sector employment is arguably more influenced by the political cycle than the business cycle. However, considering the absence of alternative indicators to identify shocks in the public sector since the correlation between annual employment growth rates in the public sector and the overall economy is moderately positive[20], we believe substituting employment for the unemployment rate may be justified if the results from the baseline and alternative models for the overall economy do not differ significantly.

Specifically, a positive demand shock is one that simultaneously boosts economic activity (measured by GVA and GDP), prices and wages. As economic activity rises, firms' greater demand for capital and labour leads to a reduction in the unemployment rate (i.e., increases employment). In the short run, following Okun's law, the effect on employment is smaller than the effect on economic activity, resulting in a rise in labour productivity. As a result, unit labour costs (wages adjusted for labour productivity) grow slower than wages. In addition to these short-run dynamics, it is assumed that economic activity does not respond to demand shocks in the long run, as standard macroeconomic theory assumes that demand shocks dissipate over time. Therefore, the long-term response of economic activity to demand shocks is assumed to be zero. On the other hand, a supply shock leads to increases in economic activity, labour productivity, and wages, while simultaneously reducing consumer prices and unemployment (i.e., increasing employment) (see, for example, Dedola and Neri, 2007; Peersman and Straub, 2009). In addition to these standard economic shocks, the model also identifies two shocks related to the labour market. A negative labour supply shock reduces labour force participation, which in turn lowers economic activity but also reduces the unemployment rate (increases employment). At the same time, wages and prices rise. This shock is differentiated from the aggregate demand shock by its distinct effect on economic activity. A wage mark-up shock, defined as an increase in the share of wages in the income distribution (wage growth[21]), raises wages while reducing producer profits (producer mark-ups). This increases marginal

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[20] The correlation coefficient is 0.56.
[21] For example, structural reforms that lead to changes in wages regardless of the prevailing economic conditions (such as the 2024 public sector reform) or alter workers' bargaining power serve as good examples.

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costs and inflation. Concurrently, the unemployment rate rises (employment decreases) as firms cut jobs due to higher hiring costs, and economic activity declines. In the case of labour market shocks in the economy-wide model, where we estimate the model using the unemployment rate, we remain neutral regarding the response of labour productivity. However, in the models estimated using employment, separating the two labour market shocks would not be possible without additional assumptions regarding the response of labour productivity to each shock. Thus, in the employment-based model, we assume that when wage mark-ups increase, GDP rises more slowly than employment, leading to higher productivity. Conversely, when a labour supply shock occurs, productivity declines. The fifth (and final) shock in the model remains unidentified. The short-term restrictions discussed above are summarized in table 1.

TABLE 1
Identification restrictions

Shocks/Variables	Demand	Supply	Labour supply	Wage mark-up	Other
GVA (GDP)	+	+	-	-	?
HICP	+	-	+	+	?
W	+	+	+	+	?
PROD	+	+	? (-)	? (+)	?
EMP (UR)	+ (-)	+ (-)	- (-)	- (+)	?

Note: GVA – gross value added, GDP – gross domestic product, HICP – harmonized index of consumer prices, W – wages, PROD – productivity, EMP – employment, UR – unemployment rate.

3.2 METHODOLOGY AND ASSUMPTIONS FOR ESTIMATING THE DIRECT AND INDIRECT EFFECTS OF PUBLIC SECTOR WAGE GROWTH ON INFLATION

To assess the direct effect of public sector wage growth on inflation, we treat wage growth resulting from the public sector coefficient reform as a wage mark-up shock in the public sector model. A key assumption is the exogeneity of public sector wage growth – meaning it is treated as a wage shock independent of other variables that typically influence wage dynamics, as outlined in the theoretical model in chapter 2.1.[22] This assumption is reasonable because the reform is exogenous by its nature, with the government making this decision independently of broader economic conditions. As a result, estimating the direct effect is straightforward, and the direct effect of public sector wage growth on inflation ($HICP_t^{direct}$) is:

$$HICP_t^{direct} = \sum_{h=1}^{4} IRF_h^{HICP_{O-Q}} shockW_t^{O-Q} HICP_t^{w_{O-Q}} \tag{6}$$

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[22] It is important to note that this approach to analysing the effects of wages on inflation differs from cases where wage changes are the result of endogenous wage reactions to various economic shocks. In those situations, it is necessary to isolate the labour cost channel to evaluate its contribution to inflation at a specific point in time, considering the mix of shocks affecting the economy at that moment. It that case the focus is on the role of wages in amplifying the effects of economic shocks on inflation. The concept of studying "amplification" in a VAR model by constructing a hypothetical scenario – where wages do not respond to a specific shock – was employed by Ivanac, Kunovac and Nadoveza (2024), drawing on the methodology of Bachmann and Sims (2012) and Ciccarelli, Maddaloni and Peydró (2015).

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In equation (6), $IRF_h^{HICP_{O-Q}}$ represents the cumulative response of prices[23] to a one-standard-deviation public sector mark-up shock over a given horizon. In this paper, we set h=4, which corresponds to one year after the shock occurs. $shockW_t^{O-Q}$ indicates the magnitude of the public sector wage shock, expressed in standard deviations of the wage mark-up shock in the public sector model, while $HICP_t^{w_{O-Q}}$ refers to the share of public services in the consumer basket, based on the conversion tables from Cai and Vandyck (2020).

The estimation of the indirect effect of public sector wage growth on inflation that we propose in this paper is more complex and relies on a greater number of assumptions. To evaluate the indirect effect, we draw on the methodology used to calculate the wage-to-price multipliers (Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; Ivanac, Kunovac and Nadoveza, 2024). The underlying idea is that exogenous, reform related, wage growth in the public sector, will stimulate aggregate demand and potentially spill over into wage growth in the private sector, creating shocks that could generate additional inflationary pressures. To estimate these effects, we first estimate a (B)VAR model for the entire economy, where we identify the same shocks as in the public sector model (demand, supply, and two labour market related shocks). This model allows us to examine the co-movements of prices and wages (labour costs) under the aggregate demand and wage mark-up shocks that could be triggered by exogenous public sector wage growth. We first estimate the strength of the wage mark-up shock resulting from the public sector wage growth shock at the economy-wide level. Then, using the wage-to-price multipliers for demand and wage mark-up shocks, we estimate the resulting effects on inflation.

To illustrate this approach, consider a positive demand shock that leads to higher prices. This happens because companies, benefiting from strong demand, have more incentives to raise prices. At the same time, as demand for inputs (labour and capital) increases, the cost of those inputs rises. Thus, wages increase endogenously, i.e. because of strong aggregate demand. To calculate the indirect effects of public sector wage growth on overall inflation through its impact on aggregate demand, we want to account for both channels (demand and cost) through which an exogenous wage increase in the public sector can influence inflation. Therefore, we need to examine the joint dynamics of prices and wages under aggregate demand and wage mark-up shocks, which is captured by the estimated (shock-dependent) wage-to-price multipliers. Hence, the indirect effect of public sector wage growth on inflation is represented by the product of the wage-to-price multipliers under aggregate demand and wage mark-up shocks, and the estimated size of the economy-wide wage mark-up shock related to public sector wage growth. As outlined in chapter 4.1, wage-to-price multipliers are defined as the ratio of the cumulative impulse response functions of HICP inflation and wages under identified economic shocks. The same methodology applies when assessing the potential

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[23] The price response is measured by the impulse response function (IRF) of the public sector services HICP to a one-standard-deviation wage mark-up shock over a given horizon, h.

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indirect effects of public sector wage growth on inflation through its potential spill-overs to private sector wages.[24] Therefore, the indirect effect of public sector wage growth on overall inflation via the aggregate demand channel ($HICP_t^{AD\_indirect}$) is estimated using:

$$HICP_t^{AD\_indirect} = \frac{\sum_{h=1}^{4} IRF(HICP)_4^{AD}}{\sum_{h=1}^{4} IRF(WAGE)_4^{AD}} \Delta W_t^W \qquad (7)$$

In equation (7), $\sum_{h=1}^{4} IRF(HICP)_4^{AD}$ represents the cumulative response of infla-tion to aggregate demand shocks in the overall economy model, while $\sum_{h=1}^{4} IRF(WAGE)_4^{AD}$ denotes the cumulative response of wages to an aggregate demand shock. ΔW_t^W refers to the change of wages under the wage mark-up shock resulting from the exogenous increase in public sector wages. It is calculated as a product of the cumulative impulse response function of wages to wage mark-up shock in the economy-wide model and the estimated size of wage mark-up shock expressed in standard deviations of the shock, i.e.:

$$\Delta W_t^W = \sum_{h=1}^{4} IRF(WAGE)_4^W \, shockW_t \qquad (8)$$

We estimate the indirect effect of the public sector wage growth shock on inflation through its potential spillover to total wages in the same manner, specifically:

$$HICP_t^{W\_indirect} = \frac{\sum_{h=1}^{4} IRF(HICP)_4^W}{\sum_{h=1}^{4} IRF(WAGE)_4^W} \Delta W_t^W \qquad (9)$$

In equation (9), $\sum_{h=1}^{4} IRF(HICP)_4^W$ represents the cumulative response of inflation to wage mark-up shock in the economy-wide model, while $\sum_{h=1}^{4} IRF(WAGE)_4^W$ denotes the cumulative response of wages to a wage mark-up shock. As in equa-tion (7), ΔW_t^W is given by equation (8) and represents the estimated wage growth in the overall economy resulting from the exogenous wage increase in the public sector.

The total indirect effect of public sector wage growth on inflation is the weighted sum of these two indirect effects, specifically:

$$HICP_t^{indirect} = \alpha_{AD} HICP_t^{AD\_indirect} + \alpha_W HICP_t^{W\_indirect} \qquad (10)$$

The equation (10) implies that we assume that the public sector wage growth, which indirectly impacts inflation through the aggregate demand channel, cannot concurrently affect inflation via a spillover to public sector wages, and vice versa. Therefore, $\alpha_{AD} + \alpha_W = 1$, or equivalently, $\alpha_W = 1 - \alpha_{AD}$, must always hold. Specifi-cally, we assume that if some part of the increase in public sector wages spills over into the economy via the demand channel, we treat the rise in private sector wages as an endogenous result of the increased demand in the overall economy.

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[24] In the case of wage spillover effects, the indirect effect can be calculated by using the impulse response func-tion of inflation to wage mark-up shock and the estimated economy-wide wage mark-up shock.

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Likewise, if some part of the increase in public sector wages spills over into the economy via private sector wages, we treat the increase in aggregate demand as an endogenous outcome of wage growth in both sectors. The total effect on inflation is calculated as the sum of the estimated direct effect and the total indirect effect.

4 RESULTS

4.1 THE RELATIONSHIP BETWEEN WAGE GROWTH AND INFLATION IN THE PUBLIC AND PRIVATE SECTORS

Before presenting the main results, this section briefly discusses key findings regarding the relationship between wage growth and inflation that can be compared with the results of existing research. The results presented are based on models that use gross value added and employment to identify shocks, with the estimated impulse response functions shown in graphs A2 and A3. The findings for the overall economy have proven to be relatively robust to the selection of variables in the model. Specifically, the key impulse response functions and the implied cumulative wage-to-price multipliers[25] (the ratio of cumulative impulse response functions of prices and wages) remain largely consistent across models that use different combinations of economic activity indicators (GDP and GVA) and labour market variables (unemployment rate and employment) for estimation and identification (see graphs A4-A15). The results are also consistent across models that are estimated using different periods (see graphs A16-A23).

Graph 3 illustrates the cumulative wage-to-price shock-dependent multipliers (CWPPT) for the public sector (graph 3a) and the entire economy (graph 3b). These multipliers, which we use to quantify the indirect effects of public sector wage growth on inflation, are calculated as the ratio of the cumulative impulse response functions of HICP inflation and wages in response to identified economic shocks in the public sector (graph A2) and the entire economy (graph A3), i.e.:

$$CWPPT_h^{k-th\,shock} = \frac{\sum_{h=1}^{H} IRF(HICP)_h^{k-th\,shock}}{\sum_{h=1}^{H} IRF(WAGE)_h^{k-th\,shock}} \tag{11}$$

The results show that the positive relationship between wages and prices is particularly strong for aggregate demand shocks in both the public sector and the overall economy, wage growth being associated with 1.5 (economy-wide) to 2 (public sector) times stronger price growth in the short run (after one quarter, or h=1). This might suggest that public service prices tend to rise more significantly only during favourable economic conditions, such as periods of robust aggregate demand growth. The stronger relationship between wages and prices in the public sector during such times may be due to the higher share of labour costs (wages) in the public sector, which mainly produces services, compared to the other sectors in the economy. However, after a year (h>4), the relationship between wages and prices in the public sector closely resembles that in the overall economy.

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[25] I.e., the relationship between wages and prices under different shocks, or the conditional correlations between wage growth and inflation.

However, the relationship remains relatively strong, which is consistent with findings from empirical studies (Bobeica, Ciccarelli and Vansteenkiste, 2019, 2021; Conti and Nobili, 2019; and Ivanac, Kunovac and Nadoveza, 2024). Additionally, under labour market related shocks, the wage-price relationship is only moderately positive in both the public and private sectors (cumulative wage-to-price shock-dependent multipliers are around 0.5). Conversely, in the case of aggregate supply shocks, the relationship between wages and prices is negative. This negative relationship is more pronounced in the public sector, in both the short run (-0.8 versus -0.2) and the long run (-0.35 versus -0.05). This may be due to public sector wage freezes during recessions, especially during the prolonged period when Croatia was under the Excessive Deficit Procedure (EDP), during which public sector wage growth was constrained regardless of inflationary pressures.
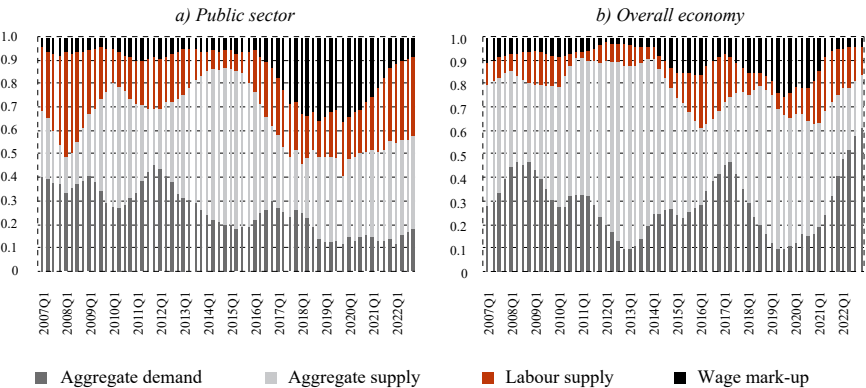
GRAPH 3

Shock dependent cumulative wage-to-price multipliers
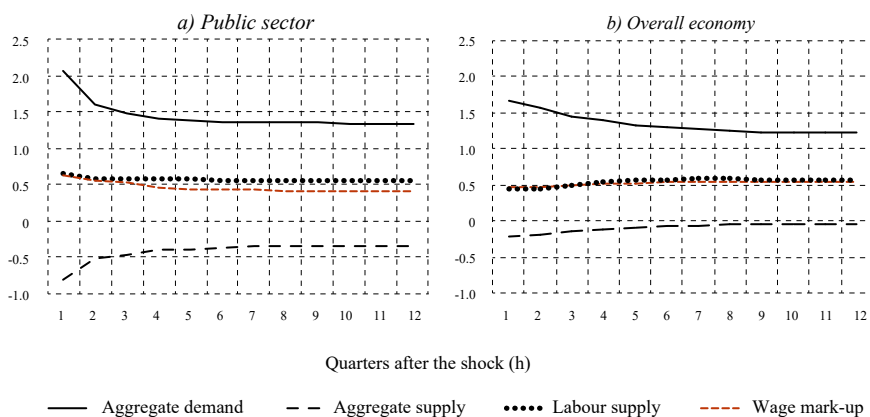
Source: Author.

The relationship between wage and price growth at any given point of time depends on the economic shocks that dominate wage dynamics, which in turn determine the ability of producers and service providers to pass on rising costs to consumers. This potential is clearly highest when wages are driven by aggregate demand shocks. Graph 4 shows that, after the first quarter of 2020, wage dynamics in the public sector were increasingly influenced by labour supply and aggregate supply shocks. This is likely related to technological changes and the digitalization of public services during the COVID-19 pandemic. In contrast, since 2022, wages in the entire economy have been primarily driven by exceptionally strong demand, which is probably at least partially related to the demand surge in tourism and the associated wage growth in the hospitality sector.

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GRAPH 4

Relative importance of shocks in wage dynamics (2-year moving average)

a) Public sector

b) Overall economy

■ Aggregate demand   ■ Aggregate supply   ■ Labour supply   ■ Wage mark-up

Note: The historical decomposition, used to calculate the relative importance of individual shocks in wage dynamics (see formulas A3 and A4 in appendix), is presented in appendix (graph A24) for both the public sector and the overall economy.

Source: Author.

As a result, the time-varying correlation between wage and price growth has been significantly higher in the overall economy than in the public sector in the recent periods (graph 5). This aligns with discussions on the potential effects of wage growth on inflation during periods of strong wage increases in Croatia, particularly in 2022 and 2023. It is also worth noting that the time-varying correlation between wage and price growth in the public sector is generally lower than in the overall economy. This is likely because public employees, when negotiating wage increases, do not typically take into account the rising prices of public services, but rather consider overall inflation during wage bargaining process.

GRAPH 5

Time-varying correlation between wage growth and inflation (2-year moving average)

—— Public sector   —— Overall economy
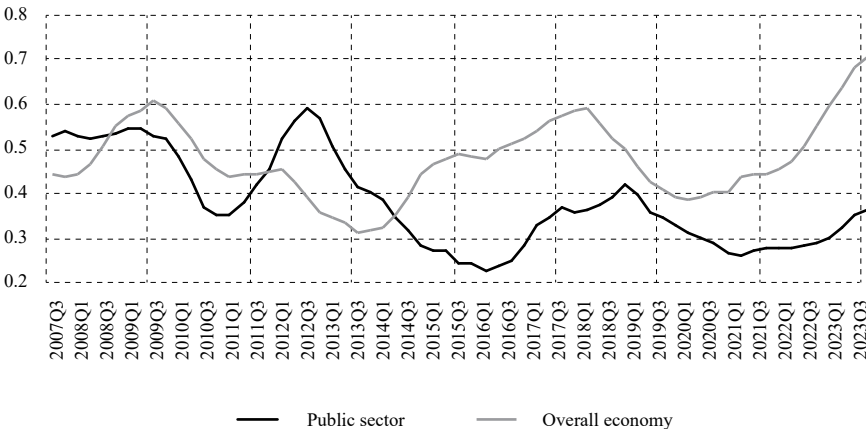
Source: Author.

4.2 ESTIMATION OF THE EFFECT OF PUBLIC SECTOR WAGE GROWTH ON INFLATION

To estimate the potential direct, indirect, and total effects of public wage growth on inflation, we use the equations (6)-(10) developed and presented in section 3.2. We estimate the direct effect of public sector wage growth on inflation as the product of three components: the cumulative response of public sector services prices to a one-standard-deviation wage mark-up shock in the public sector (see the black mark on graph 6), the estimated size of the wage shock in the public sector and the share of public services in Croatia's consumer basket (based on matrices published in Cai and Vandyck, 2020). The wage mark-up shock in the public sector ($shockW_t^{O-Q}$) is calculated by subtracting last year's inflation rate (3.5%) and the long-term trend rate of labour productivity growth[26] in the public sector from the assumed annual growth in public sector wages due to the coefficient reform[27] (15%). This shock (10.85% year-on-year / 3.6% from Q2 2024) is 3.5 times larger than the standard wage mark-up shock in the public sector when expressed in quarterly growth rates. Taking into account the transmission of public sector wage growth to public sector prices, which is given by the response of public service inflation to public sector wage mark-up shock and equals 0.3 for a standard shock, the total annualized contribution to overall inflation (for the entire year of 2024) is estimated to be 0.15 percentage points[28]. Therefore, although the wage shock is substantial, the estimated contribution is modest mostly due to the small share of public services in the consumer basket (approximately 3.5%). It is important to note that this is likely the upper bound of the direct effect of public sector wage growth on overall inflation. Namely, the methodology we use assumes that the public sector can be modelled in the same way as the entire economy. However, the public sector prices are sometimes set administratively (as illustrated by the healthcare services price index in graph A1). As a result, the usual economic mechanisms observed in the price setting process in the entire economy may not always apply to the public sector. Since our approach does not take into account these specificities, it should be acknowledged that even this small effect might be overestimated.

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[26] As explained in the theoretical section, wages are endogenous and primarily driven by inflation in previous periods (wages catch-up to maintain real purchasing power) and labour productivity (if wage growth is offset by productivity gains it does not create additional production costs). To calculate the wage shock, the wage increase related to reform must be adjusted to account for last year's inflation and the anticipated labour productivity growth in the public sector. The expected annual productivity growth rate is 0.65%, which reflects the average of the annual growth rates derived from the Hodrick-Prescott trend of public sector labour productivity, based on the ratio of gross value added to employment in the O-Q sector.

[27] See: Government of RC (2024).

[28] $HICP_t^{direct} = \sum_{h=1}^{4} IRF_h^{HICP_{O-Q}} shockW_t^{O-Q} HICP_t^{w_{O-Q}} = 0.3 * (3.5 * 4) * 0.035 = 0.15.$

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Cumulative response of public sector services HICP to a one-standard-deviation wage mark-up shock in public sector
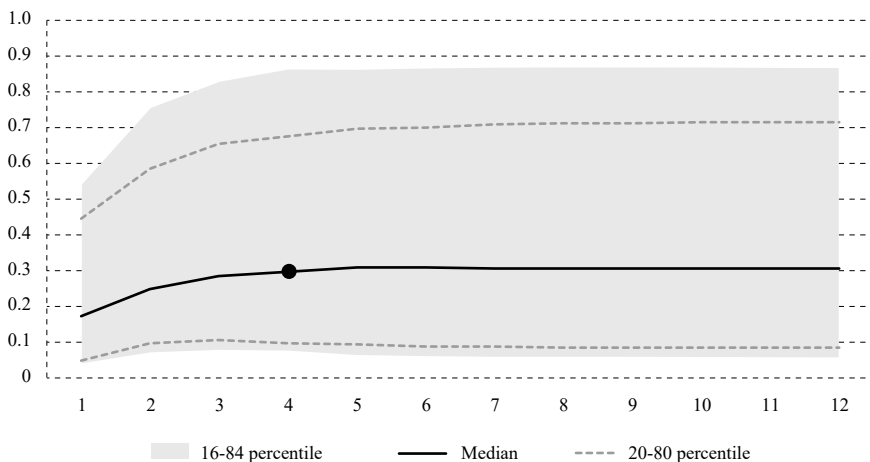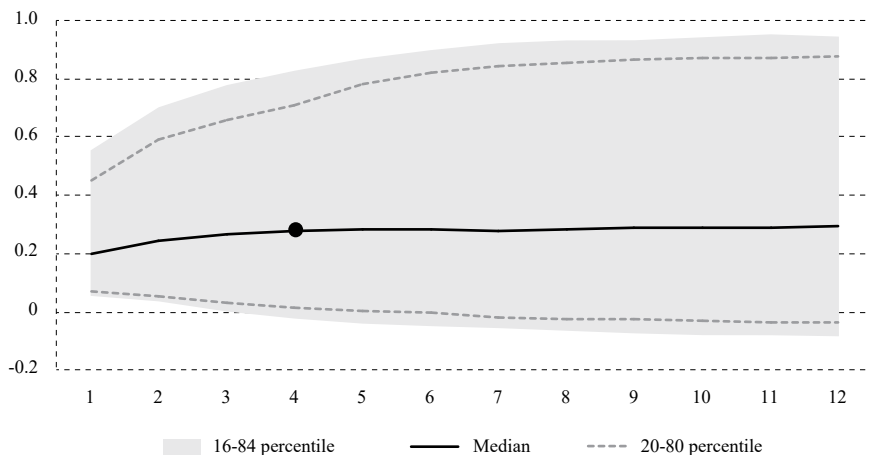

Source: Author.

The indirect effect through the aggregate demand channel is given by equation (7). It is calculated as the product of the estimated wage-to-price multiplier for aggregate demand shocks in the model for the entire economy and the estimated economy-wide wage growth resulting from wage increases in the public sector. At a horizon of h=4 (one year), the wage-to-price multiplier is 1.4 (see graph 3b). The economy-wide wage growth due to public sector wage increases is estimated as the product of public sector wage growth (10.85% yearly / 3.6% quarterly starting in the second quarter of 2024), and the share of 244,000 employees[29] affected by the coefficient reform in total employment in Croatia (approximately 20%). In terms of standard deviations of the wage mark-up shock in the entire economy, this shock amounts to 56% of a standard wage mark-up shock. The change in wages related to a one-standard-deviation wage mark-up shock is given by the cumulative wage response to this shock in the economy-wide model and amounts to 0.28 after four quarters (see graph 7). Therefore, the annualized indirect effect of public sector wage growth through the aggregate demand channel could reach a maximum of 0.88 percentage points[30], but this would only occur if the wage growth in the public sector entirely spills over to the economy through the aggregate demand channel, which is likely to be an unrealistic assumption.

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[29] See: Government of RC (2024).

[30] $HIPC_t^{AD\_indirect} = \dfrac{\sum_{h=1}^{4} IRF(HIPC)_4^{AD}}{\sum_{h=1}^{4} IRF(WAGE)_4^{AD}} \Delta W_t^W = 1.4 * 0.56 * 0.28 * 4 = 0.88.$

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GRAPH 7

Cumulative response of wages to a one-standard-deviation wage mark-up shock

| 16-84 percentile | Median | 20-80 percentile |

Source: Author.

The indirect effect through the public-to-private sector wage spillover channel is given by equation (8). It is calculated as the product of the estimated wage-to-price multiplier for wage mark-up shocks in the economy-wide model and the estimated wage growth across the entire economy, which results from the exogenous growth of wages in the public sector. At a horizon of h=4 (one year), this wage-to-price multiplier is 0.55 (see graph 3b). The increase in economy-wide wages due to rising public sector wages is the same as the one used to calculate the indirect effects of public sector wage growth on inflation through aggregate demand. Thus, the annualized indirect effect of public sector wage growth via the public-to-private sector wage spillover channel could come to as much as 0.34 percentage points[31], assuming that public sector wage growth fully spills over through this channel.
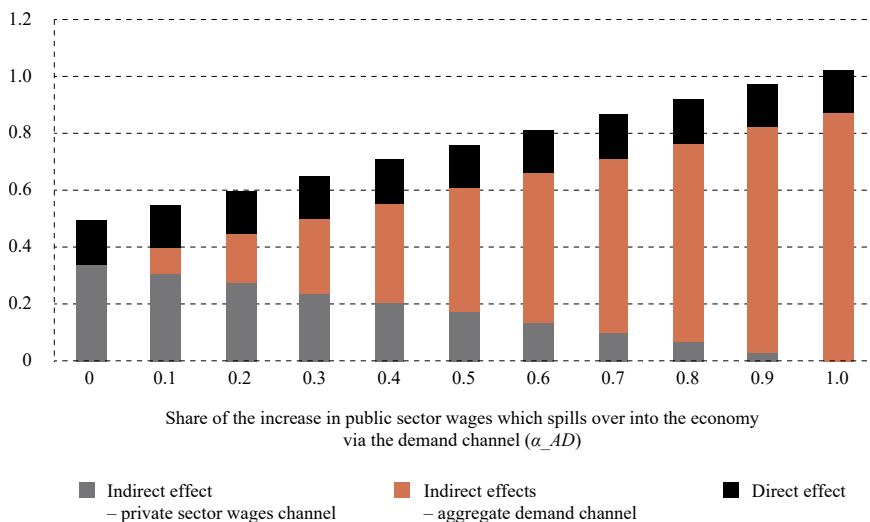
Our results indicate that the impact of public sector wage growth on headline inflation could range from 0.5 to 1 percentage point (see graph 8). Additionally, different model specifications (see graphs A4-A23) suggest that the lower bound of the estimated effect could range from 0.3 pp to 0.75 pp, while the upper bound could range from 0.6 pp to 1.6 pp (see graph 9). Graph 9 also illustrates that the results from the selected baseline model are very similar to those from models using GDP and employment data for the entire sample (2004Q1-2023Q4), as well as those using GDP and the unemployment rate for the period before the COVID-19 pandemic. Moreover, the selected baseline model results fall in the middle of the estimated effect range. Thus, despite the negligible direct effect of public sector wage growth on headline inflation, the indirect effects could be more significant, contributing between 0.34 pp and 0.88 pp to headline inflation. The strength of the estimated indirect effect depends on assumptions about the dominant public sector wage spillover channel (either through aggregate demand – α_{AD} or through public-to-private sector wage spillover – α_w).

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[31] $HICP_t^{W\_indirect} = \dfrac{\sum_{h=1}^{4} IRF(HICP)_4^W}{\sum_{h=1}^{4} IRF(WAGE)_4^W} \Delta W_t^W = 0.55 * 0.56 * 0.28 * 4 = 0.34.$

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Therefore, the overall effect will depend on which assumptions regarding the dominant channel through which public sector wage growth spills over to the economy best reflect the current situation. Since the role of wages in transmitting labour costs to inflation is weaker for the wage mark-up shocks, which is a typical cost-push shock, the potential for public sector wage growth to spill over into headline inflation decreases as a larger portion of the wage growth transmits into the economy through the public-to-private sector wage spillover channel.[32]

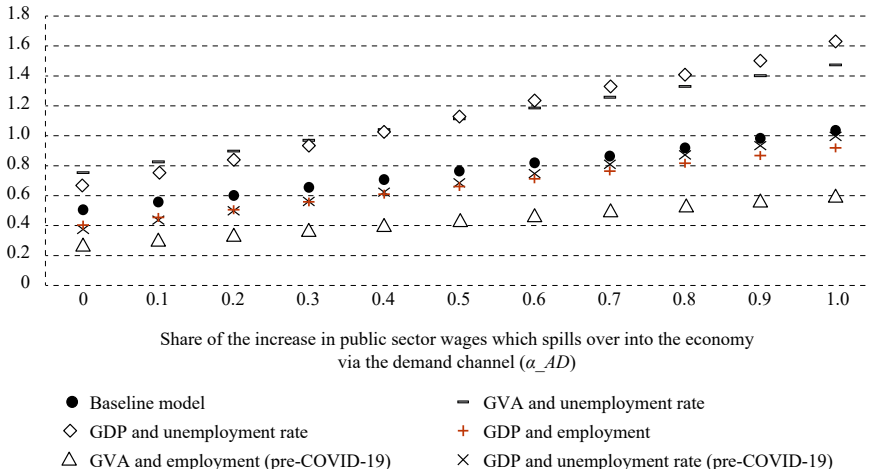**GRAPH 8**

Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)

Share of the increase in public sector wages which spills over into the economy via the demand channel (α_AD)

■ Indirect effect – private sector wages channel   ■ Indirect effects – aggregate demand channel   ■ Direct effect

Note: The total effect was calculated using the formula: $HIPC_t^{total} = HIPC_t^{direct} + HIPC_t^{indirect}$, where the total potential indirect effect is given by: $HIPC_t^{indirect} = \alpha_{AD} HIPC_t^{AD\_indirect} + \alpha_W HIPC_t^{W\_indirect}$. This was calculated under different, mutually exclusive assumptions related to α_{AD}.

Source: Author.

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[32] Although it may appear counterintuitive, it's important to note that any cost shock, by definition, negatively impacts production and leads to a reduction in employment (or an increase in unemployment). As a result, the pass-through of higher corporate wage bill to prices is moderated by the negative effects of reduced production and lower employment. In contrast, during demand shocks, the increase in costs due to wage growth further exacerbates price increases driven by strong demand.

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GRAPH 9

Range of estimated effects across different economy-wide model specifications (pp)

Share of the increase in public sector wages which spills over into the economy
via the demand channel (α_AD)

● Baseline model — GVA and unemployment rate
◇ GDP and unemployment rate + GDP and employment
△ GVA and employment (pre-COVID-19) × GDP and unemployment rate (pre-COVID-19)

Source: Author.

Predicting which of these two channels will dominate in current situation is challenging. Based on the historical unconditional correlation of private and public sector wages growth shown in graph 10, we can observe a moderate to strong simultaneous correlation (l=0) of annual wage growth rates in the public and private sectors (0.65). While the private sector has typically been wage leader, implied by the fact that the highest correlation between public and private sector wages growth appears for l=1 (0.71) to l=4 (0.65), the moderate to relatively strong simultaneous correlation indicates that we can expect at least some public-to-private sector wage spillover. This suggests that the actual effect of public sector wage growth related to coefficient reform on inflation will probably fall within the middle of the estimated range of 0.5 pp to 1 pp.

GRAPH 10

Unconditional correlation between public and private sector wage growth
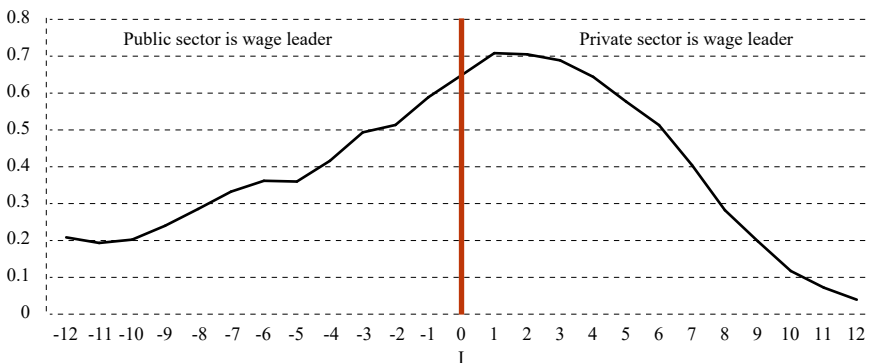
Note: The graph displays the unconditional correlation coefficients between public sector wages in period t and private sector wages in period t-l, where l represents a quarter and ranges from l = [-12, 12], corresponding to ±3 years.

Source: CBS, author.

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5 CONCLUSION

Understanding the impact of public sector wage growth on inflation, especially during a period of high inflation and a strong labour market, is crucial for both monetary and fiscal policymakers. Of interest to monetary authorities, public sector wage increases could contribute to further inflationary pressures, potentially resulting in a higher inflation differential between Croatia and the countries with which it shares a common monetary policy. This could make the common monetary policy suboptimal for Croatia, in which case a more restrictive monetary policy would be more appropriate. From a fiscal policy standpoint, sustained inflation can lead to broader social challenges, increasing costs for the government, as seen during the inflationary episodes in 2022 and 2023.

Currently, there are no estimates of the potential effects of high public sector wage growth in 2024 on inflation. This gap in systematic estimates is partly due to the absence of a standard methodology for evaluating the impact of public sector wages on inflation. This is probably influenced by the prevailing view that the direct effect of public sector wage increases on inflation is small, given that public sector prices are non-market driven and make up a small share of the consumer basket (Whiteley, 2023). In this paper, we use the results of the methodology for analysing the wage to price pass-through to assess the potential impact of coefficient-reform-related public sector wage growth to headline inflation. We also provide an estimate of the overall impact that public sector wage growth in Croatia could have on inflation.

Using quarterly data for Croatia from 2004Q1 to 2023Q4 and (B)VAR models that approximate the WS-PS model, we identify key insights into the wage and price-setting dynamics in both the public sector and the broader economy. Additionally, we estimate the potential direct and indirect effects of public sector wage growth on headline inflation.

First, consistent with existing research, this paper confirms that the direction and strength of the wage-price relationship depend on the dominant shocks that drive economic and wage dynamics. The positive wage-price relationship is somewhat stronger in the public sector during aggregate demand shocks compared to the overall economy, but only in the short run. This suggests that public service prices typically rise significantly only during periods of economic growth, or "good" economic times, marked by aggregate demand expansion. In contrast, during aggregate supply shocks, the negative wage-price relationship is more pronounced in the public sector, both in the short and in the long run. This may be due to wage freezes in the public sector during recessions even when inflation remains positive, often driven by rising raw material prices. In the case of labour market shocks, the positive wage-price relationship is moderate and similar in the public sector and in the overall economy.

Second, since wage movements at any given point of time result from a unique combination of shocks affecting the economy, the (positive) correlation between wages and prices varies across sectors and changes over time. In this paper,

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we demonstrate that the time-varying correlation between wages and prices in the public sector is generally lower than in the overall economy. This is likely because public sector employees, when negotiating wage increases, do not consider the rise in public service prices as relevant information for wage demands; instead, they focus on overall inflation. Additionally, we show that in recent years, the correlation between wages and prices has not significantly increased in the public sector, while it has reached a historical peak at the economy-wide level. This suggests that exceptionally high wage growth in the public sector will not necessarily lead to substantial increases in the prices of public services. This finding supports the interpretation that the direct effect of public sector wage growth on headline inflation, as estimated in this paper, is likely its upper limit, considering the specific dynamics of wage and price setting in the public sector.

Third, even if high public sector wage growth were to significantly increase public service prices, the direct impact of public sector wage growth on headline inflation would remain limited and negligible. While the wage shock is exceptionally large (3.5 times stronger than a standard public sector wage shock), the wage pass-through to public sector prices – measured by the response of public service inflation to public sector wages in a standard wage shock – remains modest at 0.3. Given that public services make up only around 3.5% of the consumer basket, the total annualized contribution to inflation for 2024 is estimated at just 0.15 percentage points.

Finally, despite the negligible direct effect of public sector wage growth on total inflation, we show that indirect effects could be more significant. Depending on assumptions about the dominant channel of wage spillover – whether through aggregate demand or wage increases in the private sector – public sector wage growth could contribute between 0.34 and 0.88 percentage points to total inflation in 2024.

Our results suggest that the overall effect of public sector wage growth on headline inflation is likely to fall in the range of 0.5 to 1 percentage point, depending on the assumed channels of transmission. While this effect is relatively limited, especially considering the exceptional scale of public sector wage growth – which is assumingly expected to increase demand and wages in the private sector compared to a scenario with no public sector wage growth – it still can pose a challenge for both monetary and fiscal policy. This is particularly true in the context of strong demand, which could be further amplified by foreign demand during the tourist season.

Disclosure statement
The author has no conflict of interest to declare.

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APPENDIX

Estimation and analysis using the Bayesian Vector Autoregressive (VAR) model with sign and zero restrictions

To analyse the relationship between wages and prices in the public sector and the entire economy, we employ a Vector Autoregressive (VAR) model estimated using Bayesian techniques, based on data from Croatia spanning the period 2004Q1 to 2023Q4. Our estimation of the sign-restricted and zero-restricted Bayesian VAR model follows the methodology proposed by Arias, Rubio-Ramirez and Waggoner (2014). The procedure is outlined in detail by Deskar-Škrbić, Kotarac and Kunovac (2020), with their code adapted for the specific needs of this analysis.

The SVAR model with i lags can be expressed as:

$$A_0 y_t = \mu + A_1 y_{t-1} + \ldots + A_i y_{t-i} + \varepsilon_t, t = 1, \ldots, T \quad \text{(A1)}$$

where y_t is an $n \times 1$ vector of variables, A_j is an $n \times n$ matrix of fixed coefficients with an invertible A_0, μ is an $n \times 1$ vector of fixed coefficients, and ε_t represents structural economic shocks with an expected value zero and a covariance matrix I_n. i is the number of lags, which, following standard practice in models with quarterly data, is set to four ($i = 4$).

The SVAR model is used to compute the impulse response functions (IRFs):

$$\text{IRF}: \Psi_h = \frac{\partial y_{t+h}}{\partial \varepsilon_t}, h = 0, 1, 2, \ldots \quad \text{(A2)}$$

where $\psi_{jk,h}$ represents the median response of variable j to shock k after h periods.

In order to assess the relative importance of individual shocks (in absolute terms) in determining the dynamics of wages, or the historical decomposition of wages, which is necessary for calculating the time-varying correlation between wages and prices, we use the formula proposed by Deskar-Škrbić, Kotarac and Kunovac (2020):

$$\widetilde{y_{jt}^k} = \frac{\left| y_{jt}^k \right|}{\sum_{l=1}^{n} \left| y_{jt}^l \right|} \quad \text{(A3)}$$

In (A3), the contribution of shock k to variable j in period t, can be calculated as:

$$y_{jt}^k = \sum_{h=0}^{t-1} \psi_{jk,h} \varepsilon_{k,t-h}, h = 0, 1, 2, \ldots \quad \text{(A4)}$$

Unless otherwise specified in the results, we report the median and the 16th and 84th percentiles of the distribution of impulse responses over a horizon ranging from 1 to 12 or 24 quarters.

Following the approach of Deskar-Škrbić, Kotarac and Kunovac (2020), we apply the Gibbs sampling algorithm using the Independent Normal Inverse Wishart prior. At each step of the Gibbs sampler, with a given sample of VAR model parameters in

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reduced form, we derive a set of structural models that satisfy the sign and zero restrictions used to identify the shocks. For the VAR model parameters to which no restrictions are applied, we use standard Minnesota priors, setting $\lambda_1 = 0.2$, $\lambda_2 = 0.5$, $\lambda_3 = 2$, and $\lambda_4 = 10000$. This choice reflects the use of a tight prior, in contrast to Deskar-Škrbić, Kotarac and Kunovac (2020), who employ loose priors.

Data

TABLE A1
Data and data sources, 2004-2023

Variable	Data	Source
Wages	Average wages based on regular monthly surveys of net and gross wages, classified according to the National Classification of Activities (NKD)	Croatian Bureau of Statistics (CBS), quarterly average, seasonally adjusted using X-12-ARIMA
Public sector wages	Average wages for sectors O, P, and Q based on regular monthly surveys of net and gross wages, classified according to the NKD	CBS, quarterly average, seasonally adjusted using X-12-ARIMA
HICP	Monthly Harmonized Index of Consumer Prices, seasonally adjusted using X-12-ARIMA, quarterly average	Eurostat, [prc_hicp_midx]
Public sector services HICP	See table A2 and graph A1	Eurostat, Cai and Vandyck (2020)
Gross domestic product (GDP)	GDP, constant prices, seasonally and calendar adjusted	Eurostat, [namq_10_a10]
Gross value added (GVA)	GVA, constant prices, seasonally and calendar adjusted	Eurostat, [namq_10_a10]
Gross value added (GVA) of public sector	GVA of O, P, and Q sectors, constant prices, seasonally and calendar adjusted	Eurostat, [namq_10_a10]
Employment	Employed individuals based on regular monthly surveys of employment by activity	CBS, seasonally adjusted using X-12-ARIMA
Employment in public sector	Employed individuals in of O, P, and Q sectors based on regular monthly surveys of employment by activity	CBS, seasonally adjusted using X-12-ARIMA
Unemployment rate	Unemployment rate, ages 15-74, percentage of the labour force, trend-cycle data	Eurostat, [une_rt_q_h]
Productivity	GDP/employment, GVA/employment	Eurostat, [namq_10_a10] and CBS
Productivity in public sector	GVA of O-Q sectors/employment of O-Q sectors	Eurostat, [namq_10_a10] and CBS

Source: Author.

Public sector services harmonized consumer price index calculation

The public sector services HICP is calculated by multiplying the share of spending on a specific product by activity (CPA) in the public sector, which is linked to the corresponding consumption category by purpose (COICOP) in the matrices from Cai and Vandyck (2020), with the relevant HICP index for that consumption purpose category. The columns of the matrices in Cai and Vandyck (2020) consist of the second-level hierarchical classification of products by activity, which can easily be mapped to the corresponding activities defined by the EU's statistical classification of economic activities (NACE). The rows in these tables represent consumption categories according to the COICOP classification at the second level (divisions). Each table cell contains data on spending for a specific COICOP category associated with a corresponding CPA product category. To calculate inflation for a given sector, the share of consumption allocated to that sector within the total consumption of a specific category is multiplied by the corresponding second-level HICP sub-index. A sample calculation for the health services sector (Q86) and the resulting HICP for health services is presented in table A2 and graph A1. In this case, the relevant COICOP consumption categories for the human health services are CP062 (out-patient services) and CP063 (hospital services). For each category, the share of total consumption is calculated, which is then multiplied by the HICP for outpatient and hospital services, and subsequently rescaled so that the index for the base year equals 100.
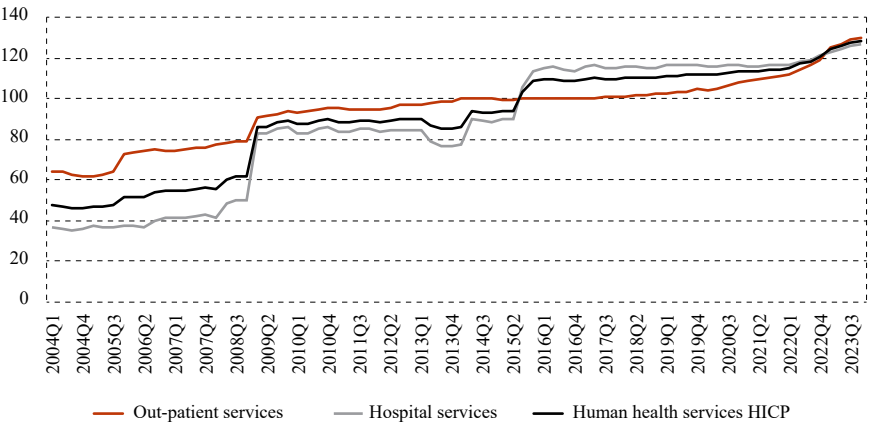
TABLE A2

Part of the bridging matrices related to the human health services

Million euro, current prices	Out-patient services (CP062)	Hospital services (CP063)
Human health services (CPA_Q86)	386.5	80.4

Source: Cai and Vandyck (2020).

GRAPH A1
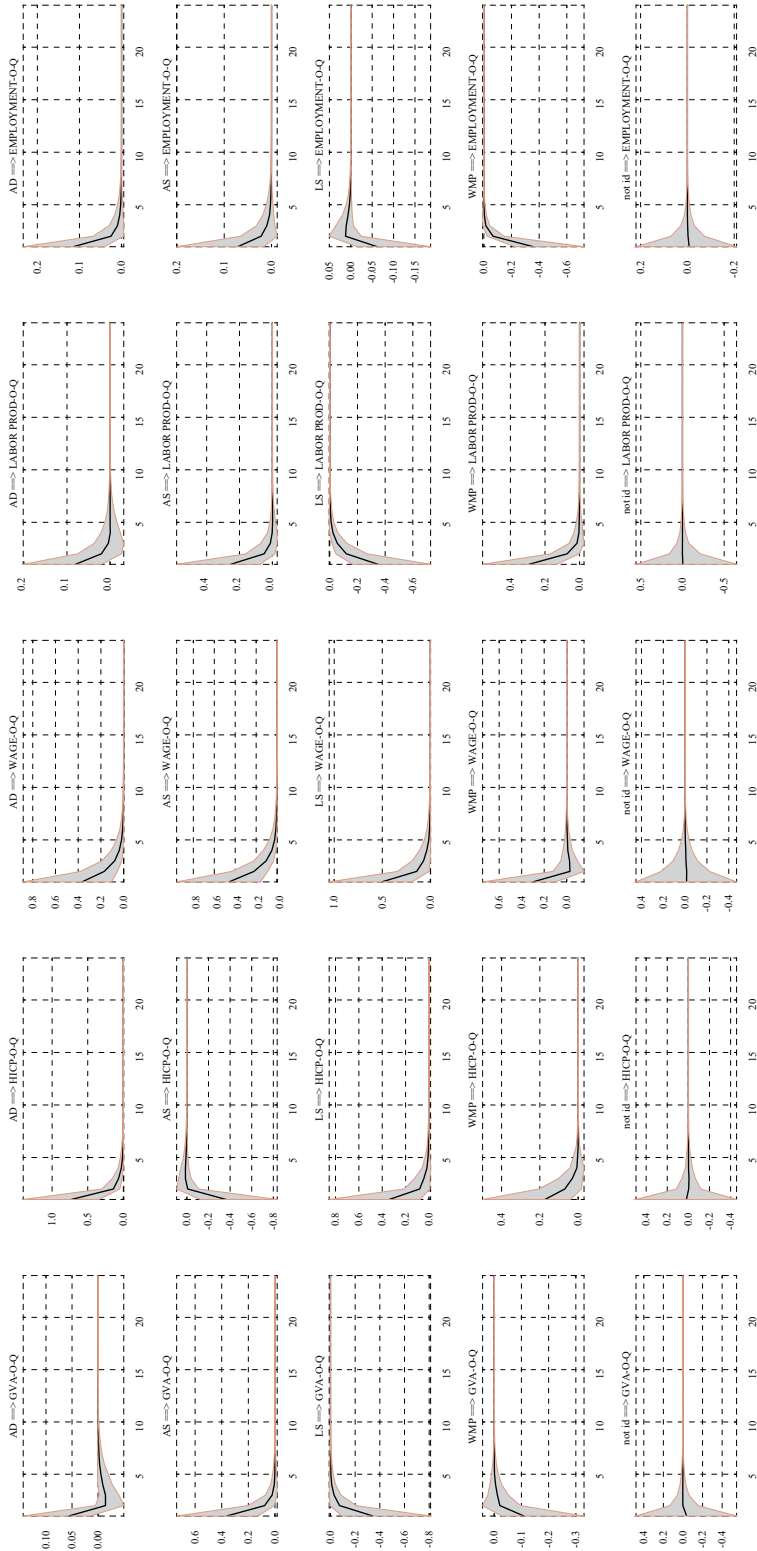
HICP for human health services and associated subcomponents

Source: Eurostat, Cai and Vandyck (2020), author's calculation.

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Impulse response functions in the public sector model

GRAPH A2
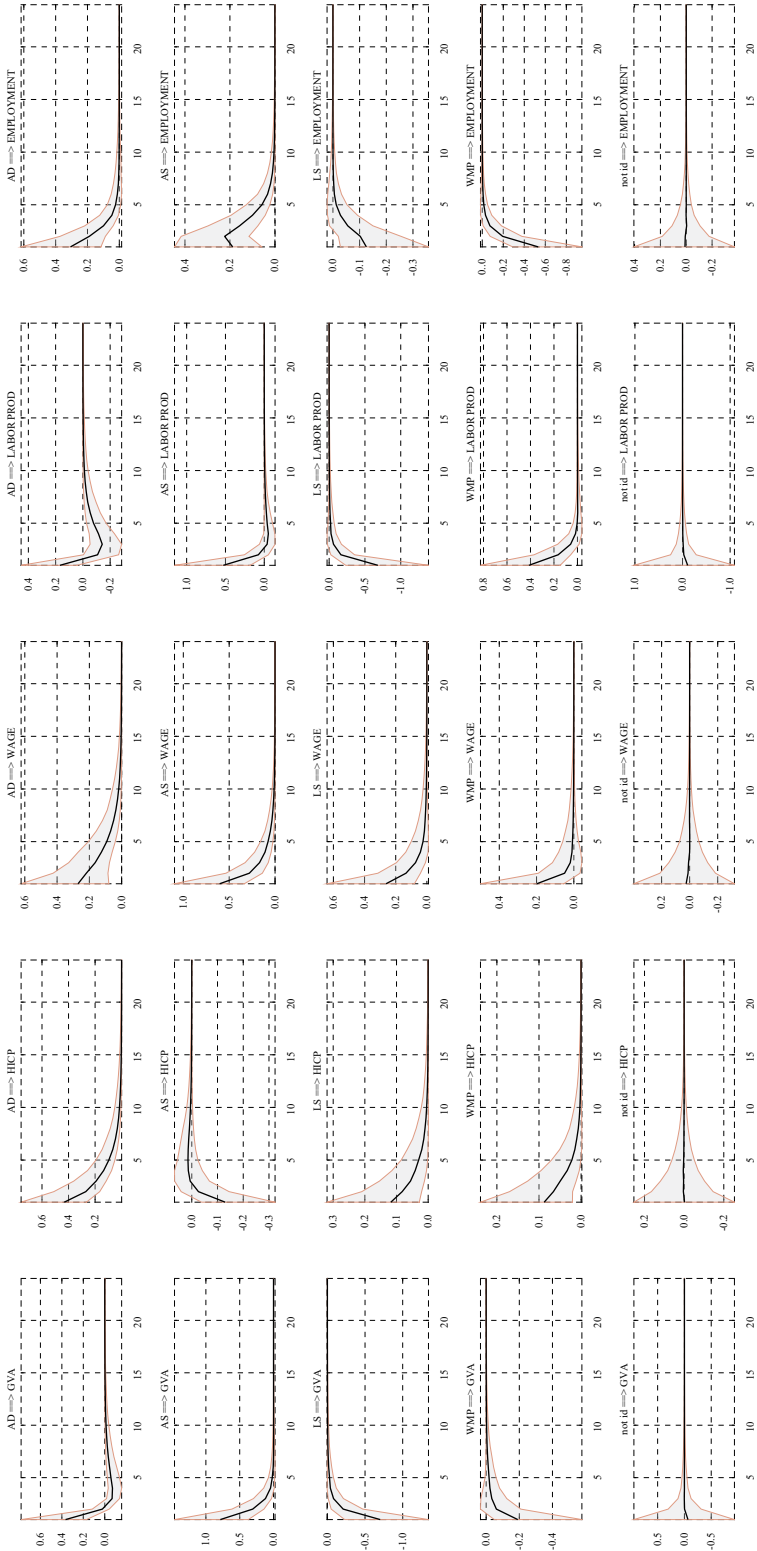*Impulse response functions*

Source: Author.

Impulse response functions in the overall economy model
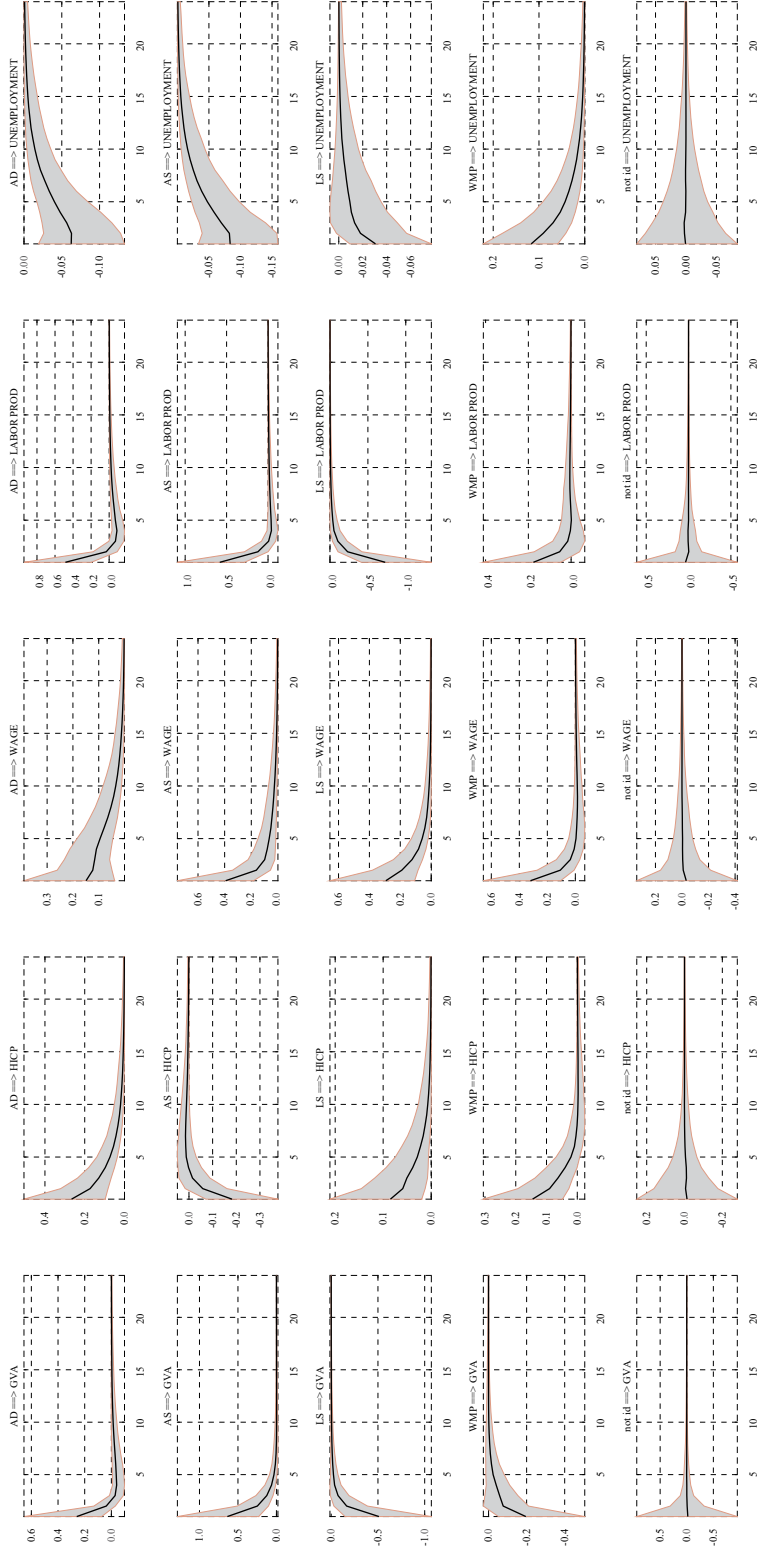
GRAPH A3
Impulse response functions

Source: Author.

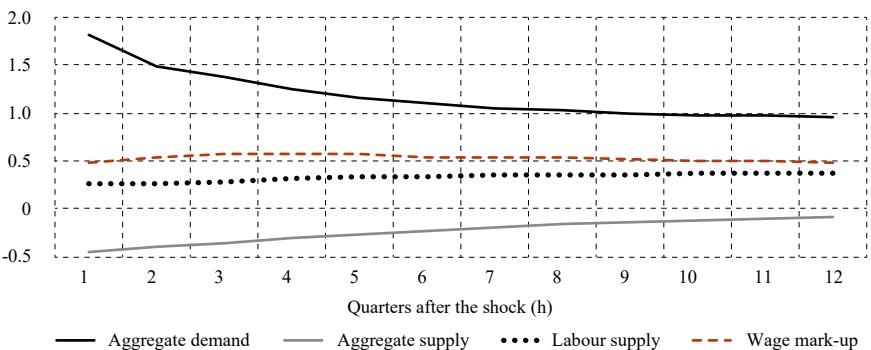**Results from the model of the overall economy using gross value added and the unemployment rate**

GRAPH A4
Impulse response functions

Source: Author.

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GRAPH A5

Shock dependent wage-to-price multipliers

Source: Author.

GRAPH A6

Cumulative response of public sector prices to a one-standard-deviation wage mark-up shock
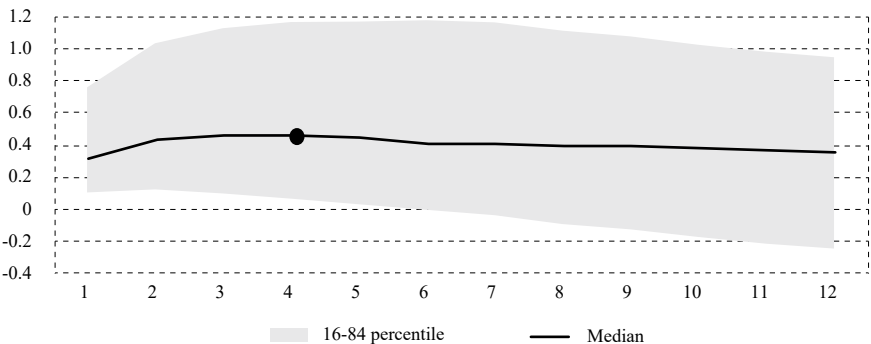
Source: Author.

GRAPH A7

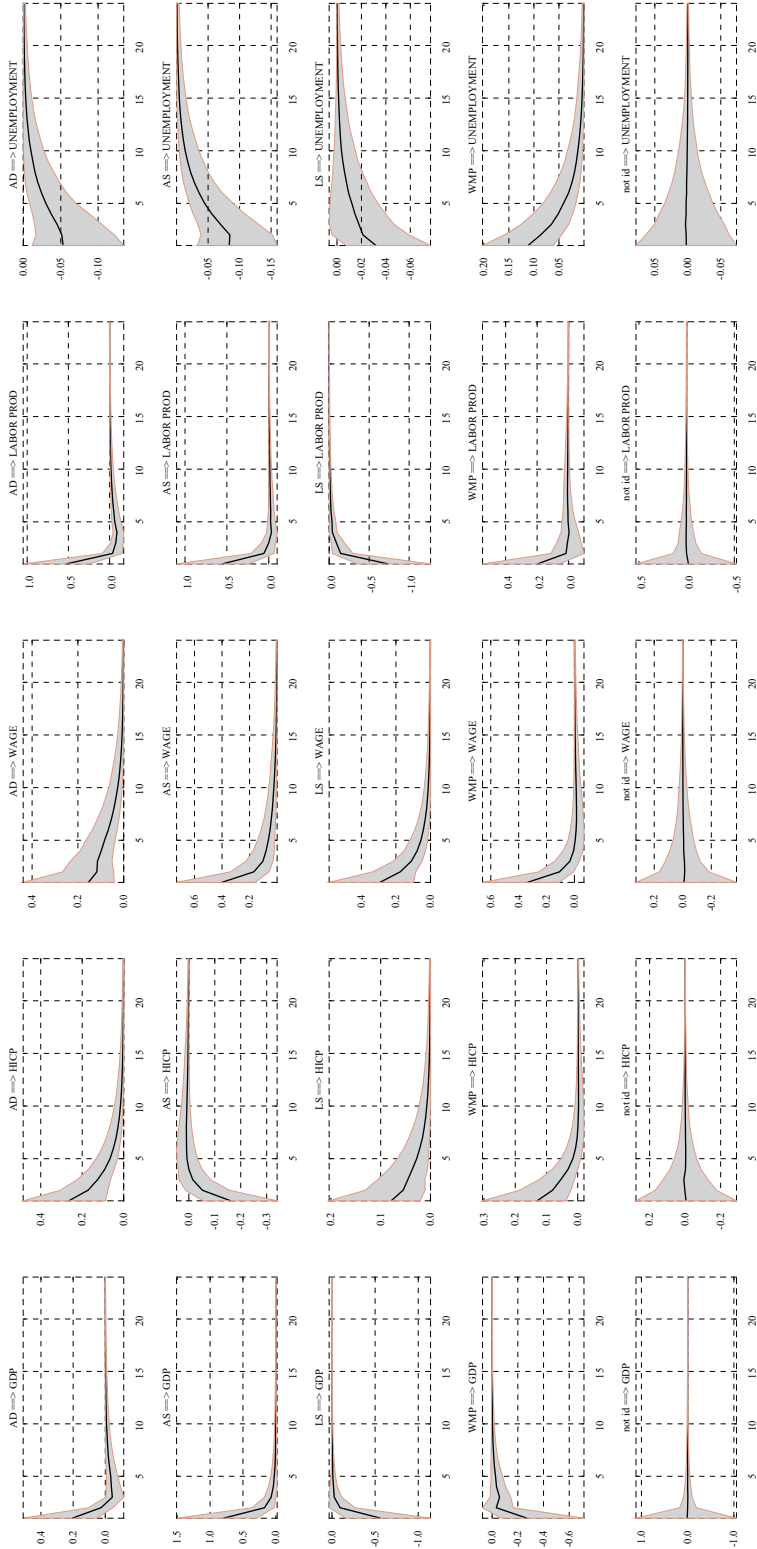*Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)*
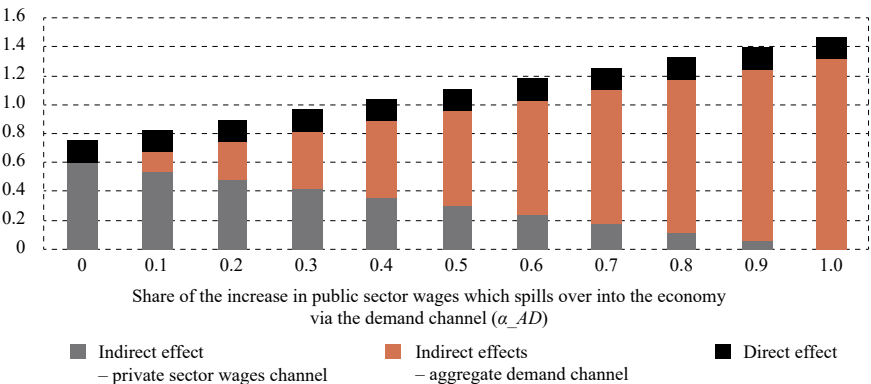
Source: Author.

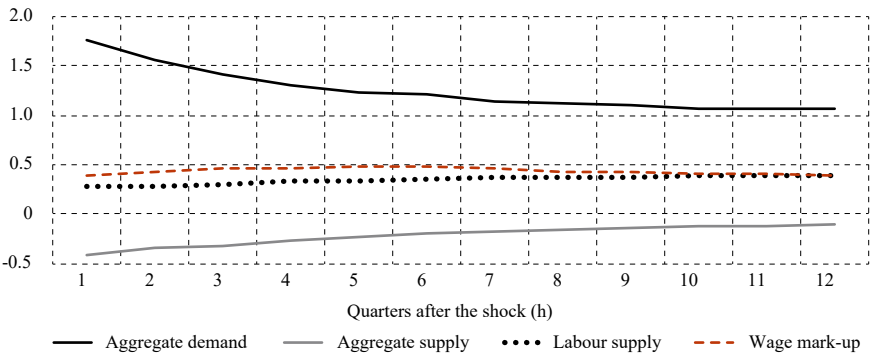**Results from the model of the overall economy using gross domestic product and the unemployment rate**

GRAPH A8

Impulse response functions
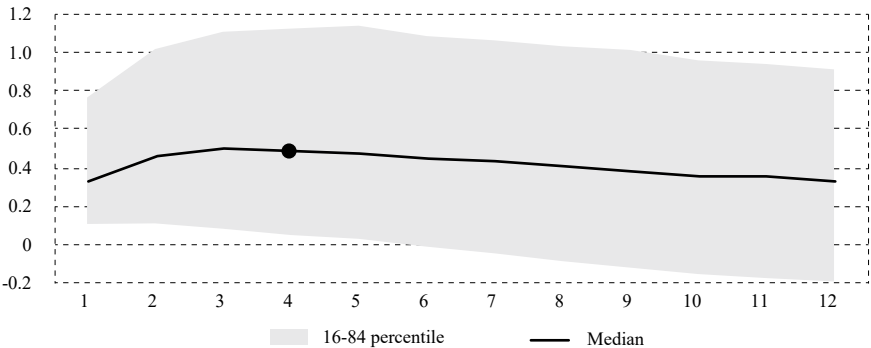

Source: Author.

GRAPH A9

Shock dependent wage-to-price multipliers
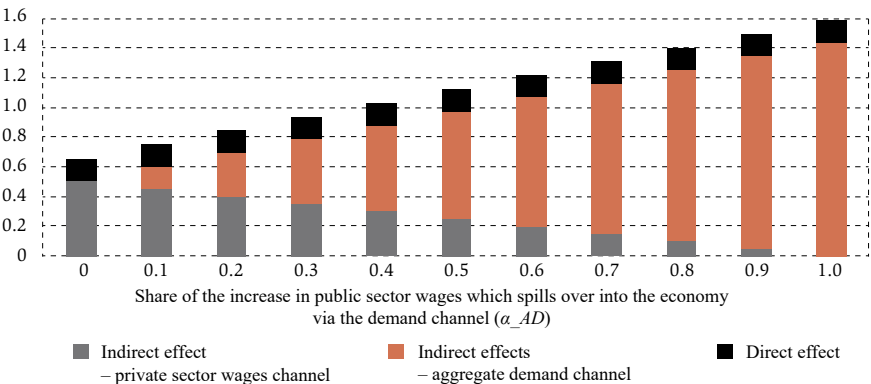
Source: Author.

GRAPH A10

Cumulative response of public sector prices to a one-standard-deviation wage mark-up shock

Source: Author.

GRAPH A11

Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)

Source: Author.

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Results from the model of the overall economy using gross domestic product and employment

GRAPH A12
Impulse response functions

Source: Author.

GRAPH A13

Shock-dependent wage-to-price multipliers

Source: Author.

GRAPH A14

Cumulative response of public sector prices to a one-standard-deviation wage mark-up shock

Source: Author.

GRAPH A15

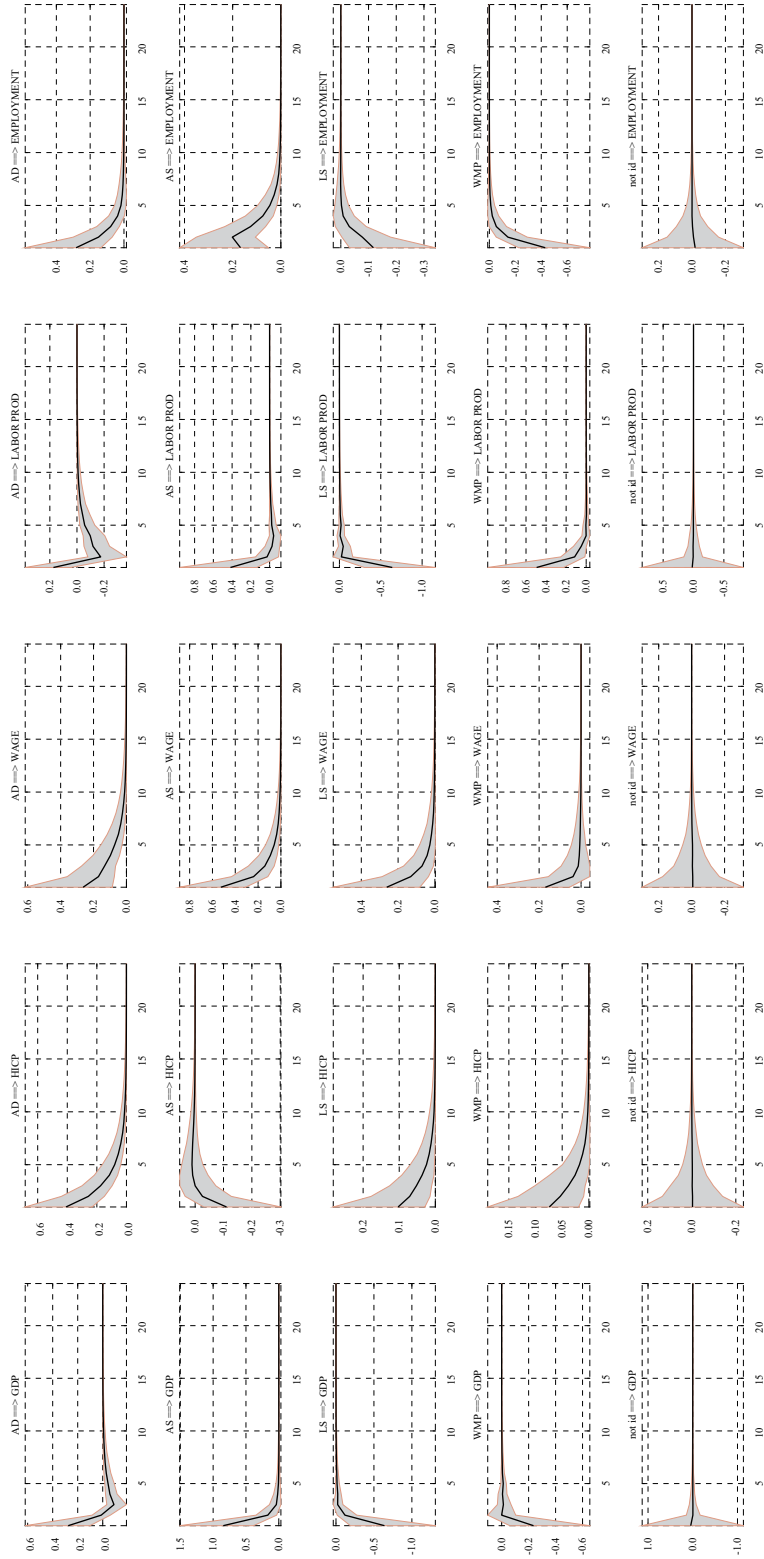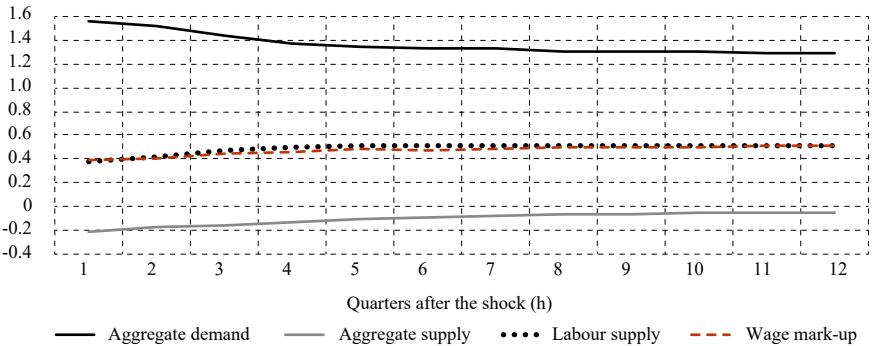*Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)*

Source: Author.

Results from the model of the overall economy using gross value added and employment estimated before the COVID-19 pandemic (2004Q1–2019Q4)

GRAPH A16
Impulse response functions

Source: Author.

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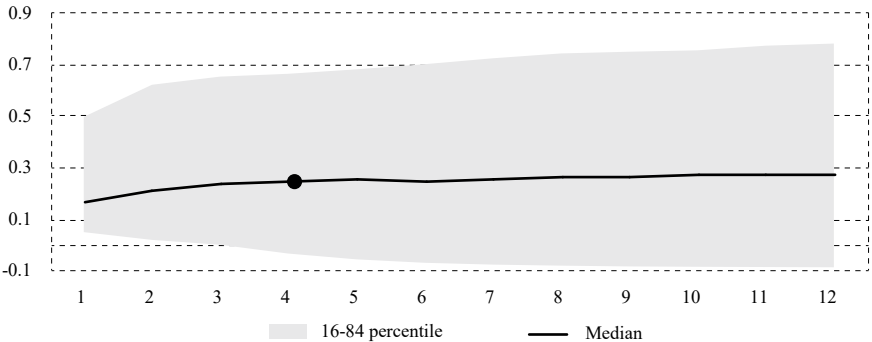SECTOR WAGES AFFECT INFLATION?

GRAPH A17

Shock-dependent wage-to-price multipliers
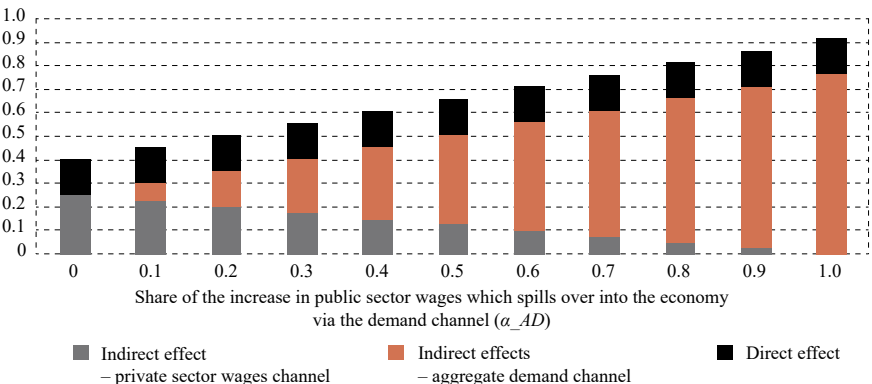

Source: Author.

GRAPH A18

Cumulative response of public sector prices to a one-standard-deviation wage mark-up shock
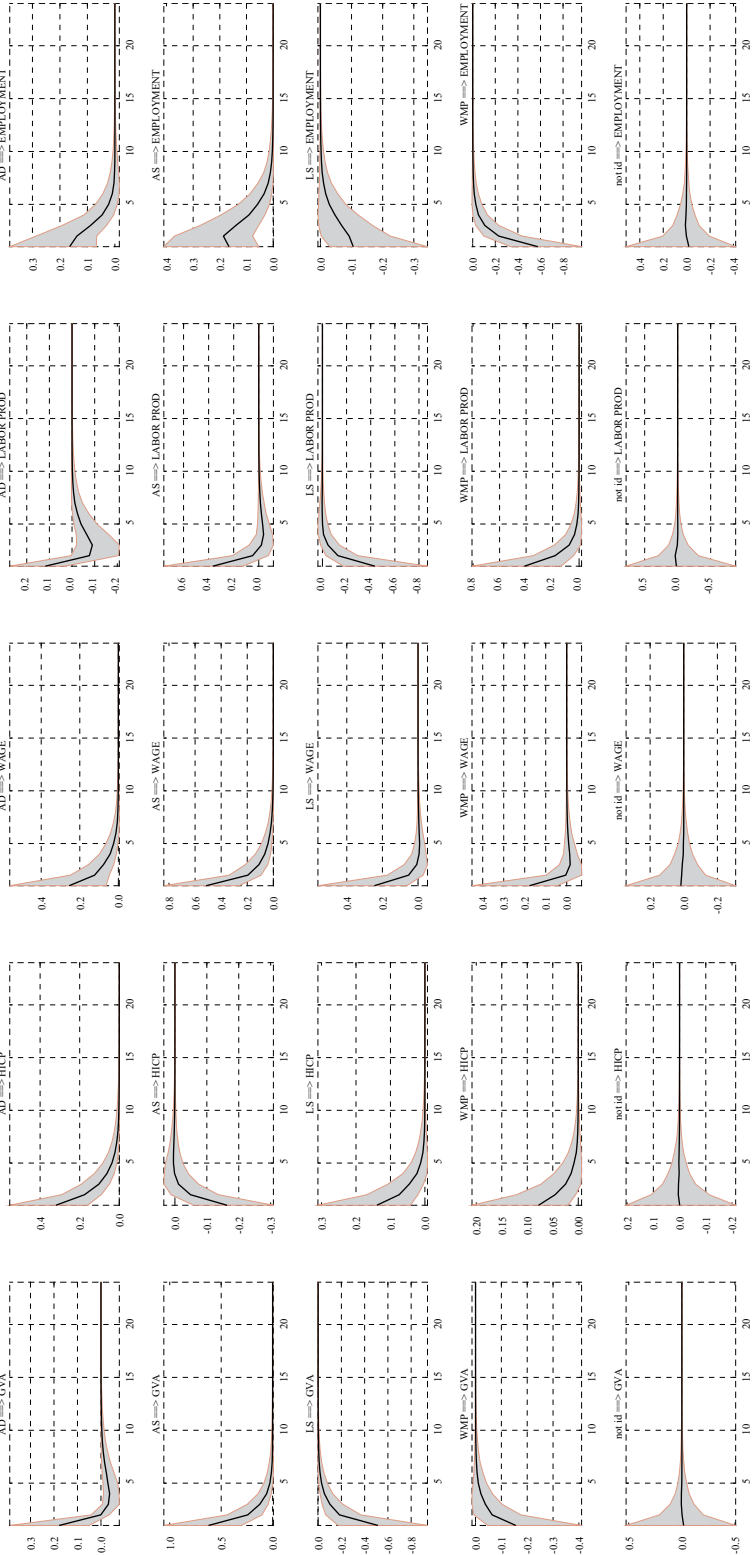

Source: Author.

GRAPH A19

Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)

Source: Author.

Results from the model of the overall economy using gross domestic product and unemployment rate estimated before the COVID-19 pandemic (2004Q1-2019Q4)
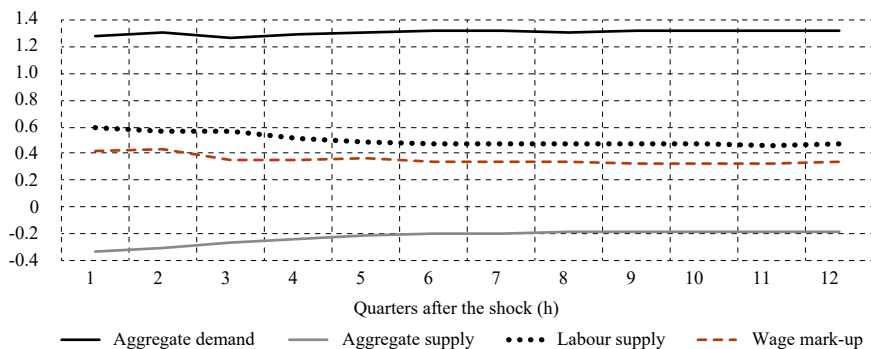
GRAPH A20
Impulse response functions

Source: Author.

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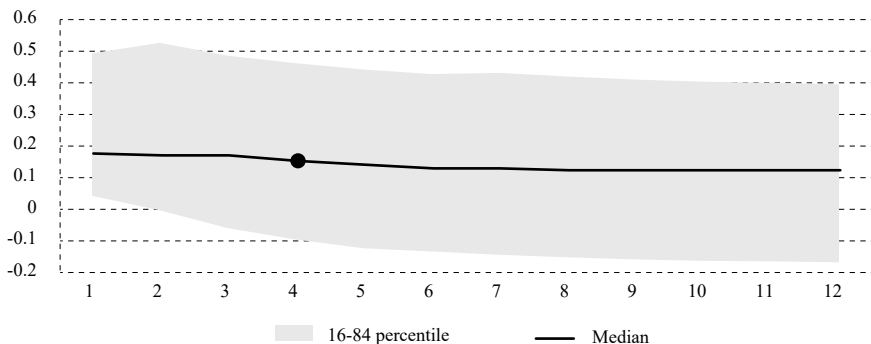SECTOR WAGES AFFECT INFLATION?
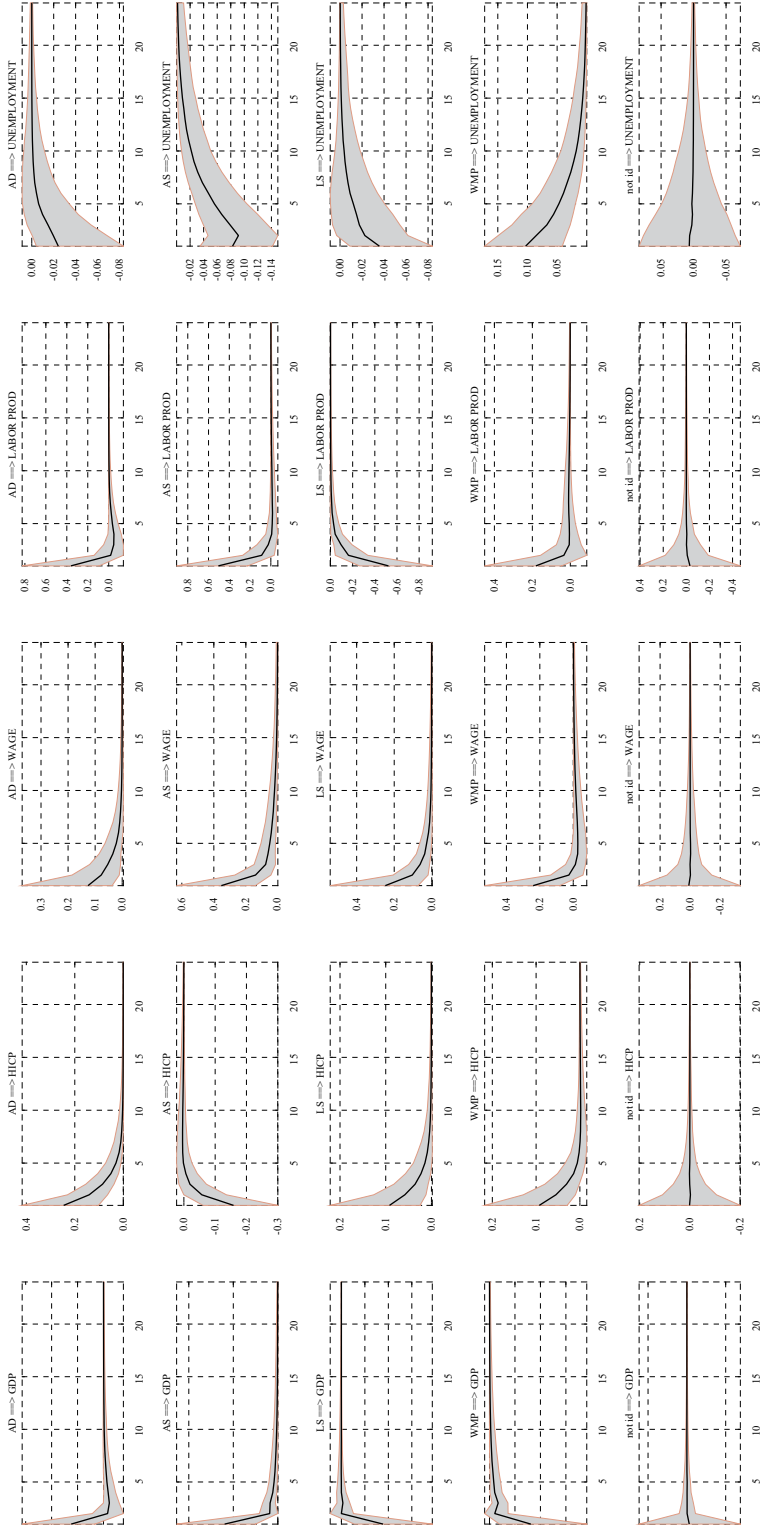
GRAPH A21

Shock-dependent wage-to-price multipliers

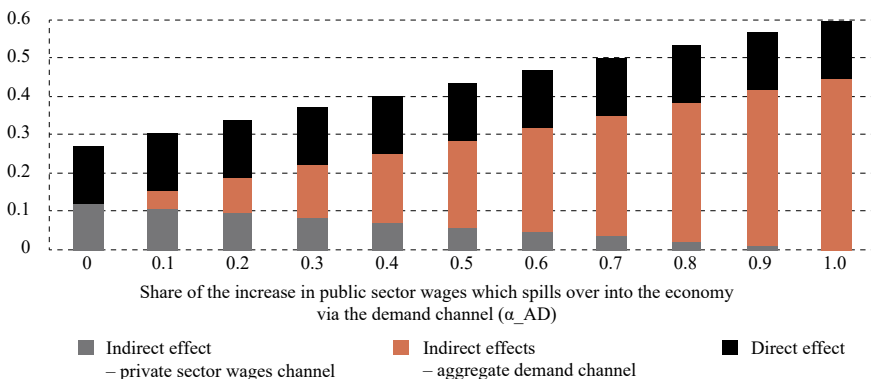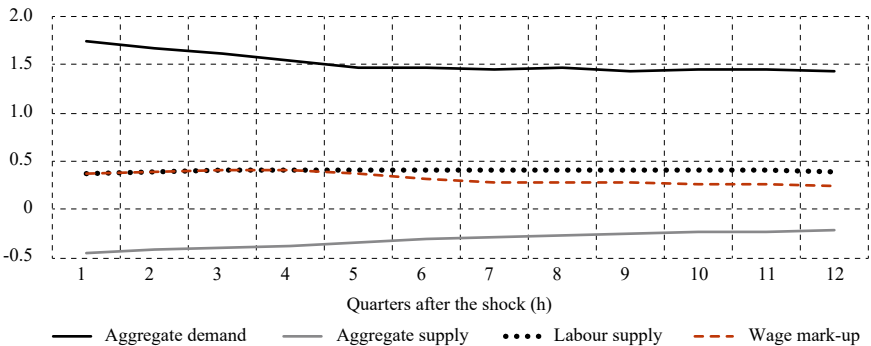*Source: Author.*

GRAPH A22

Cumulative response of public sector prices to a one-standard-deviation wage mark-up shock
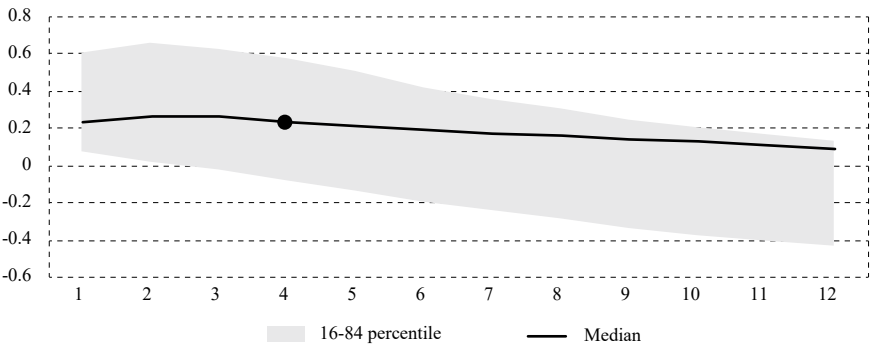
Source: Author.

GRAPH A23

Estimated potential effect of public sector wage growth on headline inflation in 2024 (pp)

Source: Author.

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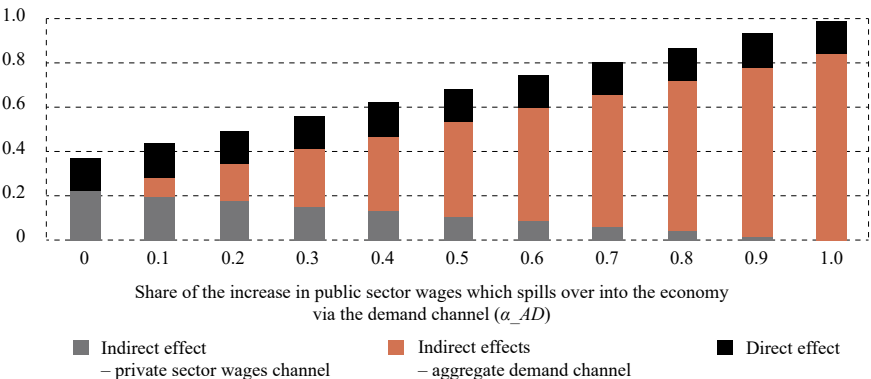
Historical decomposition of nominal wages

GRAPH A24

Historical decomposition of nominal wages

a) Public sector (% y-o-y)

b) Overall economy (% y-o-y)
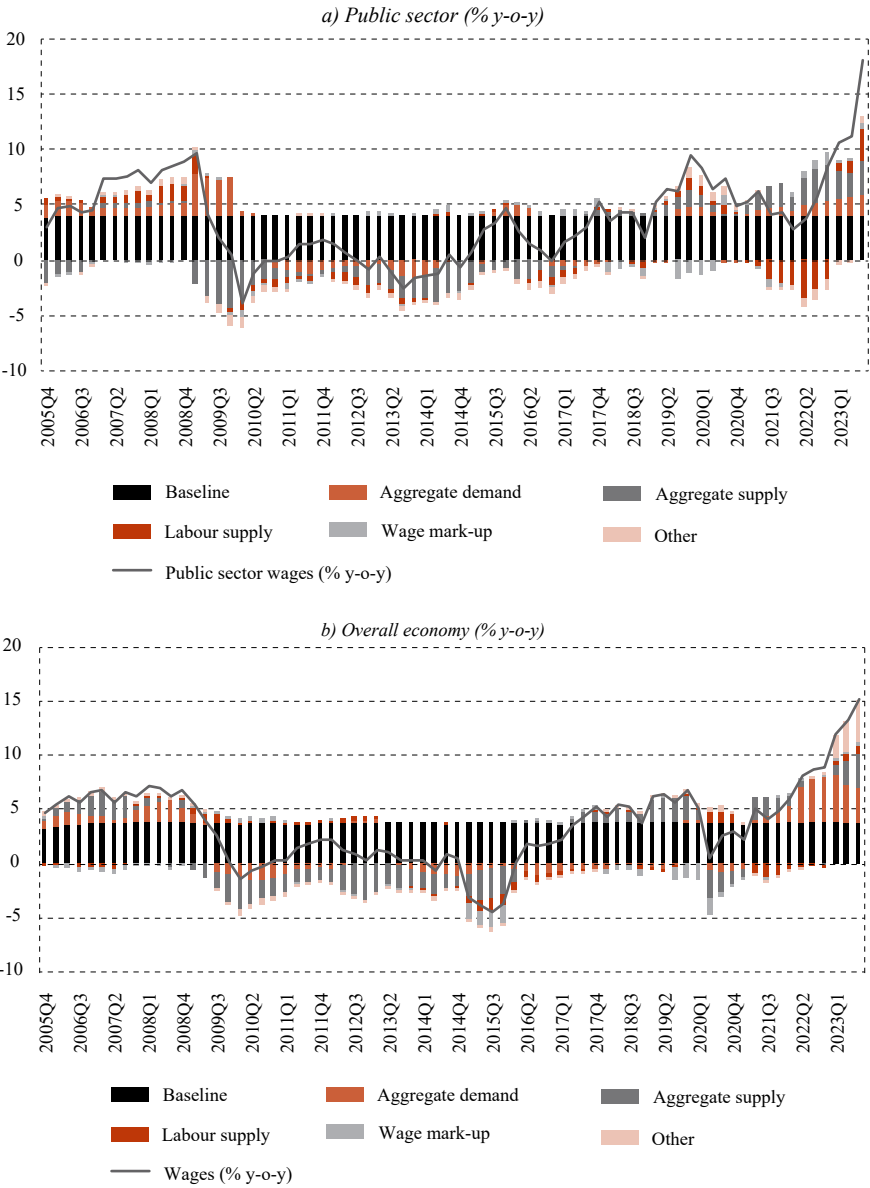
Source: Author.

Pressure on interest rates on deposits in Croatia: government bonds or European Central Bank?

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Abstract

The paper analyses the importance of government bonds as the key instrument on the capital market and their effect on interest rates on deposits in Croatia. February 2023 saw the first government bonds issued in Croatia, which provided citizens with safe investment opportunities, especially following low interest rates periods across Europe that continued several months into Croatia's accession to the euro area. The authors define two hypotheses regarding the effect of government bonds and the European Central Bank (ECB) on interest rates, trying to determine whose relative effect was greater of the two. Combining principal component analysis and regression analysis, the authors determine that government bonds have a limited effect on interest rates, whereas ECB's effect is much more significant. The results suggest a complex dynamic between fiscal and monetary policy, highlighting proactive government measures for stimulating investments and development of the Croatian capital market.

Keywords: factor analysis, government bonds, interest rates, deposits, regression analysis, Croatia

1 INTRODUCTION

Having an understanding of government bonds, which are a significant determinant of money and capital markets, is extremely important since they provide a deeper insight into a country's fiscal policy as well as reflect general macro-economic conditions and shape the investors' expectations. In February 2023, the Croatian Ministry of Finance issued government bonds, a security aimed at small investors, for the very first time. According to the Ministry, this first edition turned into the largest-ever investment of natural persons in a single security in Croatia's history.

The introduction of government bonds was preceded by a long period of low interest rates in Europe, which did not leave Croatian citizens with much alternative for investing their additional savings. The objective of government bonds is to provide Croatian citizens with access to secure and favourable investments on the capital market, setting the path for them to deposit their savings under more favourable interest rates compared to those provided by commercial banks. In addition, the amount of research done on the topic of government bonds is relatively small if we consider their potential effect on the financial system and the role they currently play in Croatia.

Two assumptions serve as the authors' starting points. The first assumption is that government bonds had a more pronounced effect on changes to interest rates compared to the policies of the European Central Bank (ECB), while the second assumption is that the ECB had a more significant effect on changes to interest rates.

Since citizens still predominantly channel their savings to current account deposits, the Analysis of household sector deposits by counties has shown, as expected, that the deposits of Croatian households increased by 7.3 billion euro in the past

two years (HGK, 2024). Croatian National Bank (CNB, 2024) reports total household deposits reaching 37.6 billion euro, which signifies the importance of investment instruments such as government bonds being available. With the first edition of government bonds collecting 1.85 million euro of citizens' savings, such instruments may attract these funds and provide citizens with safer and more favourable investment opportunities in the context of widespread effects of monetary policies and interest rates dynamics.

Croatian citizens have several other investment alternatives to government bonds at their disposal, such as structured deposits and money market funds. All of these meet the key criteria of availability, low risk and short maturity period with higher potential returns compared to classic saving schemes. In addition to debt instruments, which have lower risk levels than ownership instruments, investors have at their disposal a wide array of instruments through which they can effectively diversify their portfolios. While bond funds offer a more stable return with lower profit potential, equity funds enable diversification and higher returns in the long term but are also more prone to market fluctuations. Investing in real estate, which is a popular instrument among Croatian citizens, provides income from rent and capital growth but requires higher initial investments. Precious metals, such as gold, are also a popular instrument, but they, just like foreign currency savings, are highly volatile and risk-prone.

The paper is structured as follows: the second section provides an overview of empirical and theoretical research on the topic of government bonds and their correlation with trends in interest rates on deposits. Section three describes the methodology used in the research, clarifying the two types of analysis used – principal component analysis and regression analysis, while section four explains data sources and structure. Section five presents the results of the empirical analysis, while the final chapter provides concluding remarks.

2 LITERATURE OVERVIEW

Leko and Stojanović (2018) describe government-issued bonds, together with interest rates, yields and trends as one of the indicators of movement and a benchmark of money and capital markets. The stability of the financial and banking system – but of the economy as a whole as well – is indirectly liable to interest rates on government bonds, since benchmark interest rates applied by the state when financing deficits through debt are, as described by ECB (2019) the basis for all kinds of financial contracts. Government bonds, as defined by HANFA (2023), are bonds issued by the Ministry of Finance and intended for direct purchase by small investors, i.e. citizens. Following their initial listing on the Zagreb Stock Exchange, government bonds may be sold and bought at the secondary market.

Even though investors usually rely on generating a desired level of return at an adequate level of risk, Dragić and Lamza (2004) highlight that, in the case of investing in government bonds, investors primarily rely on acquired trust since

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government bonds are not secured by collateral. Bond purchaser is motivated by making profit through capital gain and current return, while the total return on government bond is expressed as the return until maturity. The longer the period for which bonds are issued, the higher the risk of change in market value for potential investors, which Orsag (2011) relates to the risk of interest rate changes. During the period of economic uncertainty, investors often prefer the security of government bonds over deposits, which may lead to a rise in interest rates on deposits as means of adapting to changes in demand.

In February 2023, the Republic of Croatia, represented by the Ministry of Finance, published a Public Offer expressing its intention to issue government bonds at a nominal value of 1 billion euro with a fixed annual interest rate of 3.25% minimum, with annual interest payment and one-off repayment of principal amount and 2025 as the maturity period. According to Croatian Government data (2023), by issuing government bonds for the purpose of bond refinancing and paying off due debts, a total of 1.850 billion euro was collected, which is the largest-ever investment of natural persons in a single piece of security. Whereas the first round of government bonds was primarily aimed at citizens, who registered 1.335 billion euro in bonds (Croatian Government, 2023), the second round also provided institutional investors with an opportunity to register bonds, resulting in 515 million euro of bonds registered by legal entities. Research conducted by CNB and HANFA (2023) shows that citizens' affinity toward saving, which is the part of finance with highest public awareness levels, is extremely low and only 51% of citizens (out of 1,000 respondents), are users of at least one form of active saving. The results of this research show that one-third of citizens keep their savings at home or in their wallet while one-sixth deposits them at a savings account; only 1% of citizens decided to invest their money in bonds or fixed-term deposits.

Empirical literature on the effect of government bonds on interest rates on deposits indicates a correlation between the financial instruments above. Various research has studied the way governments act when issuing bonds, which has an effect on bank deposits and, in turn, on many other macro-economic indicators.

Mourão and Stawska (2020) discovered a substantial substitution effect between government bonds and bank deposits in European countries. The authors conclude that, if the volume of bank deposits was to increase by 1%, the significance of bonds in the GDP of the analysed countries would become greater. More specifically, it increases by 0.52%, which is an especially high rate in times of expansion policies. In addition, negative interest rates may endanger depositary preferences of capital and regular investors, which further increases the appeal of government bonds and treasury bills as an alternative instrument (Mourão and Stawska, 2020). The authors also highlight that the zero interest rate (circumstances in which Croatia has found itself for the past couple of years) supports fiscal stimulation as it creates conditions for increasing budgetary deficits with lower borrowing costs. Furthermore, in the course of their research, Mourão and Stawska (2020)

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demonstrated a significant effect of the government's fiscal policies on bank deposits. The results of their analysis suggest that governments that are more dependent on issuing government bonds are able to reduce the appeal of bank deposits as a form of saving.

Grigorian and Manole (2016) also researched the return on government bonds and deposits in Europe, arriving to the conclusion that low interest rates may lead to deposit withdrawals from banks and a surge in demand for more secure government bonds, which can, in turn, further reduce interest rates on deposits. Gennaioli, Martin and Rossi (2018) conducted a similar analysis, in which they explored the relation between banks, government bonds and risks of outstanding commitments, concluding that banks often hold substantial amounts of government bonds, which can act as a stabiliser during economic crises but can also increase the banking sector's exposure to the country's credit risk. This exposure may have an effect on interest rates on deposits offered by banks, especially in situations of higher uncertainty and risk of a country going bankrupt. In addition, Grigorian and Manole (2016) highlight that changes to global economic conditions, such as recessions or financial crises, may affect the dynamics between government bonds and bank deposits.

Banks play a crucial role in transmitting monetary policies, especially in Europe as a bank-centred system. In transition economies, which need to integrate their systems with the European, the primary challenge is understanding the transmission mechanism, including its implementation and application in the financial system at hand (Žigman and Lovrinčević, 2005). Problems in transmitting monetary policies are the result of non-conventional measures prioritising economic growth and causing negative interest rates. These measures were implemented by the European Central Bank, which strives to solve the challenges which complicate the attainment of the defined inflation goals (Fernandez, 2004). Objective limitation to the transmission mechanism of monetary policies in Croatia is derived from reduced monetary sovereignty, followed by an absence of classic transmission mechanisms such as interest rates and credit channels (Žigman and Lovrinčević, 2005).

3 METHODOLOGY

Introduced back in 1901 in a paper by Pearson and developed as an independent method by Hotelling in 1933, Principal Components Analysis (PCA) is the oldest and most well-known technique for multivariate data analysis. In the words of Johnson and Wichern (2013), PCA relies on explaining the structure of variances and covariances of a set of variables through several linear combinations of these variables. They also add that PCA serves as an intermediary step in more complex research, which is also the present authors' objective – the result of PCA, i.e. several PC variables will be used in the multivariate linear regression model, in which the number of independent variables depends on the number of components which will be selected for the model, depending on the results.

Considering the complexity of the financial system and heterogeneity of the analysed countries, the authors have chosen this method in order to simplify the model which would include at least 20 independent variables in the opposite case, i.e. one variable for each euro area member state and one which signifies changes in demand for credits. Furthermore, by reducing the number of independent variables in the regression model through a factorial analysis, we prevent the loss of degrees of freedom and avoid the problem of multicollinearity.

Even though p components are required to reproduce the overall variability of the system, the majority of this variability can often be explained through a smaller number k of principal components. If this is the case, k components contain almost the same amount of information as the original p variables. Therefore, k of principal components can replace the initial p variables, while the original dataset, comprising of n measurements of p variables, is reduced to a dataset comprising of n measurements of k principal components (Johnson and Wichern, 2013).

According to Johnson and Wichern (2013), principal components (PC) are dependent on the correlation matrix R, or the co-variation matrix of $\sum$ variables $X_1,\ X_2,...,\ X_p$ Random vector $X' = [X_1,\ X_2,...,\ X_p]$ shall contain the covariation matrix $\sum$ with specific values $\lambda_1 \geq \lambda_2 \geq ... \lambda_p \geq 0$. In such a scenario, linear combinations are the following:

$$Y_1 = a'_1 X = a_{11}X_1 + a_{12}X_2 + ... + a_{1p}X_p$$

$$Y_2 = a'_2 X = a_{21}X_1 + a_{22}X_2 + ... + a_{2p}X_p$$

$$\vdots$$

$$Y_p = a'_p X = a_{p1}X_1 + a_{p2}X_2 + ... + a_{pp}X_p$$

(1)

Equation (1) is then transformed into:

$$Var(Y_i) = a'_i \Sigma a_i \qquad i = 1, 2,..., p$$

$$Cov(Y_i, Y_k) = a'_i \Sigma a_k \qquad i, k = 1, 2,..., p$$

(2)

PCs therefore represent uncorrelated linear combinations $Y_1, Y_2, ... , Y_p$ whose variances from (2) are maximally possible. The first PC is a linear combination with the highest dispersion (data variance), while the share of explained data variability progressively decreases in PCs that follow it. More precisely, the first PC maximises the expression $Var(Y_i) = a'_i \Sigma a_i$ which can be increased by multiplying a_1 with any constant. Furthermore, to eliminate this lack of definitiveness, the authors consider it reliable enough to limit the coefficients to a single-unit length to ensure lack of correlation between principal components and that each component includes the maximum possible variation of original data. From this the following is derived:

*First principal component (PC_1) = linear combination of $a'_1 X$ maximising
Var ($a'_1 X$) provided that $a'_1 a_1 = 1$*

(3a)

*Second principal component (PC_2) = linear combination of $a'_2 X$ maximising
Var ($a'_2 X$) provided that $a'_2 a_2 = 1$ and Cov ($a'_1 X, a'_2 X) = 0$*

(3b)

and on the ith iteration

*i^{th} principal component (PC_i) = linear combination of $a'_i X$ maximising
Var ($a'_i X$) provided that $a'_i a_i = 1$ and Cov ($a'_i X, a'_k X) = 0$ for $k < i$*

(3c)

Mishra et al. (2017) argue that having obtained co-variation or correlation matrix, one should calculate eigenvalues and eigenvectors of the matrix concerned, which would be used to analyse the variance PCs. Eigenvalues and eigenvectors provide eigen-decomposition of the matrix, which analyses the matrix structure and is used for discovering the maximum of functions that are present in the matrix, i.e. the maximum variability of original data. This decomposition, or the selection of PCs from equation 3, will be simplified in the form of a Scree plot, which is presented in section 5.

In order to adequately analyse the correlation between interest rates on deposits and the issuance of government bonds, the authors include in the regression model dummy variables which, according to Venkataramana et al. (2016), are used as the classification component that splits the analysed sample into different groups and enables regression analysis to be run for each group separately. Taking into account that the authors' objective is to analyse the effect of government bonds and ECB on the levels of interest rates on deposits in Croatia, the model includes two dummy variables, the definitions of which are explained in the next section.

4 DATA

Key data sources include various variables selected for the purpose of PCA, and their outcome will be implemented in the regression model. The earliest data for Croatian interest rates on deposits is available from January 2012, so all data used in the analysis have been collected on a monthly basis and cover the period between January 2012 to July 2024, which is the last month for which data was accessible. In addition, interest rate data is secondary, expressed in relative terms (interest rate amount) and has been taken over from several sources.

Data for Croatia consists of weighted averages of interest rates on fixed-term deposits of households from the consolidated balance sheet of monetary institutions, downloaded from the Croatian National Bank's website. In addition, EURIBOR historical values, which is the benchmark interest rate of the money market, administered by the European Money Markets Institute (EMMI) and which is calculated for several maturities, have been downloaded from the ECB website as the average of

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month-long observations for the euro area with variable composition (ECB, 2019). Data for other euro area countries are at the same time variables which will be used in the PCA (Austria, Belgium, Cyprus, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Germany, Netherlands, Portugal, Slovenia, Slovakia and Spain). This data was also downloaded from ECB's database and represents interest rates on overnight household deposits on newly contracted deals. Considering that banks had no urge for increasing interest rates for several reasons, such as the high liquidity surpluses as mentioned above and high demand for consumer credits, the authors introduced an additional variable into their model – credit demand. The data for this variable, seasonally adjusted, was also downloaded from the ECB website and represents an annual growth rate of credits issued to households in the euro area compared to the same period in the previous year.

FIGURE 1

Trends in interest rates on deposits (in %)
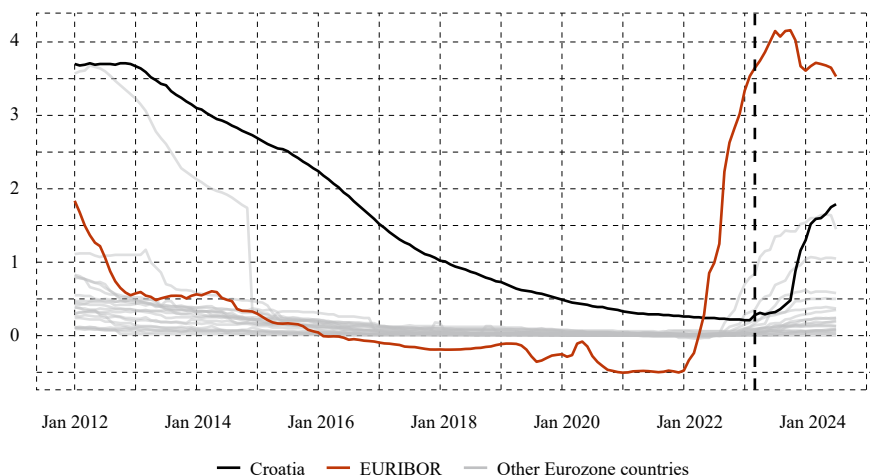
Source: Authors' based on EMMI data.

EURIBOR and interest rates trends in euro area countries in the period between January 2012 and July 2024 are presented in figure 1. Black line represents Croatia, while red line represents EURIBOR. Lighter shade of grey signifies all other countries. In the period 2012-2016, interest rates on deposits demonstrate a decline for all observed countries, including Croatia and EURIBOR. After 2016, interest rates remain low all the way up to late 2022. In June 2022, ECB announced higher interest rates. This increase spilled over to interest rates in other euro area countries in the following months.

Considering the fact that Croatia became a full member of the euro area on 1 January 2023, interest rates were not expected to rise immediately, while interest rate transfer was delayed by higher liquidity arising from a sudden reduction in minimum reserve. The dotted vertical line represents March 2023, the month

when government bonds were first issued in Croatia. We can see that interest rates in Croatia remained low until this period and cannot disregard the slight increase in interest rates in Croatia in the period following the issuance of government bonds, which became even more substantial a few months later.

As per Hair et al. (2019), the sample fed into the factor analysis, more specifically principal components analysis, should include at least 100 observations of each variable, with a 5:1 ratio of sample size and number of variables. Since the data covers a period of 151 months and the model defines 22 variables, this condition is considered met. By using the method described above, principal components are selected to represent a linear combination of all original variables derived as orthogonal projections of data to a smaller area. The quantitative analysis of the variables has been run in the RStudio software.

5 RESULTS OF EMPIRICAL RESEARCH

The analysis starts out by creating PC variables that include interest rates for individual euro area countries, excluding Croatia. This reduction in data dimensionality has been visualised in the form of a Scree diagram, shown in figure 2, which visualises eigenvalues and enables us to select the number of principal components to be included in further analysis.

FIGURE 2

Share of explained variance (eigenvalues) of each PC (in %)
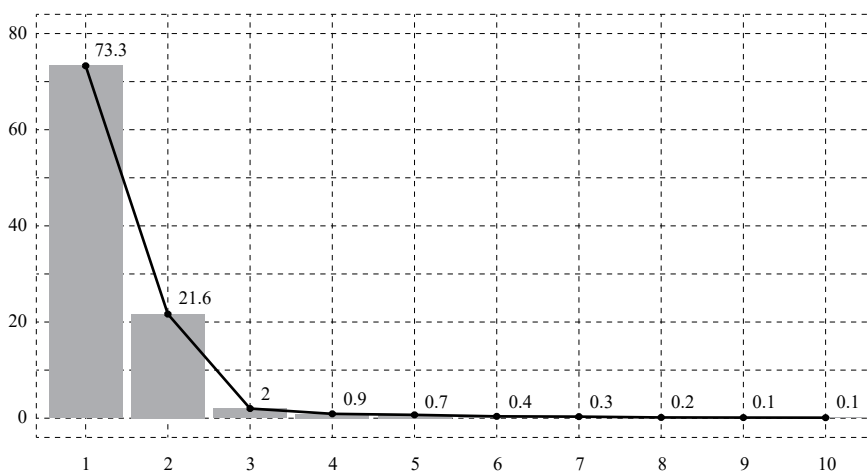
Source: Authors' based on Eurostat data.

According to Johnson and Wichern (2013), a Scree plot combines the ordered eigenvalues on the y axis and the number of relevant components on the x axis, sorting them from highest to lowest. The point in which the line bends, the so-called "elbow", represents the final number of components that should be taken into account. It is clear that the first two principal components (PC_1 and PC_2) explain the largest amount of variability in the data – 94.9% in total – and will

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therefore be included in the analysis. Since the remaining components explain for relatively small amounts of variance in the original data on interest rates on deposits in the remaining euro area countries, they are all of similar effect sizes and will not be considered in further analysis.

TABLE 1
Elements of selected principal components (in %)

Country	Share in PC_1	Country	Share in PC_2
Spain	6.10	Estonia	11.55
Italy	5.99	Luxembourg	9.58
France	5.97	Lithuania	7.99
Germany	5.97	Austria	7.37
Slovenia	5.91	Greece	7.00

Source: Authors' calculations.

Table 1 presents five countries with the highest share selected to represent the principal components. PC_1 is more-or-less equally described by countries in the first column, while PC_2 is dominated by Estonia, explaining for 11.55% of the share among the countries making up this component. The overall contribution of Luxembourg in PC_2 is slightly below 10%, while individual shares of remaining countries are below 8%. Countries such as Spain, Italy, France, Germany and Slovenia have the largest share in PC_1, which explains for 73.3% of data variance.

As described above, apart from the principal components PC_1 and PC_2 as independent variables, the model also includes dummy variables representing specific time periods. The multivariate linear regression model has been set up to analyse the effect of these variables on changes to interest rate levels in Croatia, as represented in the following equation:

$$Croatia_t = \beta_0 + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 PC_{1t} + \beta_4 PC_{2t} + \beta_5 credits_t + \varepsilon_t \quad (4a)$$

in which $Croatia_t$ represents the dependent variable – the level of interest rates on deposits in Croatia in the period t, D_{1t} and D_{2t} are qualitative (dummy) variables that would be tested through several definitions, β_0 is the constant, β_1, β_2, β_3, β_4 and β_5 are regression coefficients assigned to independent variables and ε_t represents random error. In order to remove the trends and ensure data stationarity, variables $Croatia_t$, PC_{1t} and PC_{2t} were transformed into their first differences, variable $credits_t$ was squared, leading to the final regression equation (4a) expressed in the following form:

$$dCroatia_{i,t} = \beta_0 + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 dPC_{1t} + \beta_4 dPC_{2t} + \beta_5 credits_t^2 + \varepsilon_{i,t}$$
$$(4b)$$

The model has been trained with several different definitions of dummy variables in order to arrive at a more thorough analysis of the issuance of government bonds. These definitions are provided in table 2. For each of the three definitions, D_2 acquires the value 1 in the period in which Croatia was a euro area member,

with D_1 defined differently in order to analyse the effect of government bonds: (1) throughout the period following their issuance – long-term effect, (2) at the time of issuance – immediate effect, and (3) with a delayed effect following Hrvatska poštanska banka (HPB) announcement regarding higher interest rates – additional state intervention.

TABLE 2
Definitions of dummy variables

	D_1 (government bonds)	D_2 (ECB)
Model 1	3/2023-7/2024	1/2023-7/2024
Model 2	3/2023	1/2023-7/2024
Model 3	10/2023	1/2023-7/2024

Note: Table columns represent periods (month/year) in which each dummy variable in the model assumes the value 1 (implying the value 0 in all other columns).

Source: Authors' own specification.

Table 3 shows the results of the regression models for the definitions of dummy variables presented above. We can see that the first dummy variable (D_1) is statistically significant only in Model 1, which indicates a potential long-term effect of government bonds on interest rates in Croatia. Furthermore, beta coefficient in this model is higher for D_1 than it is for D_2, which implies a relatively stronger effect in comparison to ECB, a variable that is not statistically significant at standard significance levels. On the other hand, in the remaining two models D_2 reaches statistical significance only at 1% significance level. The variable "credits" has a statistically significant positive effect on interest rates trends in Croatia in all three models, which was the assumption since a rise in demand for loans leads to a rise in the price of money, i.e. interest rates. In addition, PC_1 is not significant in either of the models, which means that changes in interest rates in countries such as Spain, Italy, France, Germany and Slovenia do not affect interest rate trends in Croatia. On the other hand, PC_2 is statistically significant (but with a negative effect) in the analysed models at 5% significance level. This can be attributed to the fact that the economies of countries making up PC_2 (Luxembourg, Austria, Estonia, Lithuania and Greece) are more similar to Croatia's economy than are the economies of PC_1 countries.

TABLE 3
Results of the regression analysis

	Model 1		Model 2		Model 3	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
constant	-0.039	0.000***	-0.037	0.000***	-0.037	0.000***
D_1	0.106	0.001***	-0.020	0.646	0.002	0.962
D_2	0.044	0.166	0.140	0.000***	0.139	0.000***
PC_1	-0.007	0.756	-0.008	0.746	-0.007	0.769
PC_2	-0.057	0.017**	-0.062	0.012**	-0.062	0.013**
credits	0.002	0.010**	0.001	0.038**	0.001	0.042**

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

Source: Authors' calculations.

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When we consider the results above, we can conclude that government bonds have a statistically significant effect on the increase in interest rates on deposits in Croatia if observed in the long term (D_1 assumes the value 1 throughout the period following the issuance). However, in this very same model ECB has no statistically significant effect on interest rates. If the effect of bonds is observed as an immediate effect (Model 2), then the bonds will have no statistically significant effect, while the effect of ECB is positive and statistically significant. In addition, if we take into consideration the initial response of HPB (bank whose majority shareholder is the state) to the Government's appeal to increase interest rates in October 2023, followed by increases in other banks, in this case the issuance of bonds has no statistically significant effect on interest rate trends.

TABLE 4

Verification of model robustness – model without PCs

	Model 1		**Model 2**		**Model 3**	
Variable	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
constant	-0.077	0.000***	-0.078	0.000***	-0.078	0.000***
D_1	0.100	0.001***	-0.009	0.820	-0.025	0.539
D_2	0.012	0.664	0.100	0.000***	0.100	0.000***
euro area	0.167	0.000***	0.178	0.000***	0.180	0.000***
credits	0.004	0.000***	0.004	0.000***	0.004	0.000***

Note: *** p<0.01, **p<0.05, *p<0.1.
Source: Authors' calculations.

In order to test the model robustness, the model replaced PCA with euro area as the independent variable coding for EURIBOR rates downloaded from ECB website. The results provided in table 4 are similar to data in table 3, where D_1 is significant only in Model 1, D_2 is significant in Models 2 and 3, while the variables "credit" and "euro area" are significant in all three models.

6 CONCLUSION

Even though government securities are primarily intended for meeting fiscal policy objectives, the issuance of government bonds to the Croatian capital market has shown that their use is much wider than just collecting funds for financing budget deficits with relatively low interest rates. Specifically channelling government bonds toward small and conservative investors enables citizens to invest securely with favourable interest rates, which stimulates financial involvement and expands the pool of investors.

With Croatia joining the euro area, the previously limited transmission mechanism of interest rates should now have a more substantial effect on bank behaviour. However, since Croatia joined the euro zone fairly recently, delays and obstacles in its functioning are possible.

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The combination of PCA and regression analysis was done in order to test the correlation of the issuance of government bonds on interest rates on deposits. As shown in the Scree diagram, the first two principal components were selected because they explain almost 95% of overall variation in data, which suggests that these two components are significant for describing changes to interest rates on deposits in Croatia. Regression models were tested by means of several definitions of dummy variables: D_2 takes the value of 1 during Croatia's euro zone membership, while D_1 analyses the effect of bonds through three definitions: long-term effect since issuance, immediate effect upon issuance, and delayed effect after seven months, when HPB announced higher interest rates. Regression analysis results indicate statistical significance of the issuance of government bonds only in Model 1, in which ECB's effect is non-significant. Furthermore, the remaining two models indicate a statistically significant effect of ECB on interest rate trends in Croatia but also a non-significant effect of government bonds.

Considering that the government is the majority shareholder in HPB, we can assume that this intervention was aimed at enhancing the effect of government bonds, which further explains their correlation with the increase of interest rates. All the results above indicate how complex the financial system is, in which phenomena such as government bonds have mixed results, depending on which of the tested models is being considered. Model 1 confirms the authors' hypothesis that government bonds have a relatively larger effect on interest rates in relation to ECB, whereas in Models 2 and 3 the opposite is the case – by increasing its interest rates, ECB had a greater effect on interest rates in Croatia than government bonds.

The results of the empirical research indicate a complex dynamics between fiscal policy (issuing government bonds) and monetary policy (interest rate trends) as well as the role of government institutions in regulating the financial market. All of the above, together with the results of the analysis, leave room for future research. Recommendations for future research pertain primarily to the need to study in more detail the causal effect of the issuance of government bonds on trends in interest rates, primarily by expanding the timeframe of the analysis, in order to estimate the long-term effect of government bonds but also the potential delayed effects that have not been recorded in the observed period.

Disclosure statement
Authors have no conflict of interest to declare.

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LUCIJA RAŠIĆ, NOA HINGER:
PRESSURE ON INTEREST RATES ON DEPOSITS IN CROATIA:
GOVERNMENT BONDS OR EUROPEAN CENTRAL BANK?

Bank profitability
in the euro area
in times of high inflation

MISLAV BRKIĆ, univ. spec. oec.[*]

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Abstract

Following the shift in the European Central Bank's (ECB) monetary policy in mid-2022, the interest income of euro area banks rose markedly, boosting their overall profitability. This paper shows that the positive impact of higher interest rates on bank profitability was amplified by the existence of abundant excess liquidity. In particular, since euro area banks held large stocks of excess liquidity, they were able to earn substantial risk-free interest income by simply putting their liquidity into the ECB's deposit facility. In addition, due to the prolonged period of monetary expansion and zero interest rates on time deposits, the share of overnight deposits in total bank liabilities had increased significantly by the time the ECB tightened its policy. Since overnight deposits typically respond slowly to policy rate changes, such a structure of funding enabled euro area banks to enjoy comfortable net interest margins for some time.

Keywords: inflation, monetary policy, fiscal policy, bank profitability

1 INTRODUCTION

The sudden rise in inflation in the period 2021-22 created many losers and some winners. The obvious losers were lower-income households, who typically spend a significant part of their income on basic necessities, such as food and energy, the prices of which rose the most in the post-pandemic period. For this reason, many of the support measures adopted by national governments were aimed specifically at mitigating the impact of inflation on this part of the population. Banks, on the other hand, were among the winners. The steep rise in the ECB's key interest rates was reflected very quickly in banks' interest income, while the rise in interest expenses was much slower. As a result, the net interest income and reported profitability of banks improved markedly. Announcements of record bank profits were not well received by the public, given rising living costs and the increasingly tight financing conditions that were felt by most households. In principle, a rise in interest rates can also affect banks in a negative way, such as through a reduction in the economic value of banks due to mark-to-market losses on fixed income assets or through a more fragile liquidity position as the situation in funding markets worsens. Furthermore, when interest rates go up, the solvency of borrowers can be undermined, exposing banks to higher provisioning costs. However, these negative effects were in this period quite small compared to the positive impact of higher interest rates on bank earnings (ECB, 2023).

The objective of this paper is to determine why the impact of monetary policy tightening on bank profitability was so strong in this particular episode. The euro area had experienced a monetary policy tightening cycle in the past, but the impact on bank profits was not even remotely as strong as it was this time. What makes the recent policy tightening cycle so special is the fact that it began right after the end of a long period of unprecedented monetary easing; the ECB had been pursuing a highly accommodative monetary policy for more than six years when inflationary pressures emerged in 2021. During this period, the ECB carried out two

rounds of quantitative easing, the first of which was launched in 2015 to tackle deflationary pressures, and the second in 2020 to contain the economic fallout from the COVID-19 pandemic. Meanwhile, the ECB supplied banks with liquidity also directly by conducting targeted long-term refinancing operations, with the aim of encouraging banks to step up lending to the private sector.

An important effect of these large-scale monetary operations was a significant injection of liquidity into the banking system. In particular, the excess liquidity of euro area banks increased from 120 billion euro in December 2014 to more than 4.5 trillion euro in March 2022, when the second round of quantitative easing finally ended. Prior to the change in monetary policy, this large excess liquidity was actually costly for banks, given that the ECB had applied a negative interest rate to banks' deposits with the Eurosystem central banks since 2014. However, as soon as the ECB began raising its key interest rates in the summer of 2022 to tackle high inflation, trillions of euros of excess liquidity became a major source of interest income for euro area banks. The interest rate that banks could earn by placing their excess liquidity into the ECB's deposit facility rose by a cumulative 4.5 percentage points from June 2022 to September 2023. Bank lending rates rose quickly as well, particularly interest rates on loans to non-financial corporations. In contrast, interest rates on customer deposits responded more gradually, with the pass-through to retail overnight deposits – whose importance as a source of funding for banks had increased considerably during the years of quantitative easing – being particularly weak. Since interest income grew much faster than interest expenses, banks' net interest income soared.

The paper is structured as follows. Section 2 provides a brief background, documenting how euro area banks performed in the period before inflation started to rise. In particular, it shows how the extremely accommodative monetary policy of the ECB led to a rapid build-up of excess liquidity in the banking system and how banks adapted to such an environment in order to maintain their profitability. Section 3 is the central part of the paper which looks at the different channels through which the ECB's policy rate hikes boosted bank profitability. In that regard, special attention is paid to the role of substantial interest income that banks earned by simply depositing their excess liquidity with the Eurosystem. Section 4 draws some policy lessons from the post-pandemic period, and section 5 concludes the paper.

2 MONETARY POLICY OF THE EUROPEAN CENTRAL BANK AND THE BUILD-UP OF EXCESS LIQUIDITY
2.1 MONETARY POLICY OF THE EUROPEAN CENTRAL BANK FOLLOWING THE EURO AREA SOVEREIGN DEBT CRISIS
To understand the link between inflation and bank profitability in the recent period better, it is important to consider the environment in which euro area banks had operated before inflation started to rise. The global surge in inflation in 2021-22 was preceded by a prolonged period of subdued price pressures. In the aftermath of the global financial crisis of 2008-09, the euro area economy experienced

several years of disappointing performance, with weak growth and an inflation rate consistently below the ECB's target of close to 2 percent. This was partly a result of high uncertainty and financial market instability caused by debt refinancing problems that some member states experienced following the global financial crisis. The debt crisis, which peaked between 2010 and 2012, was so severe that it almost led to the collapse of the monetary union. Financial stability was eventually restored, but only after a series of major institutional reforms had been implemented, and after the ECB had taken decisive steps to reassure investors that the single currency would not collapse.

FIGURE 1

ECB's key policy rates (in percent)
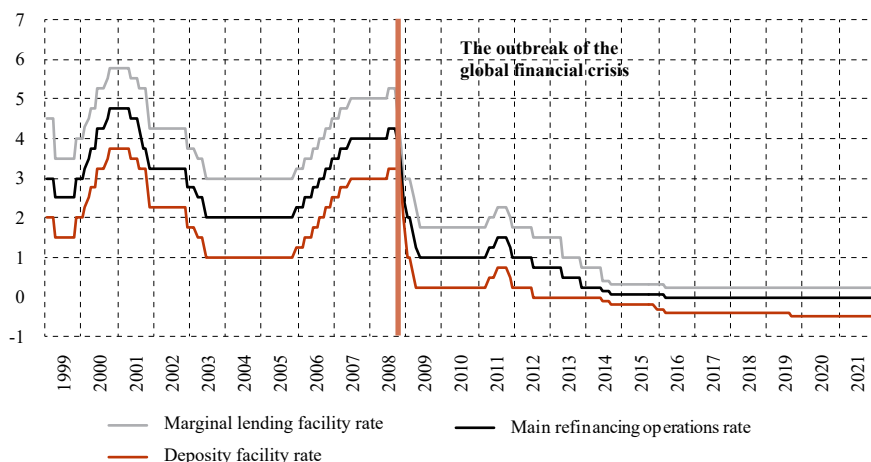
Source: ECB.

Although the sovereign debt crisis had subsided by 2013, economic growth remained modest and inflation continued to edge down. In order to facilitate the recovery and bring the inflation rate closer to its target, the ECB pursued a highly expansionary monetary policy, which continued until the end of the decade, and beyond (figure 1). The key policy rates were brought to below zero, banks were supplied with ample, low-cost funding through the longer-term refinancing operations, and a large-scale asset purchase program was introduced in early 2015 in an attempt to reduce borrowing costs more directly.[1]

The pass-through of the ECB's policy measures to financial markets was smooth and strong. For example, as shown in figure 2, euro area governments saw a substantial reduction in borrowing costs when the debt crisis had ended, and particularly after the ECB's decision in March 2015 to launch a major bond buying scheme – the Asset Purchase Programme (APP). By purchasing long-term government

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[1] While changes in key policy rates affect the borrowing costs of the non-financial sector indirectly – by altering the conditions under which banks can borrow from the central bank or deposit excess liquidity with the central bank – asset purchase programs directly reduce interest rates on the bonds that are purchased under the program.

bonds in large quantities, the Eurosystem central banks caused the term premium on these bonds to narrow, resulting in a sharp drop in bond yields (Eser et al., 2019). In such an environment, Germany, France and several other advanced euro area member states saw their 10-year government bond yields fall below zero for the first time in history. In order to secure long-term gains from such favourable financing conditions, member states' governments took measures to extend the average maturity of their debts, so that the benefits of exceptionally low interest rates would be felt also in the future (Plessen-Mátyás, Kaufmann and Landesberger, 2021).

FIGURE 2

Yields on 10y government bonds of selected euro area member states (in %)
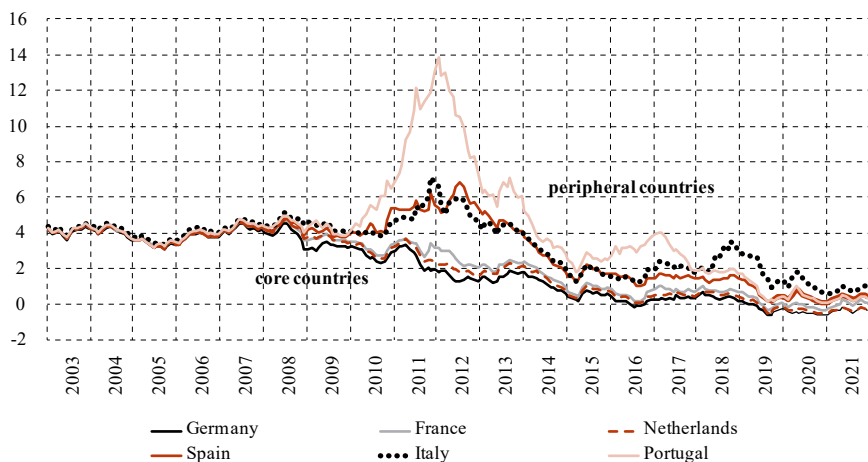
Source: Eurostat.

The transmission of the accommodative monetary policy to bank interest rates was equally smooth, as shown in figure 3. In particular, low central bank policy rates and the abundant excess liquidity created by the ECB through its unconventional policy measures exerted a strong downward pressure on bank lending rates. For example, the average interest rate on new housing loans in the euro area, which stood at 3% in 2013, declined steadily thereafter, getting as low as 1.3% by 2021. Interest rates on corporate loans decreased considerably too. The sharp drop in interest rates was not particularly good news for banks. Given that interest income is usually the main source of income for banks, lower lending rates implied a deterioration in their margin and revenue outlook. In particular, it was believed that banks, unable to impose negative deposit rates on their clients, would not be able to cut costs sufficiently to compensate for the loss of interest income. Accordingly, the environment of exceptionally loose monetary policy was challenging for banks as they had to find ways to sustain their profitability while the main source of income was drying up.

FIGURE 3

Bank lending and deposit rates in the euro area, new business (in %)

a) Households

b) Non-financial corporations

— Loans for house purchase
-- Deposits from households with an agreed maturity
— Overnight deposits from households

— Loans to NFCs
-- Deposits from NFCs with an agreed maturity
— Overnight deposits from NFCs
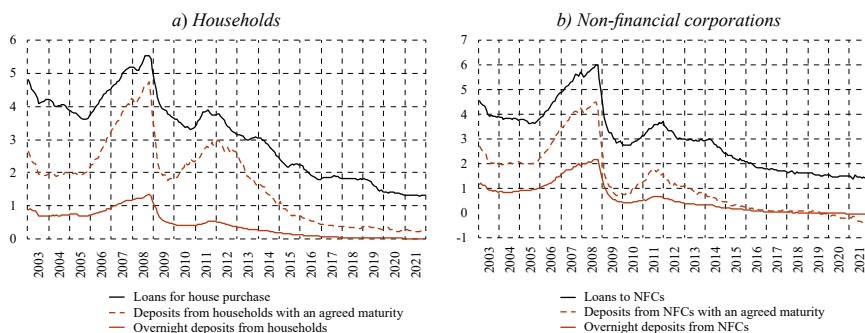
Source: ECB.

2.2 BANK PROFITABILITY DURING THE PERIOD OF EXPANSIONARY MONETARY POLICY

It turned out that banks did manage to adapt to the low interest rate environment. They even gradually improved their profitability, after the negative effects of the sovereign debt crisis of 2010-12 had faded away (figure 4).[2] Banks took actions on several fronts to support their overall income and reduce costs. First, to mitigate the fall in interest income at a time when lending rates were going down, banks increased their lending volumes, which was facilitated by strong demand for loans and a continued easing of banks' credit standards in a favourable macroeconomic environment (ECB, 2018b). Incentives for banks to step-up lending were particularly strong from mid-2014 when the ECB brought the deposit facility rate into negative territory for the first time (Boucinha and Burlon, 2020; ECB, 2018b). From that point on, excess liquidity held in their accounts with the Eurosystem was getting increasingly costly for banks, encouraging them to boost their lending.[3] This is exactly what the ECB wanted to achieve with its negative interest rate policy (Schnabel, 2020).

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[2] At the height of the 2010-12 sovereign debt crisis, banks from the most affected euro area countries had to deal with several challenges which weighed on their profitability, including a weak economy and the resulting subdued demand for loans, large stocks of non-performing loans, high provisioning costs, and impaired access to market financing, as money market investors were reluctant to lend to banks headquartered in fiscally vulnerable member states (Paries, Jacquinot and Papadopoulou, 2016; ECB, 2018a). Moreover, as they had to meet more stringent capital and liquidity requirements introduced after the global financial crisis, banks' lending capacity was constrained, limiting further their ability to generate income.

[3] It is important to note that excess liquidity at the system level does not decrease when banks increase their lending activity. When a bank grants a loan to its client and the client uses the money to spend or invest, the money circulates within the banking system, from their bank's account with the Eurosystem to other banks' accounts with the Eurosystem, but liquidity at the system level remains unchanged. The overall level of liquidity changes almost exclusively as a result of central bank monetary policy operations.

FIGURE 4

Euro area banks' return on equity (in %)
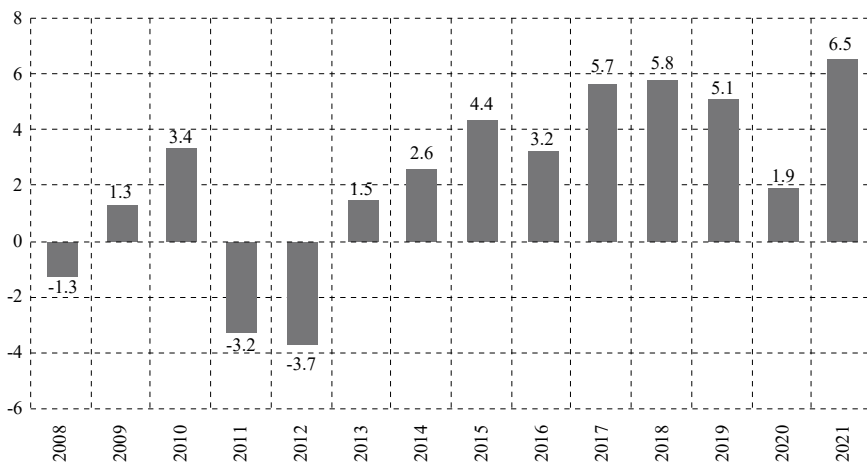
Source: ECB.

Second, banks made sure that their funding costs were reduced as much as possible. These efforts paid off, as shown in figure 5. By lowering their interest expenses, euro area banks managed to fully compensate for the sharp fall in interest income, leaving their net interest income almost unchanged in absolute terms throughout the period of exceptionally low policy rates. This was done at the expense of their depositors, as the bulk of the overall cost reduction was achieved through the reduction of interest rates on deposits.[4] Banks were able to do so without worrying about possible deposit outflows because the banking system was flooded with excess liquidity due to the ECB's quantitative easing. Since yields on safe assets were generally compressed at that time, depositors looking for safe investments had few alternatives, so they kept their money in their bank accounts despite the significant fall in deposit rates. The only noticeable change triggered by the reduction in interest rates on deposits was the migration of funds previously held in time deposits to overnight deposits. Since banks offered the same rate – zero – on time deposits as on overnight deposits, most of their customers preferred to keep their money in overnight deposits, which are more convenient. Moreover, banks took advantage of the low-cost funding provided by the ECB through its targeted longer-term refinancing operations, which further reduced their funding costs. While net interest income remained almost unchanged in absolute terms, it decreased significantly in relative terms in 2020 and 2021 as a result of the rapid expansion of banking system assets driven by the ECB's quantitative easing program (figure 5).

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[4] While interest rates on household deposits never fell below zero, interest rates on corporate deposits were actually negative from late 2019 to mid-2022. This could be attributed to banks taking advantage of the fact that some corporations keep large amounts of liquidity in their bank accounts for payment purposes, making it inconvenient for them to switch entirely to cash when deposit rates turn negative. Households, on the other hand, can more easily switch to holding cash, which limits the banks' ability to impose negative rates on them.

FIGURE 5

Euro area banks' net interest income and margin
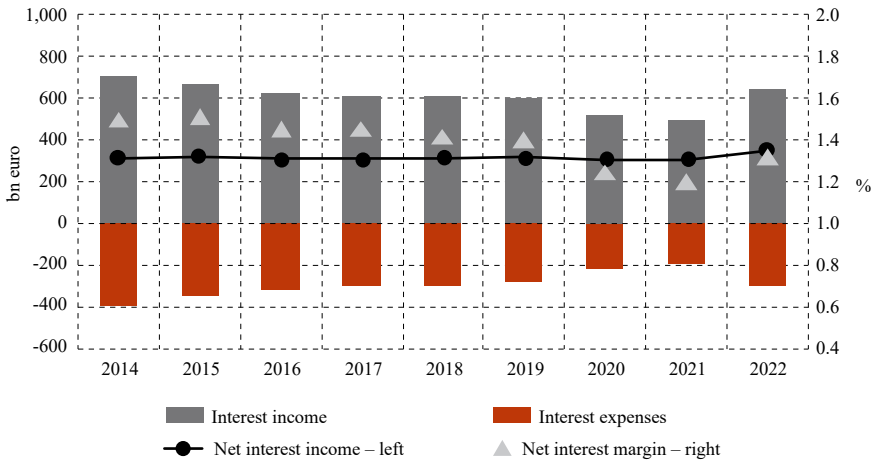
Source: ECB.

Third, to support their profits at a time when interest income was subdued, banks took measures to boost their income from other sources, including by increasing their net fee and commission income (Altavilla et al., 2019). The size of fee and commission income expressed as a percentage of total assets rose accordingly, as did the relative size of capital gains on financial instruments, driven by the positive impact of the ECB's highly accommodative monetary policy on asset valuations.

Finally, euro area banks felt, in an indirect manner, the positive effects of the expansionary monetary policy on economic activity. As the ECB's unconventional policy measures provided an impetus to growth and employment, the creditworthiness of borrowers improved as a result, and the demand for loans was strong. This not only allowed banks to achieve their desired targets for loan growth, but they also saw a steady reduction in provisioning costs. All these factors helped offset the negative impact of compressed net interest margins on bank profitability (ECB, 2016; Altavilla, 2019; Boucinha and Burlon, 2020).

The aggregate performance of Croatian banks in this period was in line with the performance of their euro area peers. Despite the steady decline in lending rates, net interest income remained largely unaffected in absolute terms because the decline in interest income was offset by an equally strong reduction in interest expenses (figure 6). In other words, banks lowered the interest rates on customer deposits to zero in an attempt to compensate for the lower interest income they were earning on their loan portfolios. The abundant and rapidly growing excess liquidity in the banking system – which reflected Croatia's strong balance of

payments position[5] – made it easier for banks to carry out these adjustments because they did not have to worry about a possible outflow of deposits. At the same time, many banks increased the fees they charge their customers in order to boost non-interest income. Moreover, the favourable macroeconomic environment supported an improvement in the quality of banks' assets, with provisions for loan losses decreasing steadily. Nevertheless, as was the case in the euro area, the net interest income of Croatian banks decreased sharply in relative terms starting from 2020 due to the pandemic-related monetary expansion and the associated significant increase in banking system assets (figure 6).

FIGURE 6

Croatian banks' net interest income and margin
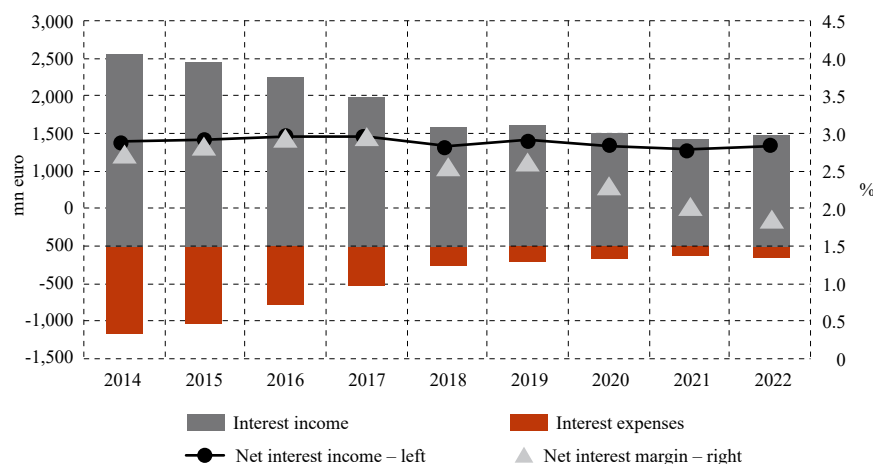
Source: Croatian National Bank.

To summarize, the environment of very low interest rates was challenging for euro area banks, as it weighed on net interest margins, their main source of profits. As shown in the next section, bank profitability indicators improved substantially following the sudden rise in inflation in the second half of 2021. In particular, given that persistently high inflation prompted the ECB to shift from a highly expansionary to an increasingly tight monetary policy, banks began to see a sharp increase in their interest income, which enabled them to enjoy record-high, if temporary, returns on equity.

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[5] In the period from 2014 to 2021, Croatia recorded steady current and capital account surpluses driven by sizeable inflows from EU funds. As these inflows exerted strong appreciation pressures on the kuna exchange rate, the Croatian National Bank frequently intervened by purchasing foreign currency from commercial banks and the government. Given that the central bank maintained an accommodative policy stance at the time, no measures were taken to sterilize the domestic currency liquidity created through these interventions, with the result being a persistent rise in excess liquidity in the banking system.

3 THE ABRUPT RISE IN INFLATION AND THE IMPACT ON BANK PROFITABILITY

### 3.1 THE IMPACT OF HIGHER INTEREST RATES ON BANK PROFITABILITY

The abrupt rise in inflation in the second half of 2021 and the associated deterioration in the medium-term inflation outlook had a profound impact on the profitability of euro area banks. Changes in inflation affect bank profitability indirectly, through the related changes in the level of interest rates, for as inflation picks up, interest rates typically rise in response, which increases – although to different degrees – both the interest income and the interest expenses of banks. Interest rates tend to rise in response to higher inflation due to two main factors: an increase in central bank policy rates and an increase in the inflation risk premium. Central banks raise their policy rates in response to unacceptably high inflation so as to tame aggregate demand and reduce pressure on consumer prices. This is exactly what the ECB, the Fed and most other central banks did once they had realized that the increase in inflation was not a transitory phenomenon. If investors expect the central bank policy rates to stay higher in the future as well, interest rates on longer-term assets will increase in line with short-term rates. The inflation risk premium may cause long-term interest rates to rise beyond the increase in the expected future policy rates. In particular, if a higher current inflation rate leads to greater uncertainty about future inflation, investors in long-term assets will demand a higher compensation for this uncertainty, which will put additional upward pressure on long-term interest rates. As noted by Camba-Mendez and Werner (2017), the inflation risk premium was actually negative in the euro area for several years after the global financial crisis due to persistent deflationary pressures. However, following the recent surge in inflation, the inflation risk premium turned positive again (Lane, 2022).

Bank profitability normally improves when interest rates rise. While their interest expenses also grow when financial conditions tighten, the response of banks' interest income is usually stronger. This seems counterintuitive at first, given the positive contractual maturity gap that most banks have, in the sense that the weighted average maturity of their interest-earning assets is much longer than the maturity of their interest-bearing liabilities. However, as noted by Borio, Gambacorta and Hofmann (2017) and Drechsler, Savov and Schnabl (2021), banks' positive maturity gap is very small in practice because the behavioural duration of deposits is much longer than their contractual duration. Specifically, an important source of funding for banks is low-cost retail overnight deposits, which respond very slowly to changes in central bank policy rates. A large base of retail overnight deposits can mitigate the impact of policy rate hikes on banks' interest expenses and thus create room for an increase in net interest income. Banks also actively hedge their exposure to interest rate risk, for instance by granting variable-rate loans and – in the case of large, sophisticated banks – using interest rate derivatives, in order to amortize the possible negative impact of changes in the level of interest rates (Coulier et al., 2023). Another factor supporting bank profits is a steepening of the yield curve, which often occurs when interest rates are rising.

Given the long average maturity of banks' assets compared to liabilities, when the yield curve becomes steeper, interest rates on their assets rise more than interest rates on their liabilities, boosting their profits (Borio, Gambacorta and Hofmann, 2017).

FIGURE 7
Euro area banks' ROA and ROE, annualized quarterly data
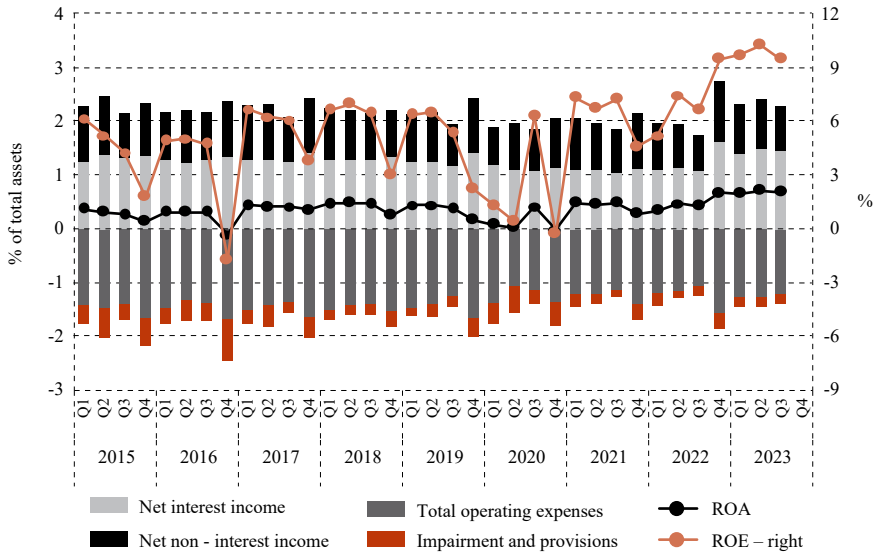
Source: ECB.

Banks in the euro area were on aggregate well positioned to take advantage of rising interest rates. Following the shift in the ECB's monetary policy, net interest income of banks rose considerably, which boosted their overall profitability (figure 7). There were three main factors supporting euro area banks' net interest income after mid-2022. First, as the euro area banking system was flooded with liquidity as a result of the prolonged period of quantitative easing, banks were able to earn substantial interest income by simply keeping their abundant excess reserves in the ECB's deposit facility, which offered an interest rate of up to 4%. Second, interest rates on bank loans – both on new loans and outstanding variable-rate loans – rose sharply in line with the ECB's policy rates, thus boosting banks' interest income. Third, given that overnight deposits constituted a significant portion of the total liabilities of euro area banks, the interest expenses of banks rose more gradually than their interest income, allowing them to enjoy comfortable net interest margins for some time.

FIGURE 8

Pass-through* of ECB policy rate hikes to selected items of assets and liabilities of euro area banks, outstanding amounts (in %)
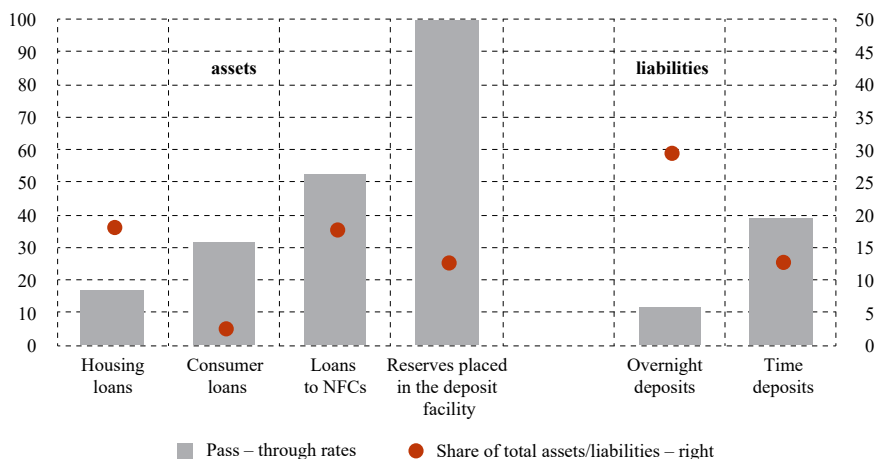
* Refers to the cumulative pass-through from July 2022 to December 2023.
Sources: ECB, author's calculations.

The relevance of these factors in driving banks' net interest margins from mid-2022 is illustrated in figure 8. It shows the extent to which the 450 basis point increase in the ECB's key policy rates had affected the interest rates on outstanding bank assets and liabilities by the end of 2023. On the asset side, the transmission was particularly strong in the case of central bank reserves and corporate loans. As a zero-duration asset, central bank reserves held in the ECB's deposit facility were directly and fully affected by policy rate increases, which considering the large size of excess reserves – they accounted for 13% of total bank assets – contributed significantly to the overall increase in banks' interest income. Interest rates on outstanding corporate loans grew more rapidly than those on outstanding housing loans, given their shorter average maturity and less frequent use of fixed-rate contracts. On the liability side, the transmission of the ECB's policy rate increases was – in line with the findings of the above-mentioned literature – much weaker in the case of overnight deposits than in the case of time deposits (figure 8). Since overnight deposits made up almost two thirds of total deposits, such weak transmission ensured that banks' interest expenses grew more gradually than their interest income. The factors driving the widening of banks' net interest margins are explored in more detail in the remainder of this section.

3.1.1 Interest income earned on excess reserves placed in the deposit facility
As noted above, following the sovereign debt crisis, the ECB maintained a highly accommodative monetary policy in order to counter deflationary pressures and support economic recovery (figure 9). The most noticeable effect of this policy was the injection of a considerable amount of central bank reserves into the banking system, due to which deposits of euro area banks with the Eurosystem increased

from under 200 billion euro at the end of 2014 to more than 4.5 trillion euro in early 2022 (figure 10).

FIGURE 9

Composition of the Eurosystem's total consolidated assets (bn euro)

FIGURE 10

Size and composition of banks' deposits with the Eurosystem (bn euro)
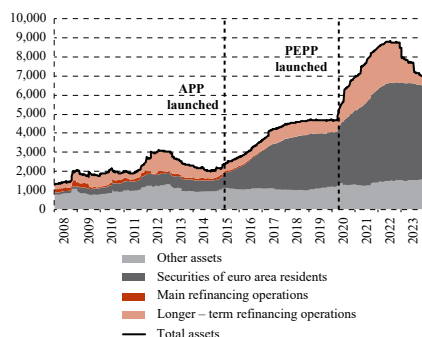
Source: ECB.

These large holdings of reserves enabled banks to start earning substantial risk-free interest income immediately after the ECB brought its key policy rate into positive territory in response to high inflation. As shown in figure 10, before the ECB embarked on its tightening cycle in the summer of 2022, banks kept most of excess reserves in their current accounts. There was no incentive for banks to put their money in the deposit facility because the same negative rate was applied to the deposit facility and current accounts. However, in July 2022, the ECB raised the deposit facility rate from -0.5% to 0%, and further to 0.75% in September of that year. In order to take advantage of the positive interest rate, within only a few days in mid-September euro area banks reallocated trillions of euros from their current accounts to the deposit facility (figure 10). At that point, the large excess reserves became a major source of interest income for banks. The ECB kept increasing the interest rate on the deposit facility until it reached 4% in September 2023.

The amount of interest paid by the Eurosystem to commercial banks after the start of monetary policy tightening was substantial. After the deposit facility rate was raised from zero to 0.75%, banks earned approximately 90 million euro per day from interest on their excess reserves. As the key policy rate was increased further substantially, banks' interest income on this basis grew steeply and in the second half of 2023 reached nearly 400 million euro per day (figure 11). Cumulatively, the Eurosystem distributed a total of 141 billion euro in interest to banks from September 2022 to December 2023, which accounted for approximately 20% of the total increase in euro area banks' gross interest income in that period (figure 12). However, it is important to note that, in net terms, the interest income earned by banks on excess liquidity was less than 400 million euro per day because interest expenses – the cost of financing bank assets, including excess reserves – grew as well in the context of tighter monetary policy, as shown in figure 12.
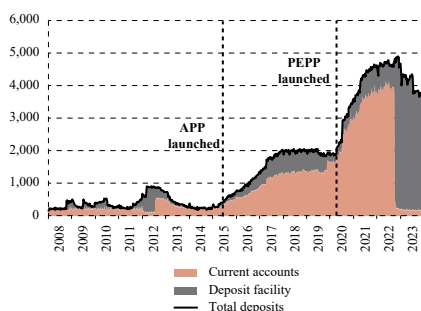
FIGURE 11

Daily interest income based on liquidity placed in the deposit facility

Interest paid to banks (daily)
Deposit facility rate – right
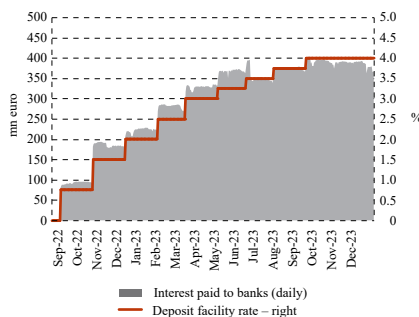
FIGURE 12

Net interest income of euro area banks, quarterly data (bn euro)

Other interest income
Interest income received from the Eurosystem
Interest expenses
Net interest income
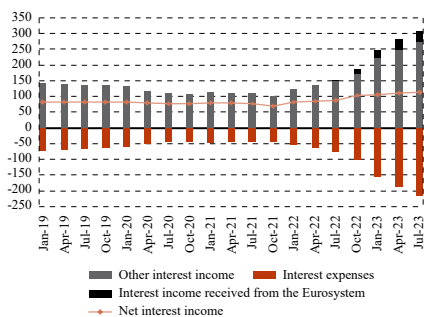
Sources: ECB, author's calculations.

The fact that banks enjoyed a sizeable risk-free income by merely keeping their excess reserves with the Eurosystem was seen as unfair, particularly because it was happening at a time when the rest of the economy was facing rising costs and falling disposable incomes. For that reason, some authors suggested that the ECB reduce the size of excess reserves by increasing the rate of non-remunerated minimum reserves (De Grauwe and Ji, 2023). By sterilizing excess reserves, the ECB would at least partly deprive the banks of the possibility of earning a substantial risk-free interest income. However, the ECB did not decide to go in that direction. If the ECB maintains this stance, which is a very likely scenario, excess reserves will fall only gradually over time, as banks repay their TLTRO loans and as bonds acquired under the two large asset purchase programs mature. Interest paid to commercial banks will fall over time also because the deposit facility rate will be lowered when the inflation rate credibly converges to its target. The first rate cut was made in June 2024, when the ECB's Governing Council decided to reduce the deposit facility rate from 4% to 3.75% prompted by an improvement in the inflation outlook.

3.1.2 Impact on interest rates on bank loans

Interest rates on loans responded quickly to monetary policy tightening, which was due to two main reasons. First, given that the deposit facility represented a very safe and profitable alternative investment option, interest rates on new loans moved up in line with the deposit facility rate. Banks simply had no reason to grant new loans – at least not short-term ones – at an interest rate below the rate they would earn by placing funds instead in the deposit facility[6]. Second, as the pass-through of ECB policy rate hikes to money market rates was strong and swift, interest rates on outstanding, variable-rate loans linked to benchmark rates such as €STR and EURIBOR rose automatically, thereby boosting banks' interest

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[6] On the other hand, it can be economically reasonable to issue a long-term loan with a fixed interest rate below the deposit facility rate if the lender expects the deposit facility rate to fall during the repayment of the loan. Indeed, in some euro area member states, interest rates on new housing loans remained below the deposit facility rate throughout the monetary policy tightening cycle.

income.[7] Therefore, both new loans and outstanding variable-rate loans generated more interest income for euro area banks after the ECB began to tighten its monetary policy. As shown in figure 13, the transmission of higher ECB policy rates to lending rates was more pronounced in the case of corporate loans due to their typically shorter maturities and less frequent use of fixed-rate contracts compared to housing loans. The degree to which banks' interest income was boosted by higher lending rates varied across countries depending on the interest rate composition of outstanding bank loans, in the sense that banks' interest income rose the most in countries where variable-rate loans were predominant. The cross-country differences in this respect are explored in more detail in section 3.2.

FIGURE 13

ECB's deposit facility rate and bank lending rates in the euro area (in %)
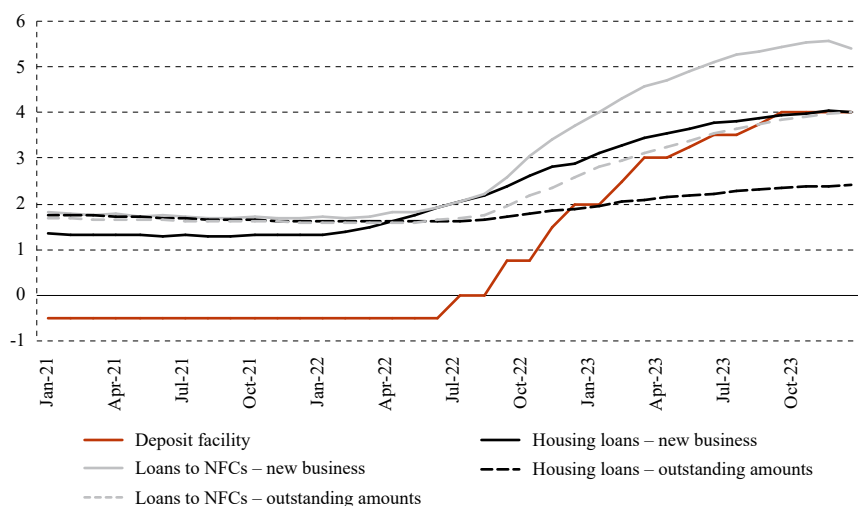
Source: ECB.

3.1.3 Impact on interest rates on deposits

While euro area banks' interest income rose sharply in line with the ECB's key policy rate, interest expenses responded more gradually, allowing banks to enjoy comfortable interest margins for some time (Grodzicki et al., 2023; Adalid, Lampe and Scopel, 2023). Figure 14 shows that, at the euro area level, the transmission of higher ECB policy rates to interest rates on time deposits was quite strong. There were some differences in the speed of transmission across countries but, on aggregate, interest rates on new time deposits, especially those of the corporate sector, went up sharply as the ECB tightened its policy stance.

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[7] Due to hedging, some banks were able to benefit from interest rate increases even on the basis of outstanding loans granted at a fixed interest rate. In particular, Dries et al. (2022) noted that euro area banks increased their reliance on interest rate derivatives since inflation started to rise in early 2021 in order to hedge loans with fixed interest rates against the expected shift in monetary policy.

FIGURE 14

ECB's deposit facility rate and bank deposit rates, new business (in %)

—— Deposit facility	– – Time deposits – NFCs	
—— Overnight deposits – households	– – Time deposits – households	
—— Overnight deposits – NFCs		
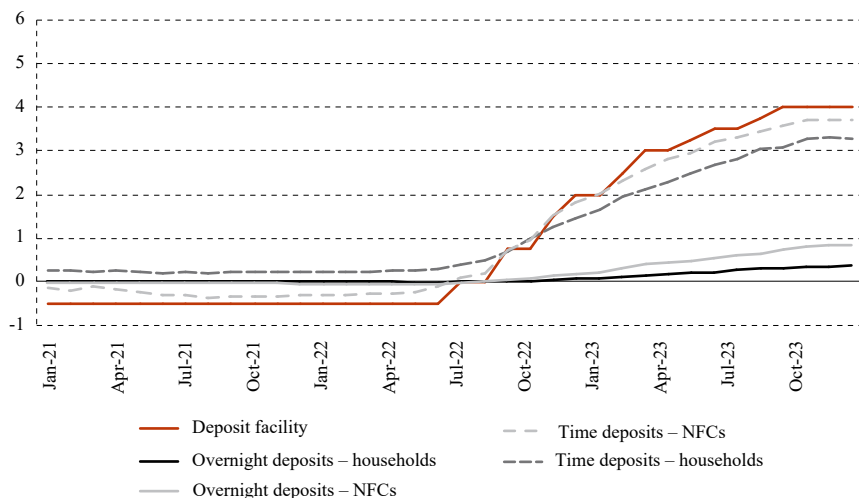
Source: ECB.

In contrast, the pass-through to interest rates on overnight deposits remained limited, as is usually the case. The weak pass-through to overnight deposit rates seems to have been a major factor behind the widening of banks' net interest margins since mid-2022. Before the global financial crisis of 2008-09, overnight deposits accounted for approximately one third of total deposits in euro area banks, which was lower than the relative share of time deposits (figure 15). The importance of overnight deposits as a source of financing for euro area banks increased substantially in the aftermath of the global financial crisis, as interest rates on time deposits fell to virtually zero driven by the persistently loose monetary policy. By the moment the ECB started raising its rates in mid-2022, overnight deposits amounted to almost two thirds of total deposits. The fact that such a large share of total deposits continued to carry a very low interest rate even after the ECB sharply tightened its monetary policy enabled banks to enjoy strong net interest margins for some time. However, the composition of deposits began to change gradually following the shift in the ECB's policy stance, as depositors transferred funds from overnight to time deposits in order to take advantage of higher interest rates (figure 15). As this process continues, banks' interest expenses will rise, causing their interest margins to narrow over time.

FIGURE 15

Composition of deposits in euro area banks (in %)
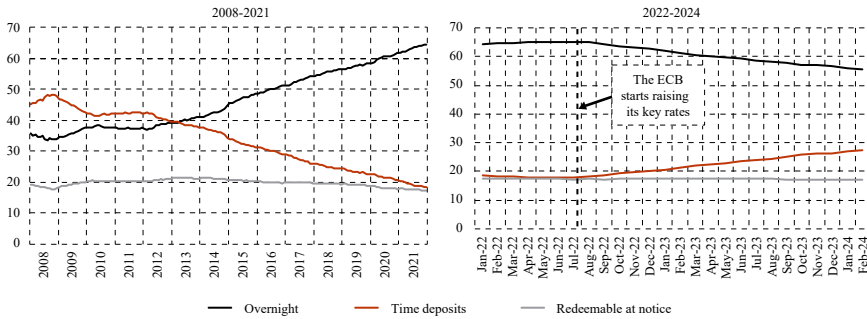
Source: ECB.

3.2 DIFFERENCES IN BANK PROFITABILITY DYNAMICS ACROSS COUNTRIES

While the profitability of euro area banks improved markedly on an aggregate level after the ECB's policy rate hikes began in July 2022, the impact of higher interest rates on bank profitability indicators varied widely across national banking systems. As shown in figure 16, the Baltic countries, Cyprus and Slovenia registered the largest increases in banks' net interest margins, with their banking system's aggregate return on equity surpassing 20 percent in the third quarter of 2023. In contrast, German, Belgian and Dutch banks saw a more moderate rise in profits, while French banks experienced a deterioration in their profitability indicators.

FIGURE 16

Banks' net interest margin and return on equity* (in %)
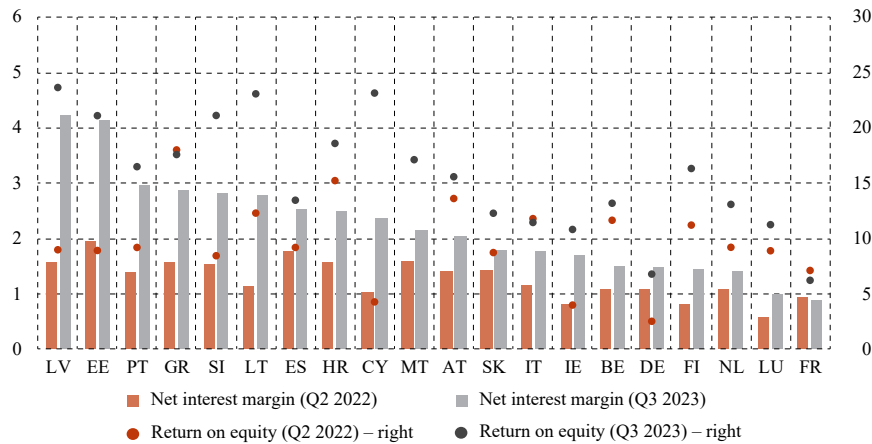
* Return on equity is calculated by dividing the annualized quarterly net profit/loss after tax by total equity at the end of the reference quarter.

Sources: ECB, author's calculations.

It is therefore interesting to examine why banks from some euro area countries benefited more from higher interest rates than banks from other countries. In the analysis, it seems appropriate to consider the factors that appear to have boosted bank profits in the euro area as a whole, namely the initial size of excess reserves, the initial share of variable-rate loans in total loans and the initial share of overnight deposits in total liabilities. Figure 17 shows that these factors indeed explain reasonably well the cross-country variation in banks' net interest margins since mid-2022.

FIGURE 17

Factors driving the increase in net interest margins of euro area banks
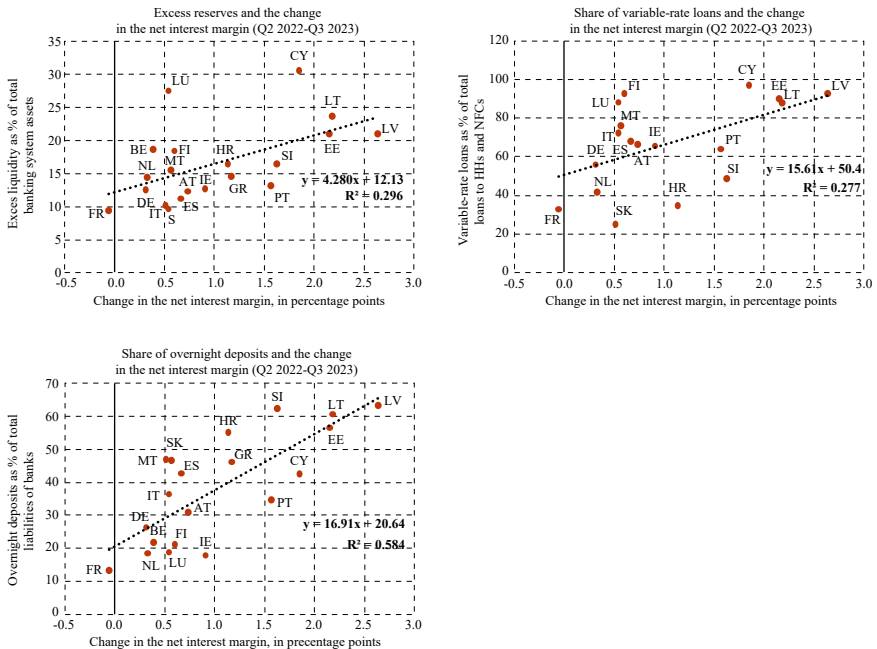
Notes: *The values for excess reserves (as percentage of total assets) and overnight deposits (as percentage of total liabilities) refer to June 2022 data, while the values for variable-rate loans (as percentage of total loans) refer to the average for the first six months of 2022. Excess reserves are calculated as the sum of funds held by banks in their current accounts above the minimum reserve requirements and funds held in the ECB's deposit facility.*

Sources: *ECB, author's calculations.*

The relation between the change in the net interest margin and each of these three factors is positive, as expected. The increase in the net interest margin was the stronger, the higher the initial level of excess reserves, and the higher the shares of variable-rate loans and overnight deposits in total loans and liabilities, respectively. Banks from the Baltic countries were well positioned to benefit from higher interest rates, as they had high initial values for all three of these variables. In particular, given that around 90% of all bank loans in these countries have a variable interest rate, the Baltic countries experienced the strongest increase in interest rates on outstanding loans, which gave a key impetus to banks' interest income (figure 18).

FIGURE 18

Cumulative increase in interest rates on outstanding private sector loans*

■ Increase in interest rates on loans to households (outstanding amounts)
■ Increase in interest rates on loans to NFCs (outstanding amounts)
● Share of variable rate loans in total new loans to households and NFCs in H1 2022 – right
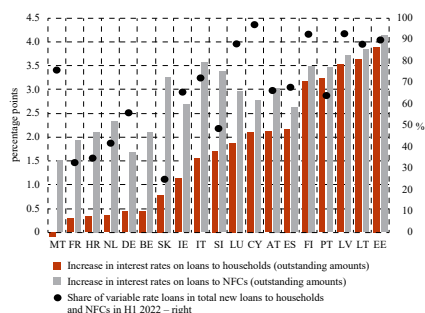
* Refers to the cumulative increase in the period between June 2022 and December 2023.

Sources: ECB, author's calculations.

FIGURE 19

Contributions to the overall increase in gross interest income* (in %)

■ Interest income received from the Eurosystem
■ Other interest income
◆ Cumulative increase in interest income
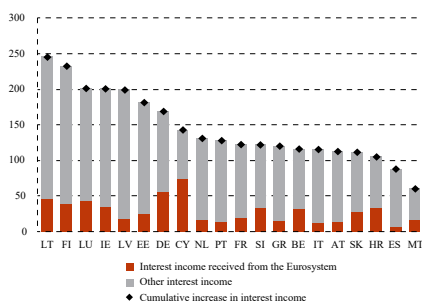
* Compares banks' quarterly gross interest income in Q3 2023 with their quarterly gross interest income in Q2 2022.

Croatia, on the other hand, was among the countries with the weakest transmission of ECB policy rate hikes to lending rates.[8] Despite this, Croatian banks recorded a marked widening of their net interest margins, supported by substantial interest income earned on their large stocks of excess reserves and the fact that interest expenses grew more slowly, reflecting the high share of cheap overnight deposits in their total liabilities (figures 19 and 20). The same applies to Slovenian banks, which also benefited from a combination of abundant excess reserves and the dominance of overnight deposits as a source of funding. German and Dutch banks, in contrast, saw a much milder improvement in their net interest margins, while French banks experienced a fall in their interest margins. The main reason why these banks benefited less from higher interest rates than banks from other countries is that in these advanced banking systems retail overnight deposits – which respond very slowly to central bank policy rate changes – account for only a small fraction of total liabilities (figure 20). Therefore, when the ECB began to tighten its monetary policy, their cost of financing increased sharply in line with interest income, which in turn prevented a stronger widening in their net interest margins.

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[8] This was a result of several country-specific factors. First, Croatia introduced the euro on 1 January 2023, which was associated with a significant increase in excess liquidity, given that the reserve requirement rate – which was 9% until then – had to be brought down to 1% to be in line with the ECB's calibration. The additional liquidity freed up on this occasion allowed banks to enjoy low funding costs even after the ECB started raising its key rates, which indirectly enabled them to earn a solid net interest income without increasing lending rates significantly. Second, in the previous years when monetary policy was highly accommodative, most housing loans were issued at an interest rate that was fixed for at least part of the repayment period. Third, prior to the adoption of the euro, the vast majority of variable-rate loans were granted using the National Reference Rate as benchmark, which is quite stable over time. For this reason, the sharp increase in EURIBOR did not have a material impact on variable-rate loans in the domestic market. Finally, the Croatian legal framework contains provisions that limit the amount by which banks can raise interest rates on variable-rate loans. These provisions, which apply to both outstanding and new loans to households, further limited banks' ability to pass on higher money market interest rates to their customers (CNB, 2023).

FIGURE 20

Absolute change in banks' quarterly interest income and expenses (Q3 2023 vs.
Q2 2022) and the initial share of retail overnight deposits in total liabilities
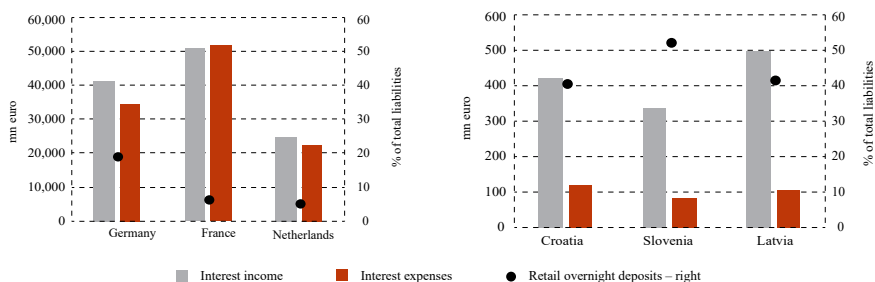
Sources: ECB, author's calculations.

3.3 COMPARISON WITH THE PREVIOUS MONETARY POLICY TIGHTENING CYCLE

The impact of the recent ECB policy rate hikes on bank profitability was much more pronounced than in the previous cycle of monetary policy tightening that took place before the global financial crisis. Specifically, from December 2005 to July 2008, the ECB raised its key interest rates by a cumulative 200 basis points in order to preserve price stability in the context of robust economic expansion. Despite the rising key interest rates, euro area banks did not see their net interest income increase. In fact, the net interest income of euro area banks declined gradually after 2005 as interest expenses grew more rapidly than their interest income (ECB, 2007).

The differences in bank profitability dynamics between the tightening cycle of 2005-08 and the tightening cycle of 2022-23 can be attributed to specific market conditions prevailing in these two periods. For example, in the period leading up to the global financial crisis, euro area banks operated in an environment of scarce reserves. At that time, the ECB implemented its monetary policy by using a corridor system, whereby the supply of reserves provided to the banking system was calibrated precisely to keep the short-term money market rate very close to the key interest rate. In this setup, excess reserves were very low – only around 1 billion euro when the ECB began raising policy rates in December 2005. Following the global financial crisis, the ECB switched to a *de facto* floor system with abundant reserves. As mentioned earlier, excess reserves were as high as 4.5 trillion euro in mid-2022 when the ECB started its recent tightening cycle.

FIGURE 21

Composition of funding of euro area banks at the beginning of the last two ECB's tightening cycles (percentage of total liabilities)
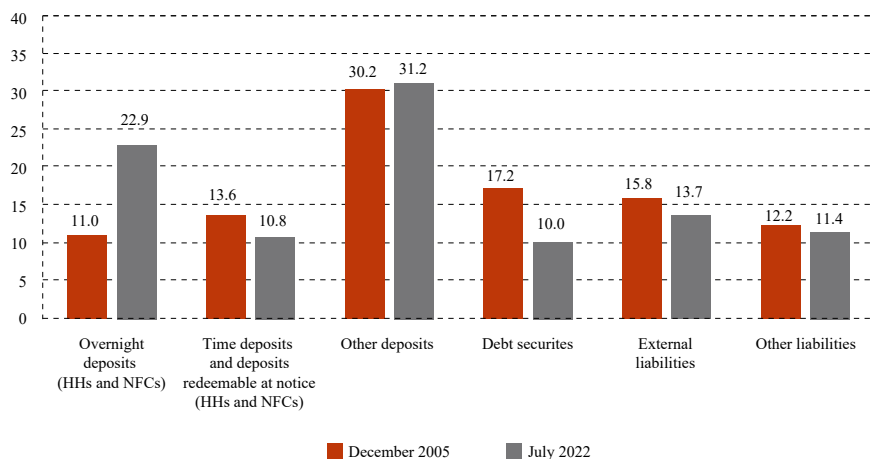
Sources: ECB, author's calculations.

The size of excess reserves is relevant for bank profitability because it can affect the composition and overall cost of bank funding: when reserves are scarce, competition among banks for deposits will be stiff, which will in turn put upward pressure on deposit rates, while also encouraging banks to rely on alternative, wholesale sources of funding. Conversely, when reserves are abundant, as they have been in recent years, the supply of client deposits – and, possibly, longer-term central bank funding – will be large, and banks will have less need for wholesale funding sources that are more expensive. As shown in figure 21, there was indeed a noticeable difference in the composition of euro area banks' funding between the two last ECB's tightening cycles. Specifically, the share of overnight deposits in total bank liabilities was twice as high in 2022 as in 2005, while the share of issued debt securities was notably lower. This can partly explain the differences in the dynamics of bank profitability between the two cycles. As noted earlier, large stocks of overnight deposits have been a major factor supporting the profitability of euro area banks since mid-2022, as the weak pass-through of ECB rate hikes to overnight deposits rates mitigated the overall increase in banks' interest expenses. In contrast, in the tightening cycle of 2005-08, overnight deposits could not support banks' net interest margins in the same way because their share in total bank liabilities was significantly lower. Adalid, Lampe and Scopel (2023) show that the relative shares of overnight deposits do explain well the differences in deposit betas – the strength of the transmission of the ECB policy rate changes to deposit rates – between the ECB's last two tightening cycles.

Another part of the explanation lies in the fact that euro area banks were in the past more reliant on wholesale funding markets – such as the interbank money market and the bond market – which respond very rapidly to central bank policy rate

changes. Therefore, when the ECB tightened its policy stance starting from December 2005, banks very soon felt the impact through higher funding costs. Strong competition for deposits in a context of scarce reserves contributed as well to the overall increase in funding costs in this period (ECB, 2007). Interest income, on the other hand, did not increase sufficiently to compensate for higher interest expenses, given that the yield curve flattened as monetary policy became tighter. That is to say, due to strong global demand for long-term assets, yields on long-term assets remained compressed despite the rising short-term rates, thereby diminishing banks' returns from maturity transformation (ECB, 2006). Moreover, since excess reserves were very low at the time, banks could not benefit significantly from increased remuneration of reserves through the deposit facility, as they did in the 2022-23 tightening cycle.

In conclusion, taking into account the performance of euro area banks during the two last cycles of monetary policy tightening, it can be argued that the ability of banks to benefit from higher policy rates was much stronger in the most recent cycle. The combination of abundant excess reserves on the asset side and large stocks of low-cost overnight deposits on the liability side enabled euro area banks to enjoy a substantial increase in net interest margins and overall profitability from mid-2022. However, the elevated interest margins and profits will moderate over time, as the Eurosystem's balance sheet continues to shrink and as depositors shift funds from overnight deposits to time deposits that offer better returns.

4 LESSONS LEARNED IN THE AFTERMATH OF THE PANDEMIC CRISIS

The inflationary shock that took place following the COVID-19 pandemic will at least partly change the way central banks and governments respond to major crises in the future. Every crisis offers specific lessons that can be studied by policymakers and academics after the crisis is over. Was the overall size of support measures adequate, insufficient or excessive? Which of the policy measures adopted were effective and which were not? Was there a sufficient degree of coordination between different policymakers within the country, and between policymakers internationally?

For example, the main lesson of the Great Depression of 1929-1933 was that monetary and fiscal policies should be used vigorously in times of crisis to prevent an ordinary recession from morphing into a deep economic depression. The Great Depression also illustrated that protectionist policies do not enable individual countries to cope better with a major recession (Crucini and Kahn, 1996). On the other hand, the experience of the global financial crisis of 2008-09 has taught us that a premature withdrawal of policy support measures can be detrimental to economic recovery after a major crisis (Kelton, 2015; Independent Evaluation Office, 2014).

In line with this lesson, during the COVID-19 pandemic, massive policy support measures remained in place even after the worst phase of the economic turmoil had ended. This applies to both fiscal and monetary policy. In the US, the government

ran a highly expansionary fiscal policy in 2020 and 2021, whereby the fiscal effort was equally strong in both years (Whelan, 2023). Fiscal policy was expansionary also in the euro area, but the overall size of fiscal support – measured by the change in structural deficit – was more limited compared to the US. When it comes to monetary policy, both the ECB and the Federal Reserve kept their pandemic-related emergency measures in place until early 2022. In March 2022, both central banks ended their net purchases of government bonds, and in the same month, the Fed also increased for the first time its key policy rate in response to rising inflation. The ECB followed suit four months later, in July 2022, when the inflation rate in the euro area had already reached 8.9%. In contrast, a number of emerging market central banks tightened their monetary policy much earlier, in the first half of 2021, as soon as inflation started to soar (Cavallino et al., 2022; Evdokimova et al., 2023). The reason for such a late reaction by the Fed and the ECB was their initial belief that inflationary pressures were a transitory phenomenon associated primarily with global supply bottlenecks.

With the benefit of hindsight, it is clear that the policy response to the pandemic crisis contained some errors, which exacerbated the rise in inflation that followed. In particular, the size and duration of particular support measures in the aftermath of the COVID-19 pandemic appear to have been excessive. For example, as already well documented in the literature, the exceptionally strong fiscal expansion in the US was one of the key drivers of the inflation spike in the second half of 2021 (De Soyres, Santacreu and Young, 2022; Hodge et al., 2022). Having learned this lesson, policymakers should not ignore possible unintended inflationary effects when designing fiscal stimulus packages in the future.

Another important lesson concerns the major central banks. While their balance sheets were already very large at the moment the pandemic crisis broke out, from that point on the ECB and the Fed further aggressively expanded their balance through asset purchases and other unconventional measures. Such interventions were necessary and very effective during the acute phase of the turmoil in the first half of 2020, but it is highly questionable whether they should have remained in place all the way until March 2022. Due to prolonged quantitative easing, the two central banks found themselves in an uncomfortable position when inflation suddenly started to rise in 2021-22. In order to achieve the desired tightening of financial conditions and curb inflationary pressures, the ECB and the Fed had to significantly increase the interest rate applied to the excess reserves of commercial banks. The large payments of interest to commercial banks were very unpopular because they boosted banks' profits at a time when the rest of the economy was faced with rising prices and increasingly tight financing conditions.

In short, the experience since the outbreak of the pandemic crisis has taught us that even in the most advanced economies – that have a virtually unlimited capacity to borrow and to create money – there are certain limits to what expansionary fiscal and monetary policy can do. Inflation is a factor that should and will be

taken more seriously next time. Determining the appropriate level of policy support, which will ensure a swift recovery after the crisis without triggering inflationary pressures, will not be an easy task, though.

5 CONCLUSION

The long period of quantitative easing from 2015 to early 2022 was challenging for banks as interest income, their main source of revenue, declined significantly due to falling interest rates. However, they managed to adapt successfully to this environment. By lowering to zero the interest rates applied to customer deposits and by making extensive use of the cheap funding provided by the ECB through its longer-term refinancing operations, banks reduced their interest expenses sufficiently to fully compensate for the loss of interest income. Owing to this, their net interest income remained almost unchanged in absolute terms compared to the period before the start of quantitative easing. At the same time, banks felt the positive effects of favourable economic conditions, particularly through increased lending volumes and very low provisioning costs, which also supported their earnings.

The profitability of banks increased significantly after the ECB began to tighten its monetary policy in mid-2022 in order to contain inflationary pressures. The fact that the banking system was flooded with liquidity as a result of several years of quantitative easing amplified the impact of higher ECB policy rates on bank profits. In particular, the availability of abundant excess liquidity made it possible for banks to enjoy higher interest income immediately after the ECB raised its key rates, while it also indirectly contained the rise in interest expenses. Specifically, as the interest rate applied to the deposit facility was brought into positive territory in September 2022, banks immediately put more than 4.5 trillion euro of their excess liquidity in the deposit facility in order to earn interest income. When the deposit facility rate reached 4% in the second half of 2023, euro area banks were earning close to 400 million euro in gross interest per day on this basis. Never before had banks had the opportunity to earn so much without exposing themselves to any risk. Interest rates on bank loans, both new loans and variable-rate outstanding loans, rose in line with the ECB's key policy rate. The impact of higher lending rates on banks' net interest margins was particularly strong in countries where loans with a variable interest rate make up a very large share of total bank loans.

In contrast, the pass-through to deposit rates was much weaker. The slow response of deposit rates to monetary policy tightening can also be partly attributed to the environment of abundant excess liquidity. Having sufficient liquidity at their disposal, banks could, at least in the beginning, afford to raise interest rates on deposits more gradually than on loans, without worrying about possible outflows. While interest rates on time deposits did increase in line with higher ECB policy rates, the pass-through to overnight deposit rates was very weak. Given that overnight deposits accounted for almost two thirds of total deposits in mid-2022, the low pass-through of policy rate hikes to overnight deposits was a major factor behind banks' strong net interest margins. The composition of deposits started changing from

mid-2022 in favour of time deposits as bank clients took advantage of higher interest rates on these deposits, but the transition was gradual. This enabled banks to enjoy relatively low funding costs and thereby strong net interest margins for a while. However, the ability of euro area banks to generate unusually strong profits will diminish over time as the transition of funds from overnight to time deposits continues and as the ECB gradually eases its currently tight monetary policy stance.

There is no doubt that the experience gained in the aftermath of the COVID-19 pandemic will affect the way governments and major central banks respond to severe crises in the future. It illustrated clearly that even in the most advanced economies – that have seemingly infinite capacity to borrow and create money – there are objective limits to what fiscal and monetary interventions can achieve. In particular, the size of the fiscal stimulus adopted by the US government to facilitate economic recovery after the pandemic appears to have been excessive, as it was one of the triggers of the abrupt rise in inflation in 2021. The risk of unintended inflationary effects should be taken more seriously when preparing fiscal responses to future crises.

In addition, with the benefit of hindsight, the implementation of large-scale asset purchase programs seemed to have lasted too long both in the US and the euro area, which made it more difficult for their central banks to tackle inflation once it spiked. While the ECB and the Fed successfully tightened their monetary policies starting from 2022, this tightening came at a cost of a substantial transfer of interest to commercial banks which was both costly and highly unpopular. Having learned this lesson, it seems unlikely that their balance sheets will expand again to the levels reached following the COVID-19 pandemic. Both central banks have by now started downsizing their balance sheets, with the aim of moving permanently to regimes with less abundant reserves.

Disclosure statement
The author has no conflict of interest to declare.

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Intragenerational occupational mobility: the effect of crisis and overeducation on career mobility in a segmented labour market

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Abstract

This paper explores occupational and employment mobility over the previous decade in Greece and contributes to a better understanding of the consequences of the sovereign debt crisis. Our findings suggest that downward mobility was the common trend in intra-generational occupational mobility during the first period of the crisis. Significant changes occurred between 2011-2015. The recovery is apparent during the third bailout program with higher upward occupational and employment movements. However, polarization in the middle-paid professions was noticed. Additionally, this paper highlights the role of education in career mobility and the problem of overeducation. The empirical results reveal that tertiary graduates were more likely to move downward during the first period of the crisis even though overeducated workers had more possibilities to experience upward mobility. Overeducation in Greece seems to be the result of the increasing number of tertiary graduates, low proportion of high-skilled job positions and high levels of unemployment.

Keywords: social mobility, occupational mobility, overeducation, economic crisis, public sector

1 INTRODUCTION

Intra-generational occupational mobility reflects the trajectories of the careers of workers, and it is responsive to labour market shocks such as drops in economic activity. The advantage of studying career mobility (intra-generational mobility) is that it is more volatile than the mobility of social classes and is responsive to labour market shocks such as drops in economic activity (OECD, 2018; Constant and Zimmermann, 2003). The main effect of the recent financial crisis on occupational and employment mobility in Greece was that many people became unemployed, changed their occupational status or type of occupation or increasingly became part-time employed. A larger percentage of older workers taking early retirement was observed during that period as well as extension of years in education because of the difficult conditions in the job market.

Changes in the **composition of economic activity** are a major factor in occupational mobility. The post-industrialization era was a period when occupational stratification was transformed into a more open and merit-oriented structure with the importance of educational achievements being crucial for social mobility. Unlike the hypothesis that industrialized and modern economies would present similar patterns of occupational mobility during periods of economic growth (with prevalent upward mobility) or decline, comparative research indicated that the significant differences among them tend to be influenced by country-specific characteristics (labour market institutions, expansion of the public sector, employment legislation, educational system, etc). Such factors can have implications for labour market segmentation and deregulation (Pohlig, 2021; Symeonaki and Stamatopoulou, 2020). The **business cycle of the economy** is linked with mobility rates. Higher upward mobility is found in countries with continuous expansion of the market while in countries with lower mobility this expansion took place earlier and affected the possibilities of the

previous generation. In the former case, more jobs were created for the upper classes in the occupational strata, there was a moderate shift in the middle of the occupational distribution and shrinkage for the lower tail. In the second case, the lower classes expanded and it is common to notice downward mobility as well (OECD, 2018). Occupational changes through geographical mobility are a major objective of **European integration.** EU citizens have more chances to deal with macroeconomic shocks at the national level because there is the option of emigrating to find work in another country. When these shocks affect a greater number of countries, this mechanism may not be able to absorb the effects of the disintegration of the labour market (Anastasiadou, Batiou and Valkanos, 2015). **Additional institutional factors** such as the extent of market competition particularly during a recession can affect occupational mobility.

The individual characteristics of labours can create **patterns of occupational mobility**. Better education increases the likelihood of job upgrading. That is, better educated individuals have a higher probability of accessing jobs with higher incomes and fewer chances for downward mobility into low-paid jobs (Symeonaki, Stamatopoulou and Michalopoulou, 2012). Higher education outcomes and overeducation (higher qualifications than necessary for a specific job) favour upward mobility and penalize downward direction, while undereducation is a factor in demotion (Crespo, Simoes and Moreira, 2013). However, further evidence may lie in the findings that possession of an undergraduate degree does not seem to reduce the risk of unemployment during a recession (Bisello, Maccarrone and Fernández-Macías, 2020). The position of young educated workers, important during periods without many opportunities, is under discussion in Europe due to the data showing that the young are affected more by the crisis. Symeonaki and Stamatopoulou (2020) revealed that Italy, Croatia, Greece, Spain, and Romania presented the lowest positive labour market mobility (from one job position to a better one or from unemployment/inactivity/education to employment status) over this period in Europe. The effects of such shocks are heterogeneous, sometimes accelerating these movements, and certain groups of people have comparative and relative gains while others lose the social status of prior to the crisis. In Greece, compulsory education is not selective, tertiary education is free, vocational training is considerably weak, and high percentages of people prolong their studies and delay their entry into employment. Also given the rigid labour market conditions, this country can be confronted as a case study creating different motives.

We will try to answer the following research questions:
What were the patterns of intra-generational occupational/employment mobility in Greece during the crisis? Are there any potential differences in mobility patterns between the various classifications?
Do individuals' characteristics and overeducation continue to be linked to specific opportunities for occupational mobility and undereducation with risks of downgrading?
What are the characteristics of people who as workers are overeducated compared to people who are appropriately educated workers?

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To our knowledge, very limited empirical research has been carried out regarding this aspect of social mobility in Greece. The main contribution of this paper is that it sheds light on the research of the evolution of intragenerational occupational mobility in Greece during the crisis. The unique contribution is that this study provides empirical evidence that there is a linkage of this aspect of mobility with the phenomenon of overeducation. Moreover, the results do not concern only the changes in professions, but basic changes in professional prestige through the skill levels of professions, changes in wage scales as well as inflows and outflows in the labour market.

The rest of the paper is organised as follows. In section 2, we review the literature regarding occupational mobility and its determinants as well as the background of the sovereign debt crisis in Greece. In section 3 we describe theories about occupational mobility and the challenges in measuring intragenerational mobility. In section 4 we describe the phenomenon of overeducation and characteristics of non-adequately educated workers in mobility patterns. Sections 5 and 6 discuss the data and methodologies used in our analysis. Section 7 presents our main findings with robustness checks. Concluding remarks are found in section 8.

2 THE BACKGROUND OF OCCUPATIONAL MOBILITY DURING AN ECONOMIC CRISIS

The Great Recession in Europe in 2008 disintegrated the labour market in many countries. The unemployment rate increased and the recovery was slow. The effects of such shocks are heterogeneous. They appear to have affected younger employees more, people with temporary contracts and medium-skilled workers, while showing different results across countries and genders (Eurofound, 2017). Also, to be noticed is a "negative job polarization". Many medium-paid jobs have been destroyed, with reference to the mean salaries of each state in relation to the tails of occupational structure. As a result, individuals faced the challenge of reallocating to jobs with remuneration commensurate with their skills, which reduced opportunities for upward mobility (Bisello, Maccarrone and Fernández-Macías, 2020). Moreover, this polarization can affect the career decision of highly qualified people to stay out of employment for a long time anticipating better opportunities or else to relocated abroad. The recent studies about **the impact of a financial crisis** mainly discuss its effects on wages and unemployment rates and whether it amplifies the changes in social stratification. The trends of these changes are less predictable. In similar cases, there is greater labour mobility (Korea) and stagnation in other countries (Japan, US, Estonia) during recessionary periods. On the other hand, a crisis can create opportunities and innovation, because people and organizations are pressed to adapt and survive as internal labour markets are less stable. In Europe, the consequences of the outbreak of the European debt crisis, characterized by abrupt devaluations created a duality between peripheral Southern countries like Italy, Portugal, Spain and Greece with shrinking employment rates and the central Northern European states (Eurofound, 2017; Pohlig, 2021; Symeonaki, Stamatopoulou and Michalopoulou, 2020). **The institutional**

differences among states tend to be crucial for occupational mobility in Mediterranean countries, indicated high levels of stability before the crisis while downward occupational mobility was negligible. The structural features and stricter employment protections in these countries, the significant number of public servants and bureaucratic constraints and severance legislation are the explanation for the previous patterns over time (Bisello, Maccarrone and Fernández-Macías, 2020; Pohlig, 2021). Prior to the crisis these economies were distinguished by their creation of many medium-level occupations and forming a powerful middle class. After the onset of the recession, they tended to become more polarized.

The empirical literature on labour addresses **the determinants of mobility decisions**. The main focus is to find out the magnitude of human capital and the role of the business cycle. During a period of economic growth individuals may be disposed to take risks in their search for jobs and find a post more appropriate to their skills. On the contrary, periods of recession and unfavourable structural changes in the labour market make the job security more attractive, even if the occupation or wages do not match the abilities of the worker. Downward occupational mobility (move to a job with lower status or wage) can result from efforts to avoid unemployment. The increase in fixed-term contracts leads to a higher turnover rate, which influences the mobility figures, especially among women, who tend to be overrepresented in this form of employment. As a result, greater mobility is expected in relation to employment contracts due to labour market deregulation, higher unemployment rates and recession (Crespo, Simoes and Moreira, 2013; Eurofound, 2017; Symeonaki, Stamatopoulou and Michalopoulou, 2012). On the other hand, **the professional lifecycle and career evolution** are also correlated with occupational changes, but the exact influence of age has been disputed in recent literature. Over the years, most people have sought higher wages, a better quality of life, which means better working conditions. This can lead to occupational immobility and substantial returns to experience tend only to mitigate the effects of downward mobility. **Policies** that moderate the negative aftermaths of this period are determined by the duration of the crisis, the control of measures implemented by the government and labour market regimes.

The Greek crisis started in late 2009, but it was in 2010 that the country was unable to borrow from the financial markets when the real debt and deficit figures came to light. The fiscal crisis turned into a sovereign debt crisis. Greece received financial assistance from three creditors: the International Monetary Fund, the European Commission, and the European Central Bank. They lent financial aid to Greece with the agreement of an economic adjustment program which would be modified in 2012 and 2015. The bailout programs required the Greek governments to implement austerity and tough fiscal measures, which included cuts to public spending, social benefits, and public-sector wages, extra social insurance contributions to face the problem of rising unemployment numbers, an increase of indirect and direct taxes, introduction of new emergency taxes and extra charge in self-employed contributions above 100%. These affected the living conditions of

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Greek citizens with differing results among different sub-groups (Matsaganis and Leventi, 2014; Kaplanoglou and Rapanos, 2018; Andriopoulou, Karakitsios and Tsakloglou, 2017). According to the OECD (2018) the Greek crisis was the deepest with major impacts on GDP, employment and wages. The third memorandum was concluded in 2018.

3 OCCUPATIONAL MOBILITY: THEORIES AND METHODOLOGICAL APPROACHES

Human capital studies investigating the effects of human capital investment on income have started increasing the attention they pay to labour mobility. The human capital theory argues that people are more likely to choose the occupation that offers the greatest current value of potential future earnings (Dekker, de Grip and Heijke, 2002; Constant and Zimmermann, 2003). Human capital investments can lead to optimal wage returns. However, if individual and societal beliefs about formal education as a mechanism for promoting equality and mobility are misguided, these benefits may be diminished (Capsada-Munsech, 2017). **The theory of career mobility** argues that at entry levels individuals may choose positions with lower returns on education if they believe that the effect of schooling will give them positive opportunities in the future. This theory taking into account both the supply and demand sides considers this mismatch as economically prudent at the beginning of a working career, as a short-term situation (Büchel and Mertens, 2000).

The common methodological approach for exploring occupational and employment mobility involves the use of **transition probability matrices**. It is suitable when the researcher based on categorical scale, the International Classification of Occupations (ISCO) for instance. The detailed occupational scheme takes into account the cumulative human capital required for a particular job and creates distinct segments of the labour market (Eurofound, 2017; Katsimi et al., 2013; OECD, 2018). In mobility terms based on occupational classification of the profession, an upgrading means that an individual moves from a lower-skilled profession to a higher one. As well as for occupational classification, it is also common to examine **labour market flows between jobs with wage differences**. This approach uses the salary as a signal for the quality of the job. This analysis derives from the fact that wages are also linked to the levels of consumption that affect the standard of living of workers. By putting workers with similar pay levels into groups of approximately similar sizes (occupations being ranked by the average monthly earnings), insights into occupational mobility are enriched (Bisello, Maccarrone and Fernández-Macías, 2020; Crespo, Simoes and Moreira, 2013). In terms of average wages, occupational upgrading means that high-paying, prestigious jobs are increasing in number relative to medium-paying jobs, and there is a shift towards these higher-paying positions. **Wage polarization** is described as an increase in high-wage and low-wage jobs awhile mid-wage jobs drop out (Eurofound, 2017; Pohlig, 2021). The limitation of the second approach is that it is not identical among the recent studies as the allocation of occupations in quantiles may not be the same over the given years or among different researchers.

To explore the patterns of **employment mobility** during recession periods, researchers include **unemployment as an additional level/category in the transition matrices**. In this way, they tried to gauge the implications of economic shocks on employees' life chances. The interpretation is that moving from a specific job to unemployment is considered downward mobility in the mobility grid. The absence of flows or flows to low-wage employment or specific occupations creates a two-speed labour market. On the contrary, movements across the occupational distribution reveal greater mobility possibilities, which may contribute positively to the economic impact of society (Bisello, Maccarrone and Fernández-Macías, 2020). One of the features of traditional mobility approaches is that **we assume that all transitions are equally important**. Apparently, the transition from one skilled level to a lower one differentiates the transition from employment to unemployment or maintaining employment stability does not mean the same with persistent unemployment. Symeonaki, Stamatopoulou and Michalopoulou (2020) suggest that it should only assess positive movements when considering labour market mobility. In essence, these good transitions imply a labour market with greater opportunities. Favourable transitions are the transition from unemployment or inactivity to employment in which the opposite direction is undesirable.

4 THE PHENOMENON OF OVEREDUCATION

The expansion of education and the improvement of educational outcomes in recent decades for young generations in advanced countries has triggered the debate about overeducation. Overeducation is defined as a mismatch between workers' educational backgrounds and the requirements necessary to perform the average job. An overeducated employee is a person whose skills and qualifications exceed the skill level of an occupation (Erdsiek, 2021). Educational expansion does not necessarily lead to overeducation. This depends on the demand for high-skilled jobs required for educated people and the number of them in the labour supply. This will depend on the demand for high-skilled jobs from firms and the availability of highly educated workers in the labourpool. The issue of overeducation does not mean that the expansion of education has been a negative evolution, or a state does not need so many well-educated individuals. They are essential for economic growth. This inadequacy means that the quality of education and the target of education systems must be more labour market-oriented and technology-driven (Patrinos, 1997). Suboptimal allocation of educated workers or the inefficiency of an economy to absorb these people also affects the economic growth of a country for it will lose valuable human capital due to inadequate jobs or immigration (European Commission, 2020). According to the human capital theory introduced by Becker in 1964, overeducation occurs because of a temporary mismatch in the labour market. To address this problem, the willingness of companies to fully utilise the skills of educated people and the efforts of more educated individuals to find more suitable work will improve the situation rapidly. The hypothesis of maximizing utility and homogeneity on both sides does not take into account the different preferences and incentives of individuals and businesses. Therefore, the solution is the adjustment of individuals and firms. The model of Thurow in 1975 about job competition theory analysed overeducation as a persistent

phenomenon in which workers are ranked hierarchically in a queue depending on their qualifications and compete for the best jobs. This creates incentives for educational investments and promotes credential inflation. Overqualified people are also allocated to the highest occupations and new job positions need to be created, it being the responsibility of the demand side to create them (Capsada-Munsech, 2017). **Other theories (assignment theory and career/job mobility theory)** consider individuals' preferences on specific sectors, jobs, wage threshold, etc. and the difficulty to signal their skills properly, prove that the occurrence of overeducation is a more complex issue and each theory has something to add in the understanding of the situation. Overeducation can be temporary or permanent.

The **matching studies** between jobs and qualifications of the workers support the view that overeducation can be a temporary situation at an individual level but a permanent phenomenon for the economy (Patrinos, 1997; Zhao et al., 2017). Dekker, de Grip and Heijke (2002) indicate that overeducation is more likely to lead to upward mobility, which being translated means that it is a temporary situation at the individual level. Sicherman's (1991) work that had positive conclusions about the future of overeducation was later on disputed. Overeducation can be a temporary or long-term structural condition. If it affects the prospects of well-educated people, actions need to be taken analogous to the duration of the incidence. In addition, the business cycle of the economy exacerbates the mismatch between workers and jobs. During the recession, this mismatch worsened and the numbers of overqualified workers increased.

The incidence of overeducation emerges when comparing the level of education with **an indicator of the typical requirements** for an occupation in terms of educational background needed. The first one is straightforward (labour economists tend to measure the role of education by using the years of schooling or the highest level of attainment) but the second part has been criticised about how objective or subjective it is. The subjective approach is through individuals' opinions about the connection between their job requirements and their educational background. The objective approach is obtained when we measure this mismatch with an indicator set by an acknowledged authority or organization. The former has been characterised as unreliable due to the arbitrariness of these measures, and as a result the latter is preferred (Patrinos, 1997). In those cases where formal education and training requirements are used as part of the measurement of the skill level required for an occupation, these requirements are defined in terms of the International Standard Classification of Education (ISCED). A mapping between ISCO-08 skill levels and levels of education in ISCED-97 is provided in table 1 (ILO, 2012). Based on the mapping between ISCO skill levels[1] and levels of education in ISCED the term overeducated can be applied to people whose level of

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[1] EU-SILC (European Union Statistics on Income and Living Conditions) datasets used ISCO-08 to describe the occupation of the responders. The nine occupational classes are shown in table 1. Following the group definitions of International Labour Office (ILO), they arrange occupations in skilled groups as the second column presents (ILO, 2012; Pohlig, 2021).

education exceeds the formal educational level required for a given occupation. For instance, a person who is working as a service and sales worker, if she/he has a tertiary degree is overeducated while someone who has completed secondary education is an adequately matched worker. Someone who has completed only primary education is considered undereducated.

TABLE 1

Mapping of ISCO-08 major groups to skill levels and skill levels to ISCED-97 levels of education

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

Source: ILO (2012).

The question is to what degree the labour market can create high-skilled job opportunities for the increasing number of educated workers so that the individual's investments and the state's investments in education will not be lost. To assess these efforts, it is important to focus not only on wage returns but also on other aspects of working conditions that matter to employees: the degree of autonomy, the prestige, the working environment. Interestingly, past studies have shown that overqualified individuals have lower motivations and productivity than those with the same qualifications but are appropriately matched (Capsada-Munsech, 2017). With regard to the field of study, it was also pointed out as a factor to predict whether the individual will experience overeducation. Patrinos (1997) raised concerns about how the phenomenon of overeducation in Greece might evolve if the public sector stopped absorbing graduates, especially from faculties without many alternatives (such as the humanities and social sciences) and about what would happen during a recession of the Greek economy. These graduates tend to acquire general knowledge but not practical skills and find transfer to different occupations difficult. In some segments of the economy, workers who have received vocational training can readily meet the demands of their jobs. In other cases, overeducation may be acceptable at entry-level as the years of experience and in-job training will lead to internal promotions or better opportunities in the same

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employment sector (Dekker, de Grip and Heijke, 2002). International labour mobility is one of the benefits of European integration. The EU can be developed by reallocating highly skilled workers through intercultural tolerance that drives innovation, but this should not happen at the expense of the poorest/underdeveloped countries. This transition must be bilateral rather than unilateral.

The hypotheses on the effects of education and overeducation on intragenerational mobility described above are given below:

(a) Tertiary education and overeducation have a positive effect on intragenerational occupational mobility in the Greek labour market.
(b) The changing reality of the labour market during the crisis implies that the effects of an extra degree can produce debateable results.
(c) The effects of such shocks are heterogeneous. Sometimes these economic shocks accelerate them and some groups of educated people have comparative and relative gains while others lose their pre-crisis social status.

5 DATA AND LIMITATIONS

In this section, we describe the dataset and variables used in the analysis, along with the rationale for our decision. We use the European Union Statistics on Income and Living Conditions (EU-SILC) survey between 2011-2019 (Eurostat, 2024)[2] due to changes from the ISCO-88 version (up to 2010) to ISCO-08 (since 2011). This is the first limitation of the data to explore a longer period. We create two different datasets, civilian labour force who remain in the sample for 2 years between 17-67 years old, creating transition matrices for people who work excluding armed forces jobs. We have excluded pupils, students, men in a compulsory military community or service, people in retirement or in early retirement, individuals who are permanently disabled or/and unfit to work, women with fulfilling domestic tasks and care responsibilities and other inactive persons. Numerous previous studies have used the EU-SILC dataset (Symeonaki, Stamatopoulou and Michalopoulou, 2012; Whelan, Nolan and Maître, 2012; Eurofound, 2017). This dataset uses ISCO-08- 1 digit as occupational classification (without giving more detailed information for each subcategory-second limitation). According to European Commission (2014) Greece use only ISCO as the national socio-economic classification. Symeonaki, Stamatopoulou and Michalopoulou (2012) classified the occupations into 4 categories – elementary occupations, skilled manual, lower-skilled non-manual, higher skilled non-manual. The drawback is that they used occupational rather than skill categories. We can't adopt this approach due to its being inaccurate to suppose that skilled manual occupations are inferior to lower skilled non-manual and a movement from one class to another is an indicator of upward or downward mobility.

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[2] The year 2011 can be characterized as the year in which EU-SILC survey informs us about the situation on income mobility before the first economic adjustment program applied due to the data referred to the previous year. Therefore, the 2011 module included information about households and individuals who were interviewed in 2010 and declared their income for this year. Therefore, the effects of the first memorandum policies had not had any impact. Further, 2019 can be characterized as the year which informs us about the situation at the end of the bailout programs.

We have chosen to analyse occupational and employment mobility year on year for the sample of persons mentioned in each approach. The analysis requires valid information on the classification used to construct occupational mobility. For this reason, we based our analysis on the skill level classification[3] (table 1) as well as the job wages tiers (appendix table A1). The second approach of our analysis requires a wage criterion to rank occupations. We use the common method of average annual salary. The income from work corresponds to an index of the job quality as we mentioned in previous subchapter. Table A1 in appendix shows the ranking of the occupations from the highest quality tiers to the lowest paid, considering average wages in both years. We follow the OECD (2019) definition of the middle class of income. It defines as "middle-income class" incomes ranging between 100% and 150% of medium. Correspondingly, the upper-middle class includes incomes between 150% to 200% of medium and lower middle-incomes class (75% to 100% of medium). By calculating the average wage for each occupational category and comparing it with the medium income for that year (10,985€), the nine occupational categories are subdivided into three groups: Lower middle-income: 8,238.75€ – 10,985€, Middle middle-income: 10,985€ – 16,477.5€ and Upper middle income: over 16,478€. The division is robust because the mean income of each category corresponded between the limits that applied in both years 2011 and 2019. Both approaches respond to the necessity of ranking indicators that allow the estimation of occupational indices as reliable measurable classifications. The respective employment mobility measured in skill levels added unemployment as an additional category (appendix table A2). We assume that a movement from a skill level to unemployment is a downward movement and from unemployment to any skill level as upward mobility. The sensitivity of our index is to assume that unemployment is the lowest level of occupational classification. The three different classifications are offered for immediate confirmation of the results (a direct robustness check). However, in order to evaluate factors of the Greek economy which may affect mobility we need more detailed individual characteristics in national data (such as the areas in which people live, more detailed occupational information).

6 METHODOLOGY

To summarise, in order to answer the research questions, we use the following statistical and econometric tools.

6.1 ABSOLUTE MOBILITY INDICES

To establish specific patterns of mobility during the three bail-out programs we use absolute mobility indices. Absolute mobility indices measure the total number of people who change to an occupational level higher than their previous job (upward mobility) or whose new job is lower in the occupational hierarchy than the older one (downward mobility) or whose previous and current jobs have the same occupational prestige (immobility). The sum of the previous ratios is equal to one (Symeonaki, Stamatopoulou and Michalopoulou, 2016; Eurofound, 2017).

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[3] How skill levels are defined: 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 (ILO, 2012).

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The following equations estimate the absolute mobility indices:

$$Upward\ Mobility = \frac{1}{N}\sum_{j>i} n_{ij} \qquad (1)$$

$$Downward\ Mobility = \frac{1}{N}\sum_{j<i} n_{ij} \qquad (2)$$

6.2 MULTINOMIAL LOGIT ANALYSES

To investigate the effects of a set of individual and job-related characteristics on mobility patterns, using multinomial logit analysis is employed. Using multinomial logit analyses with regard to upward and downward mobility, we define three possible states: not mobile (the reference category), upwardly and downwardly mobile following a model suggested by Plewis and Bartley (2014).

The multinomial logit models have a dependent variable that is a categorical, unordered variable (Stawarz, 2018). The choices/categories are called alternatives (1, 2, ..., m).

As a multiple logit thus ignoring the ordering using mlogit in Stata[4]:

$$\log[\frac{\pi_m}{\pi_M}]m = 1 \ldots\ M - 1 \qquad (3)$$

where M is the reference category and π is the probability of being in category m.

The explanatory variables consist of a set of individual-specific characteristics such as marital status, age and sex, human capital is captured by the completion of tertiary education (binary variable of completion or not this level of education), years of experience and whether the worker is in educational training as well and dummy variables for over- or undereducated. The overeducation captured as a dummy variable comprises overqualified workers who have completed tertiary education and the undereducation captured as a dummy variable comprises under-qualified workers who have completed secondary education. The coefficients of other alternatives are interpreted in reference to the base outcome.

6.3 LOGIT REGRESSION

This step is to examine the determinants of overeducation in Greece, using a logit regression which explores the characteristics of people who are overeducated workers compared to people who are adequately educated workers.

Logit estimation is performed with a dichotomous dependent variable indicating mobility (Crespo, Simoes and Moreira, 2013; Sicherman and Galor, 1990):

Log[Prob(being overeducated)/Prob(adequately educated)]it $= X_{it}\beta + \varepsilon_{it}$ (4)

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[4] Stata is a complete, integrated software package that provides all your data science needs-data manipulation, visualization, statistics, and automated reporting.

Logit regression: Dependent variable = 1 if the worker is overeducated, 0 if he/she is adequately educated- correctly allocated workers, undereducated workers excluded while X is a vector of variables including individuals' characteristics and family background variables (parental education and occupation). We used data from people who remained in the sample for 2 and 4 consecutive years to check both temporary and long-term overeducation. Logit regressions fit the model for a binary response by maximum likelihood using robust standard errors.

Finally, a statistical approach for presenting the incidence of overeducation during the previous decade. We check the unmatching between the supply and demand side in the labour market.

7 RESULTS

7.1 CHANGES IN INTRAGENERATIONAL OCCUPATIONAL MOBILITY DURING THE CRISIS

Dividing this period into three parts according to the bailout programs (in 2010 the first, in 2012 the second and in 2015 the third) the absolute mobility indicators present specific patterns regardless of the type of classification. The changes occurred during the first 4-5 years of the crisis (until 2015-2016, the first 2 bailout programs) while noticeable after that is an adjustment to the reverse of the distribution at the beginning of the crisis. Figure 1 (appendix table A3) plots the upward and downward occupational mobility. We can see that downward mobility rates (people who moved from a higher-skill to a lower-skill level occupation) overtake upward mobility percentages (people who moved to a higher-skilled job) until 2015. The rate of downward movements peaked at the beginning of the crisis at 10.14%. A different pattern applies after 2015 when the absolute mobility rates are higher. Moreover, total mobility rates (both upward and downward) are higher during the first memorandum (lower immobility rates). Along similar lines, the same pattern exists if we see the absolute mobility rates of paid jobs classification. The percentages of both directions are low compared to the previous classification, but the changes among the periods remain similar (figure 2 and appendix table A4). Small differences occurred with respect to employment mobility. Figure 3 (appendix table A5) shows that the effects of the crisis had started earlier in Greece, the official percentage rates having increased from 2008. A slight decline in unemployment rates started after the second bailout program. Following this approach, the downward mobility rates continue to be higher than upward percentages during the first memorandum but this changed during the second one and not after the third one as the previous specifications revealed. However, taking into account the people who were stuck in unemployment in our sample it can be noticed that the percentages of these individuals follow an upward trend from 17.89% in 2011 to 24.26% in 2015 and a steady decline later, proving that the normalization of the labour market took place mainly after 2015. In the transition tables (appendix tables A6-A9), it is noticed that the downward trend in mobility before 2015 represents mainly movements from the skill level 3 (technicians and associate professionals) to skill level 2 occupations (a sharp increase of service workers). Therefore, there is a polarization in the middle. The majority of

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people are working in occupations with skill level 2 (appendix table A10). The previous analysis referred to people aged 17 to 67 who are active in the labour market at the beginning and at the end of each specific period or looking for a job. To check the robustness of these patterns, we re-estimated the absolute mobility rates for a different age range (30-60 years old) with similar results (appendix figures A1 and A2).

FIGURE 1

Patterns of intra-generational occupational mobility (skilled levels) across the 3 bailout programs (in %)*
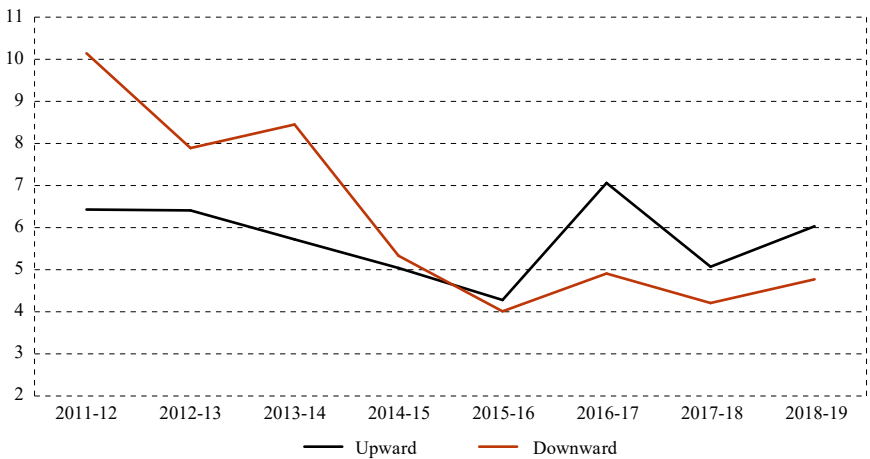
*Absolute occupational mobility (workers 17-67).
Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

FIGURE 2

Patterns of intra-generational occupational mobility (paid-job tiers) across the 3 bailout programs (in %)
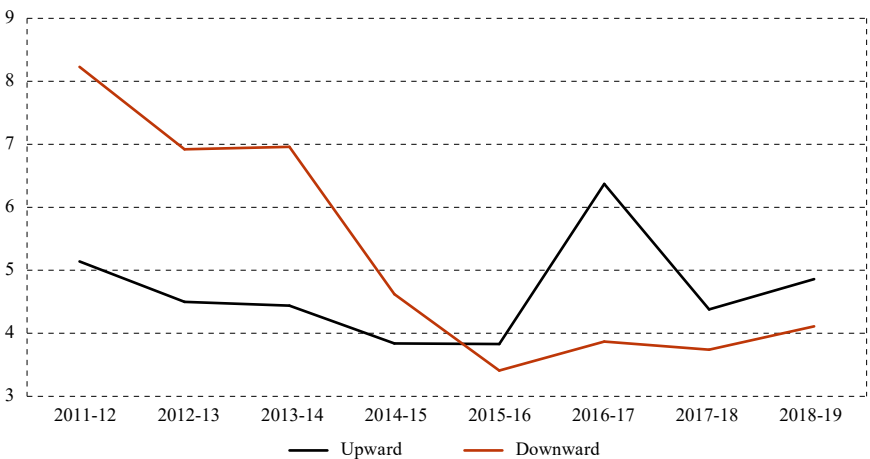
Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

FIGURE 3

Patterns of intra-generational employment mobility (in %)
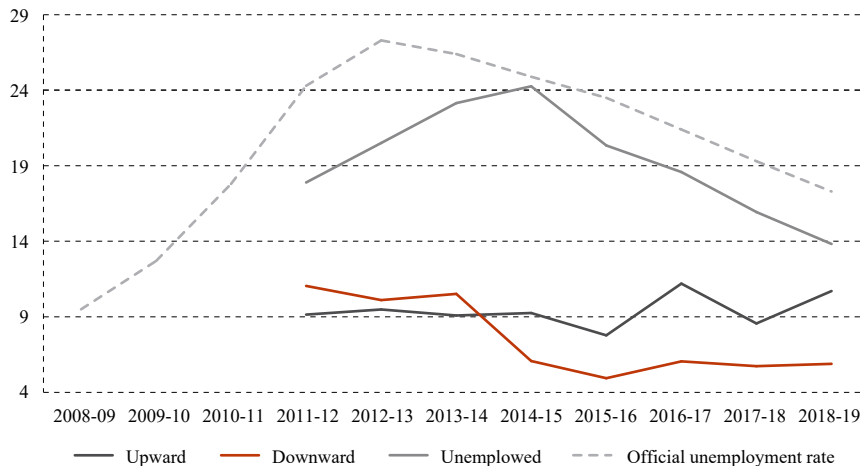
*Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors'
calculations).*

The previous findings show a differentiation in the effects of the memorandums on
the labour market. During 2011-2015, as a result of hight unemployment, many
workers also experienced downward occupational mobility. We recall that the main
policies implemented were the following: cuts in public wages and unemployment
insurance benefits above 20%, extra social insurance contribution, increase of indi-
rect taxes (like VAT) by 10%, rise of direct taxes (like personal income taxes), intro-
duction of new emergency taxes, extra charge in self-employed contribution above
100%. About employment contracts, flexible forms of employment (non-standard
work, temporary contracts) were expanded while severance regulations ceased to be
strictly applied (Galata and Chrysakis, 2016; Koutsampelas and Tsakloglou, 2013).
After 2015, when the 3rd bailout program began, the mobility patterns become more
positive. More workers were experiencing upward mobility, fewer people were
stuck in unemployment, and more people were finding work. This does not neces-
sarily mean that the policies pursued during the third program were necessarily
positive with respect to the labour market (additional increase of social insurance
contributions, changes in personal income taxes and solidarity taxes, introduction of
guaranteed minimum income and a social dividend paid to payees, changes in social
benefits like child and large family benefits while tax credits for employees stopped).
Nor does it mean that the new government corrected the mistakes of the previous
ones. It is possible that the disintegration of the labour market that emerged from the
crisis and the memorandums had reached a peak in 2015 when there were still polit-
ical forces in Greece arguing that there were solutions outside the European Union.
When the third memorandum was signed (the only one that was finally completed)
the country seemed to have entered a period of stability, which had a positive impact
on the labour market as well whereas the "voices" that proposed easy solutions
ceased (Varvitsioti and Dendrinou, 2019; Hope, 2015; Tsebelis, 2015).

When comparing our findings with those of Pohlig (2021), it becomes evident that the immobility rates are notably high, despite a decrease during the economic crisis. Our research reveals distinct patterns when the period of the crisis is isolated. Greece exhibits similar trends to countries such as Iceland, Ireland, Latvia, Malta, and Slovakia. Furthermore, Mediterranean countries displayed comparable patterns. There are similarities to the high immobility rates in Italy (Bison, 2011). Contrasting our findings with other studies examining countries outside of Europe during periods of economic crisis or stagnation, it is observed that Greece demonstrates higher immobility rates than Korea and Japan (Choi, 2016; Yu, 2010). However, as in the case of the USA, the results indicate lower occupational mobility rates during recessions. Occupational mobility tends to be higher during recovery and economic boom periods, and lower during recessions (Roosaar, Mõtsmees and Varblane, 2014). Regarding paid jobs classification when comparing our results with those from other EU countries during the Great Recession, the differential impact on mobility is evident. Some countries, such as Sweden and the United Kingdom, sustained high levels of mobility, while others, including France and Italy, exhibited lower levels of mobility, which were further diminished by the crisis. The findings for Greece align with those for France and Italy (Bisello, Maccarrone and Fernández-Macías, 2020). Finally, with respect to employment mobility, a distinctive pattern emerged with an increase in mobility rates, specifically during the initial phase of the crisis.

Next, we continue our analysis by estimating the direction of these movements across job quality levels measured by the average salaries of each occupational level during the crisis. Between 2011 and 2016 medium-paid jobs increased from 56% to 61% while high-paid jobs declined from 22% to 18%. Since 2016 more high-paid jobs have been created and the situation before the crisis established again (figure 4). The mobility rates in figure 5 treat distance mobility, for example from high-paid jobs to medium-paid occupations is the dominant movement between 2011-2014, the same as incremental advancement, for example from medium-paid jobs to low-paid jobs. The opposite direction from bottom-medium wages levels to upper occupations occurred after 2015. Middle-income economies witnessed occupational upgrading, particularly in medium-level occupations (Pohlig, 2021) a phenomenon not indicated by our results. Furthermore, in contrast to previous research indicating that the Great Recession resulted in job polarization and a net loss of mid-paid jobs in certain countries, Greece experienced a modest increase in such jobs (Bisello, Maccarrone and Fernández-Macías, 2020). The crisis had a particularly severe impact in Spain, leading to the destruction of mid-paid jobs.

FIGURE 4

The distribution of wage-job levels between 2011-2019 (in %)

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

FIGURE 5

The direction of movements across the wage-job levels (in %)

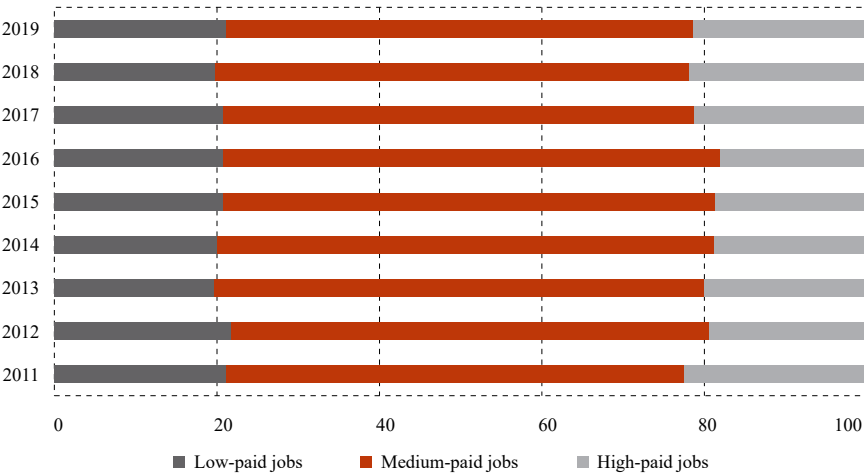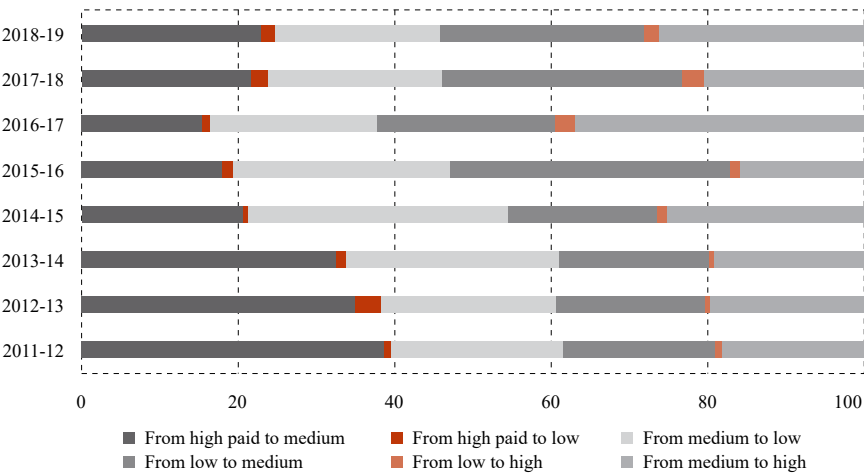*Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).*

7.2 THE EFFECTS OF INDIVIDUAL AND JOB-RELATED CHARACTERISTICS ON MOBILITY PATTERNS

The review of the existing literature showed that there is significant variation in labour market mobility within employment across different members of society. For this reason, we will discuss the results of the multivariable model in which the effects of a set of sociodemographic characteristics on mobility patterns are analysed. Specifically with mobility as a dependent variable, the multinomial dependent variable has 3

categories/alternatives: from an upper skilled level to middling or lower, from lower-skilled level to upper and persistence. Persistence in the same occupational status (that is, absence of mobility) is used as a reference category so that the probabilities of transitions between different skill-level occupations are calculated and the coefficients of the multinomial logistic regression expressed as marginal effects can be interpreted as a relative chance/risk of a particular transition. The model is run separately for different periods. In a world of equal opportunity, differences in occupational opportunities should be derived from personal preferences only, *ceteris paribus*. In this section, the emphasis is on the role of main individual characteristics (age group, gender, education, marital status) as well as job related characteristics (years of experience, overqualification and underqualification, training and education during the professional lifetime).

Tables 2 and 3 show the results of multinomial logit analyses with regard to downward and upward mobility. Starting with downward mobility, the most interesting evidence is that the completion of tertiary education increases the possibilities for downgrading in terms of occupational level. The "all years" estimations results reveal that downward mobility in the labour market is significantly higher for tertiary graduates than occupational immobility. These probabilities are higher in the first period of the crisis and statistically significant in all periods, with the exception of 2013-14. Along similar lines, a tertiary degree is less likely to lead to upward occupational mobility (table 3). This significant effect contradicts traditional human capital theories, which emphasise the effectiveness of human capital investments for workers who had completed tertiary education with regard to possibilities for the direction of occupational mobility. The fact that bachelor and higher degrees are not linked with greater mobility is the first signal of overeducation in Greece during the last decade. In addition, the outcomes obtained from the meticulous regressions showcase results that are incongruent with the predictions set forth in hypothesis (a), prompting a reconsideration of the proposed relationship between tertiary education and this aspect of mobility.

On the other hand, overeducation indicates the expected positive effect on upward and downward mobility focused on overqualified workers who have completed tertiary education. Overqualified workers tend to be more mobile upwards, mainly during the first period of the crisis (figures 6 and 7). Taking these results together indicate that this level of education is not sufficient to protect workers from experiencing downward occupational mobility during a crisis period but can boost the upward possibilities for overqualified workers to find an adequate job to their own skill levels. And it confirms the hypothesis that the changed character of the labour market during the crisis can have contradictory results about the effects of an extra degree. As expected, undereducated workers with secondary education have higher chances of moving downward in the occupational strata and less chances to experience upward mobility (already working in a job where their qualifications fall short of the qualifications required). The empirical findings elucidated through the regression analyses contribute substantial and compelling support for hypothesis (b).

To capture differences between men and women we include the sex variable which takes the value of 1 if the respondent is female and 0 if male. In the case of absence of discrimination and segregation, we would expect to find no significant gender differences in occupational distributions. Indeed, females presented no significant differences to men in the majority of years and in both directions of mobility. The same thing was noticed about marital status as well. Consistently with the traditional theory of career mobility, younger people have lower chances of mobility than people between 30-50 years old[5]. The age after 30 is considered crucial about the decision of mobility due to the fact the person has completed the education and training needed for a specific field of occupations and has obtained the experience which allows him to search for the ideal career. Surprisingly, older workers are the most mobile within occupational classes, although in many cases the marginal effects are not statistically significant. The analytical results derived from these sub-groups affirm the tenability of hypothesis (c).

Each year of experience reduces the likelihood of a downward move but it is also clear that it also negatively affects the possibilities for upward occupational change. We assume that additional years of experience lead workers to an adequate job linked to their preferences and for this reason to immobility. However, it is worth noting that even highly significant coefficient of this variable, are very low, and this diminishes the importance of this factor. Finally, as anticipated, current education, simultaneously with working, affects the ability to gain promotion in occupational levels and offers a kind of protection regarding downward mobility.

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[5] Middle age group 30-50 is excluded to serve as reference category.

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TABLE 2
Estimations of downward mobility#

From upper skill level to middling or lower	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Marital	-0.004	-0.001	0.015	-0.001	-0.003	0.001	-0.001	-0.007**
	(0.010)	(0.008)	(0.013)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
Female	-0.012	-0.006	-0.014	-0.001	-0.002	-0.005*	-0.002	0.015***
	(0.009)	(0.007)	(0.013)	(0.005)	(0.003)	(0.003)	(0.002)	(0.003)
Tertiary	0.075***	0.050***	0.060	0.030***	0.028***	0.040***	0.036***	0.037***
	(0.009)	(0.008)	(0.037)	(0.005)	(0.003)	(0.003)	(0.002)	(0.003)
Overqualified × tertiary	-0.177***	-0.187***	-0.107***	-0.080***	-0.071***	-0.081***	-0.071***	-0.084***
	(0.034)	(0.039)	(0.019)	(0.013)	(0.009)	(0.007)	(0.007)	(0.009)
Underqualified × secondary	0.176***	0.149***	0.195	0.085***	0.067***	0.080***	0.062***	0.069***
	(0.013)	(0.015)	(0.912)	(0.008)	(0.006)	(0.006)	(0.004)	(0.005)
Years of experience	-0.001***	0.0001	-0.001	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.0006)	(0.0004)	(0.0009)	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Current education	-0.089*	-0.004	-0.066	-0.005	-0.030*	-0.006	-0.007	-0.006
	(0.045)	(0.025)	(0.043)	(0.016)	(0.017)	(0.011)	(0.009)	(0.010)
Young (17-30)	-0.020*	0.034**	-0.004	-0.005	-0.008**	-0.001	-0.003	-0.005
	(0.012)	(0.017)	(0.025)	(0.007)	(0.003)	(0.005)	(0.004)	(0.004)
Old (50-67)	0.009	-0.004	-0.014	0.002	0.015***	0.005	0.008**	0.008*
	(0.014)	(0.009)	(0.012)	(0.007)	(0.005)	(0.004)	(0.004)	(0.004)

#*Marginal effects from multinomial logistic regressions, mobility as dependent variable.*

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

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

TABLE 3
Estimations of upward mobility

From a lower skill level to an upper	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Marital	-0.008	0.022***	-0.001	-0.001	-0.003	0.002	-0.005	-0.002
	(0.009)	(0.008)	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)
Female	-0.001	-0.016**	-0.001	-0.001	-0.004	0.002	0.007**	0.005
	(0.008)	(0.007)	(0.018)	(0.005)	(0.003)	(0.004)	(0.003)	(0.004)
Tertiary	-0.026**	-0.004	-0.003	-0.004	-0.056***	-0.046***	-0.055***	-0.020***
	(0.012)	(0.010)	(0.065)	(0.007)	(0.006)	(0.006)	(0.005)	(0.006)
Overqualified × tertiary	0.098***	0.109***	0.047	0.069***	0.057***	0.085***	0.083***	0.066***
	(0.014)	(0.012)	(0.918)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Underqualified × secondary	-0.017	-0.071	(-0.047)	-0.016	-0.034*	-0.094***	-0.044***	-0.054***
	(0.022)	(0.045)	(0.107)	(0.021)	(0.020)	(0.030)	(0.015)	(0.019)
Years of experience	-0.001**	-0.001	-0.001	-0.001	-0.001***	-0.001	-0.001***	-0.001***
	(0.0005)	(0.001)	(0.001)	(0.001)	(0.0002)	(0.001)	(0.0002)	(0.0002)
Current education	-0.067	0.051**	0.014	-0.016	-0.007	0.015	0.019**	0.004
	(0.056)	(0.021)	(0.027)	(0.022)	(0.014)	(0.014)	(0.008)	(0.013)
Young (17-30)	-0.034***	-0.009	-0.012	-0.018***	-0.002	-0.008	-0.008**	0.001
	(0.008)	(0.011)	(0.241)	(0.006)	(0.004)	(0.007)	(0.003)	(0.007)
Old (50-67)	0.014	-0.010	0.002	-0.005	0.010**	-0.007	0.015***	0.004
	(0.013)	(0.009)	(0.042)	(0.007)	(0.005)	(0.005)	(0.004)	(0.006)
Obs.	3,501	3,511	4,614	5,912	9,894	13,965	14,898	11,379

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

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

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FIGURE 6

Coefficients for educational variables of downward mobility with standard deviations (reference group immobility)
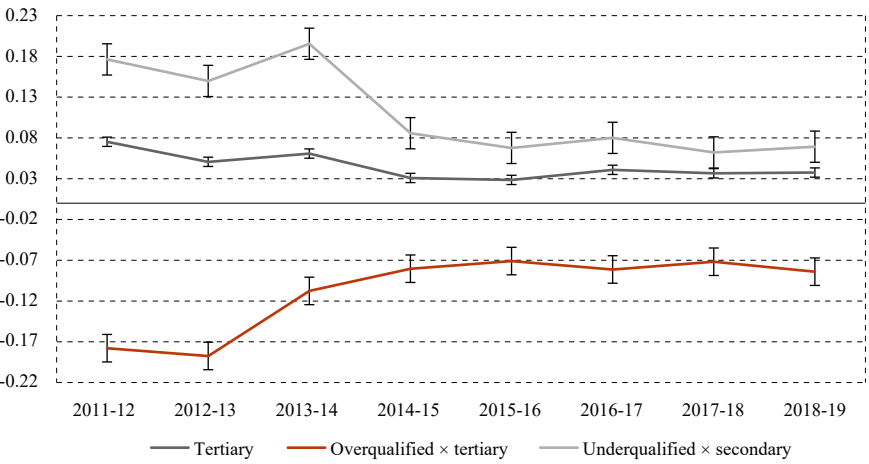
Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

FIGURE 7

Coefficients for educational variables of upward mobility with standard deviations (reference group immobility)
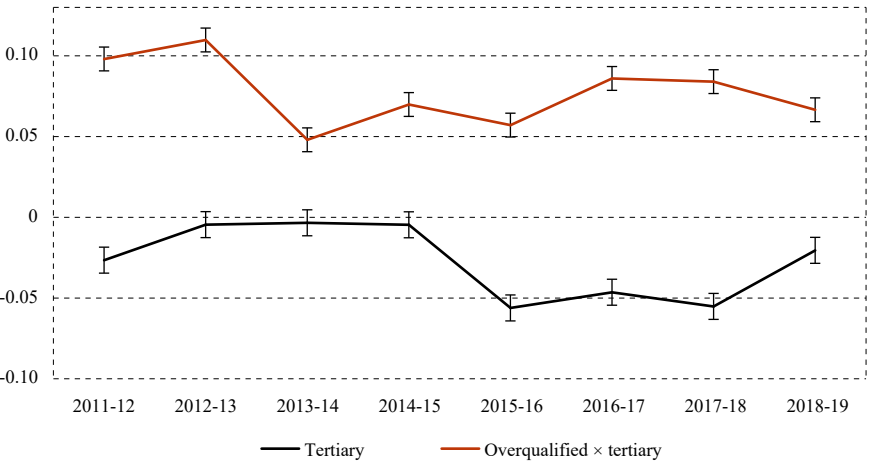
Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

Robustness check: To allow for upward and downward mobility for all persons, data was limited to 2nd and 3rd skill levels excluding those who were positioned at the top or bottom level of the respective position measure in the base year (appendix table A11). We took a particular interest in the role of education in mobility. The interpretation of the results shows that tertiary education did not offer protection against downward mobility and tertiary graduates have more chances of

moving downward and fewer to indicate maintenance of level during the crisis. The findings are more pronounced and clearer between 2011-2015. The overqualified were protected mainly against downward movements but we do not find in this case that they had more possibilities for upward movements than appropriately qualified workers. On the contrary, overqualified workers tend to indicate more persistence and this is a negative sign that overeducation is not a "waiting room" but more possibly a trap. The disadvantage of less-educated workers with respect to mobility has a declining trend during this crisis. It seems to have had less effect than the other two categories. Their potential for downward mobility diminishes and the probability of persistence increases. Contrary to findings in Europe, which indicate that women in most countries face a higher risk of downward mobility (Bisello, Maccarrone and Fernández-Macías, 2020), our research shows that women exhibit higher immobility than men. Our findings align more closely with the situation in Sweden, which is an exception in this regard. Regarding upward mobility, Greece shows similarities to France and Italy, where gender does not significantly impact job mobility. However, in other EU countries, women experience negative effects on upward mobility. In Europe, individuals under 30 are the most mobile within employment across all countries, particularly in Sweden and the UK, in comparison to middle-aged workers.

7.3 OVEREDUCATION IN GREECE AND THE CHARACTERISTICS OF OVERQUALIFIED EMPLOYEES

The crisis and the educational expansion exacerbated the incorrect matching between workers and jobs. Despite the concerns about the possible imbalance between tertiary educational expansion and the lower proportion of job positions in high-skilled jobs in the previous 10 years, Greece experienced a dramatic increase in the percentage of young workers holding bachelor degrees (ISCED 5-8). Analysis of Eurostat data illustrates a comparison between the educational attainment of employed individuals and the share of skilled jobs by year (appendix figure A3). This allows us to compare supply and demand sides over time. Comparing the proportion of people who work as managers, professionals and technicians (ISCO 1-3) and the total number of workers, we discovered the proportion of individuals who work in professions that require at least the completion of tertiary education according to the International Labour Office. It is noted that the percentage of highly skilled non-manual jobs declined in Greece from 34.5% in 2010 to 29.9% in 2015 (secondary vertical axis). During the same period the proportion of tertiary graduates in the working population between 25-64 years old from 22.8% to 32.7% (primary vertical axis). Applying the same approach to our sample, the gap between positions in skilled levels 3 to 4 that require higher education and the corresponding graduates increased (appendix table A12). Only in 2011 did the vacancies in these professions exceed the numbers of university graduates. Then there is the overabundance of highly educated people in relation to these jobs. The mismatch peaks in 2016 but is steadily present until the end of the crisis. If we take into account the large number of graduates who immigrated in the first years of the crisis, we can assume that the problem is even bigger for

the Greek economy, which does not create highly skilled jobs. We can also check the unmatching between occupations' requirements and workers' backgrounds in all levels of professions and education. With regard to Level 2 skilled occupations, we can see that they constitute the majority of jobs in Greece with a proportion of more than 60%. The lower percentage of adequately educated workers leads to the assumption that these professions absorb workers with higher or lower qualifications creating the incidence of overeducation and sometimes of undereducated workers as well. Finally, the low demand for skilled workers at level 1 is covered by the higher percentage of those completing primary education.

Overeducation rates vary across EU countries, with the highest incidence observed in peripheral nations (McGuinness, Bergin and Whelan, 2018). The contextual core characteristics of tertiary education in Greece can help us to interpret partly the results. The university sector includes high education institutions (AEIs) and Technical Universities (TEIs) which provide ISCED 6 and 7 level degrees. They have been equated to the previous decade and the minimum registration period is four years. Compared to other EU countries, Greek students present the highest proportion in the total population, women outnumbering men while they choose more social sciences and other humanities and less engineering and other studies oriented to manufacturing. This means that the vast majority of graduates have not acquired specific knowledge about a discipline but general skills, which creates problems in landing an adequate job (European Commission, 2020).

Overeducation has regained importance given that there are few studies on occupational choices in Greece, and the characteristics of the overeducated are even less investigated. We address a specific logit regression for those who were overqualified in a specific year and those who are correctly allocated workers (undereducated workers excluded) in our sample. We also check workers who are overqualified for four consecutive years by calling them long-term overqualified workers. We run the regression for pool data across this period (table 4). Starting with the job-related variables, employees are more exposed to overeducation. The self-employed and family workers are more likely to be correctly matched by having the opportunity to choose a position suitable to their educational background. Overeducated workers have less experience and tenure than adequately educated workers. That means overeducation may be part of a career mobility process. The overeducated may be temporarily employed in jobs that require fewer skills to gain the experience and training necessary to advance career mobility in their future working lives. Women face lower risks of being overeducated than men in the short and long term. It is interesting due to the fact that they are more educated in Greece and it is assumed that they would be vulnerable to employment mismatching. As a consequence, this evidence shows the ability of women to better identify the correct job. The results also indicate that young people do not have significantly different probabilities of temporary overeducation. However, it is possible to experience long-term traps in times of recession. Married workers have responded affirmatively to over-skilled positions. As previous literature has

shown, family commitments, less time to search for another job as well as less geographical movement flexibility can explain why the overeducated were more represented in both regressions.

Three dummy variables for the highest educational level attained by individuals (secondary, bachelor and master) were created. With so many graduates of tertiary education, it is essential to be report potential differences in tertiary level between those who completed a bachelor degree and those who have a higher qualification. In both types of tertiary degrees, our empirical estimates unveil a positive and significant association between this level of attainment and overeducation. Nevertheless, postgraduate degree holders have lower possibilities of ending up overqualified for their job position. All previous findings remain significant, even in controlling the degree of urbanization. Living in cities offers better opportunities for correct job matching in Greece. Greece has only two major cities (Athens and Thessaloniki) in which 60% of the population lives. Finally, we reported here a function of parental background as potential factor needed for a successful search and help for finding a more suitable position. We conjectured that family networks through social contacts, experience and level of education can help a descendant to make better choices when entering in labour market. The higher educational attainment of parents reflects fewer opportunities for the child to be overeducated, but applies to one of the four regressions. Higher occupational skill level of parents has a negative association with being overeducated, but it is not statistically significant, except the case in which they belonged in the highest level and their children avoid long-term overeducation.

Contrary to the general European trend (McGuinness, Bergin and Whelan, 2018) where female overeducation rates tend to be higher than those of male, our findings indicate that females in Greece are less likely to occupy positions requiring lower skills than their qualifications. Individuals with higher levels of education are more susceptible to overeducation, particularly when the job market does not demand their specific qualifications. Our results align with previous research concerning the determinants of overeducation, which include factors such as age and experience.

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TABLE 4

Logit regressions of overeducated workers

	Overeducated		Long-term overeducated	
Young <35	0.242	0.186	**0.370****	**0.343***
	(0.159)	(0.179)	(0.177)	(0.199)
Female	**-0.293*****	**-0.340*****	**-0.269****	**-0.330****
	(0.102)	(0.118)	(0.116)	(0.135)
Marital	**0.337*****	**0.285****	**0.364****	**0.323****
	(0.130)	(0.144)	(0.146)	(0.160)
Secondary	-0.450***	-0.294	-0.606***	-0.407***
	(0.170)	(0.205)	(0.198)	(0.242)
Bachelor	**2.259*****	**2.548*****	**2.403*****	**2.688*****
	(0.175)	(0.215)	(0.201)	(0.251)
Master	**1.278*****	**1.580*****	**1.175*****	**1.395*****
	(0.232)	(0.272)	(0.271)	(0.325)
In education	0.422	0.174	0.505	0.169
	(0.281)	(0.322)	(0.323)	(0.369)
Experience	**-0.018****	**-0.021****	**-0.018****	**-0.018***
	(0.007)	(0.008)	(0.008)	(0.009)
Employees	**0.581*****	**0.680*****	**0.454*****	**0.535*****
	(0.105)	(0.124)	(0.117)	(0.139)
Age began the first job	**-0.027***	**-0.046****	**-0.046****	**-0.585*****
	(0.014)	(0.018)	(0.177)	(0.022)
Parental education (reference: primary)				
Secondary	**-0.321****	**-0.284****	**-0.461*****	**-0.351****
	(0.125)	(0.140)	(0.140)	(0.156)
Tertiary	**-0.339***	**-0.338**	**-0.273**	**-0.221**
	(0.197)	(0.222)	(0.211)	(0.242)
Parental occupational (reference: skill level 1)				
Skill level 2	-0.093	-0.355	-0.044	**-0.334***
	(0.127)	(0.173)	(0.143)	(0.198)
Skill level 3	0.191	0.085	0.115	-0.015
	(0.260)	(0.349)	(0.276)	(0.381)
Skill level 4	-0.252	-0.451	**-0.577****	**-0.923*****
	(0.257)	(0.297)	(0.288)	(0.344)
Living in cities		**-0.292****		**-0.335****
		(0.126)		(0.142)
_cons	-2.27508	-1.126503	-2.36122	-1.190575
Obs.	3,055	2,304	2,835	2,122

The symbols *, ** and *** denote statistical significance at 10%, 5% and 1%.

Robust standard errors in parentheses.

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

8 DISCUSSION

Our motivation in this paper has been to explore the intragenerational occupational mobility over the past decade and to contribute to a better understanding of the consequences of the crisis. The memorandums intensify the segmentation of the previous situation on the labour market and in the public sector facilitating the incidence of severance leading to occupational changes and decisions for many Greeks. Our results showed that downward mobility was the common trend in intra-generational occupational mobility during the first period of the crisis. Significant changes occurred between 2011-2015. The recovery is apparent after 2015 translating as higher upward occupational and employment movements but with a polarization of middle paid professions. Our analysis also showed that this trend is similar independently the classification of occupations. No significant mobility differences were noticed among occupational, employment and paid-jobs mobility.

Subsequently, we explore who has been affected and what characteristics have determined mobility and immobility. Tertiary education did not protect against downward mobility during the first period of the decade as tertiary graduates had more possibilities to go downward and fewer possibilities to go upward. More educated workers had greater mobility than adequately educated workers in similar jobs during 2011-2015 but this mainly had negative effects. Overeducation and undereducation are associated strongly with the possibilities of mobility during the decade of 2010. Overqualification mainly protected against downward movements, while underqualification offered more opportunities for downgrading, although their disadvantage had a downward effect. During most of the survey periods, women were also less likely than men to be more mobile since the onset of the crisis. Young people under the age of 30 are the least mobile within occupational skill levels across all the age groups studied. Incidence of overeducation, the factors influencing it and the characteristics of overeducated people were the next issues which we explored. Overeducation in Greece was a sum of increasing tertiary graduates, demolition of high-skilled job positions and creation of more positions requiring lower skills. Consistent with the previous findings even those with a master's degree may be overeducated in the long run. Contrary to previous career mobility literature, overqualified employees are not mainly females while workers in education don't lead to better jobs. We are also addressing whether human capital accumulation or family background are the drivers of this situation. The policy implications of these findings are that it is necessary for the state to intervene to provide educational knowledge and skills transferable in the labour market and not just qualifications through the free entry into tertiary faculties. It is crucial that modern higher education offer skills that are transferable and adaptable in different fields and offer flexibility to graduates to move to another job and not create barriers. The skills acquired from formal education also need to contribute to entrepreneurship. The Greek state can control the unmatching of qualification and job requirements in public sector but it is difficult to solve the problem of overeducation in the private sector which is self-regulating. The rising stock of educated young people who migrate abroad for a better professional future, the

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reducing rate of returns to education may signal the need for extra measures in tertiary education. An introduction of minimum tuition fees in public universities (with a British model of funding) and limits on the years of studies (plus a limit on how many times you can be re-examined in a module) will help to increase the quality of teaching, studies and research (by saving money that is being spent without reason) and discourage people who study for irrelevant reasons (being hired for any public position, delay in military service, studies to apply for various permits, acquisition of professional rights for self-insurance).

Social equity entails better functioning of the labour market, new skills training for unemployed people, especially among the vulnerable groups identified by the analysis and aid for correct matching between them and emerging job positions. This paper suggests further research directions. A first step could involve an econometric analysis of reforms implemented. It should assess the comprehensiveness of these reforms and their effectiveness in mitigating the social impact on the Greek labour force. Such an analysis would inform the development of long-term, coherent, and well-designed mobility policies. Furthermore, it would be interesting to examine the diminishing returns of overeducation, the workers who were affected by the crisis with job exits and long-term unemployment and the positive labour market movements when the country started recovering after 2015.

Disclosure statement
Authors have no conflict of interest to declare.

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APPENDIX

TABLE A1

Mapping of the three job quality tiers based on average annual salaries

ISCO-08	Job quality tiers	Mean annual wages in 2011 (in thousand €)
2 Professionals	High-paid jobs (ISCO 1-2) Upper-middle income	19.4
1 Managers		18.5
3 Technicians and associate professionals	Mid-low paid jobs (ISCO 3-4-5-7-8) Middle income	16.3
8 Plant and machine operators and assemblers		14.6
4 Clerical support workers		14.0
7 Craft and related trades workers		11.6
5 Services and sales workers		11.2
6 Skilled agricultural, forestry and fishery workers	Low-paid jobs (ISCO 6-9) Lower middle income	8.9
9 Elementary occupations		8.3

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

TABLE A2

Structure of i *x* j *design matrices[6]*

Year t	Status/Skill level in year t+1				
	Unemployed	Level 1	Level 2	Level 3	Level 4
Unemployed	i1j1	i1j2	i1j3	i1j4	i1j5
Level 1	i2j1	i2j2	i2j3	i2j4	i2j5
Level 2	i3j1	i3j2	i3j3	i3j4	i3j5
Level 3	i4j1	i4j2	i4j3	i4j4	i4j5
Level 4	i5j1	i5j2	i5j3	i5j4	i5j5

Source: Pohlig (2021).

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[6] These matrices are presented as outflow tables with columns representing destination statuses and rows representing origin statuses. The immobility design matrix includes a parameter for the diagonal, indicating occupational immobility or stability. The upgrading (U) and downgrading (D) matrices each have one parameter for cells above the diagonal (upward mobility) and below the diagonal (downward mobility), respectively. Here, *ikjl* represents the transition probability from state *k* at time *t* to state *l* at time t+1.

TABLE A3

Absolute mobility indices of occupational skill levels (in %)

Skill levels	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Upward	6.4	6.4	5.7	5.0	4.3	7.0	5.1	6.0
Downward	10.1	7.9	8.4	5.3	4.0	4.9	4.2	4.8
Immobility	83.4	85.7	85.8	89.6	91.7	88.0	90.7	89.2

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

TABLE A4

Absolute mobility indices of job-paid levels (in %)

Wage levels	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Upward	5.1	4.5	4.4	3.8	3.8	6.4	4.4	4.9
Downward	8.2	6.9	7.0	4.6	3.4	3.9	3.7	4.1
Immobility	86.6	88.6	88.6	91.5	92.8	89.8	91.9	91.0

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

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TABLE A5
Absolute mobility indices of employment levels (in %)

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Upward	–	–	–	9.1	9.5	9.1	9.2	7.8	11.2	8.6	10.7
Downward	–	–	–	11.0	10.1	10.5	6.1	4.9	6.0	5.7	5.9
Unemployed in our sample	–	–	–	17.9	20.5	23.1	24.3	20.3	18.6	15.9	13.8
Immobility	–	–	–	61.9	59.9	57.2	60.4	66.9	64.2	69.8	69.6
Official unemployment rate	9.5	12.7	17.8	24.3	27.3	26.4	24.9	23.5	21.4	19.3	17.3

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

TABLE A6

Employment mobility between 2011-2012 (in %)

			Year 2012					
		Unemployed	Skill level				Total
			1	2	3	4	
	Unemployed	77.19	4.56	16.32	0.88	1.05	100
Year 2011	Skill level	1	8.75	63.33	27.08	0.83	0	100
		2	4.48	3.39	86.88	4.65	0.60	100
		3	4.49	1.43	33.27	55.10	5.71	100
		4	2.35	0	6.10	5.16	86.38	100

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

TABLE A7

Employment mobility between 2012-2013 (in %)

			Year 2013					
		Unemployed	Skill level				Total
			1	2	3	4	
	Unemployed	79.71	3.01	14.10	1.11	2.06	100
Year 2012	Skill level	1	10.08	74.03	15.50	0.39	0	100
		2	5.38	2.48	86.08	4.75	1.32	100
		3	2.89	1.05	33.07	55.91	7.09	100
		4	3.38	0	3.60	3.83	89.19	100

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

TABLE A8

Employment mobility between 2013-2014 (in %)

			Year 2014					
		Unemployed	Skill level				Total
			1	2	3	4	
	Unemployed	79.33	4.18	13.24	1.32	1.93	100
Year 2013	Skill level	1	11.34	75.26	12.37	0.69	0.34	100
		2	6.12	3.58	86.34	3.08	0.87	100
		3	3.60	0.45	29.66	58.43	7.87	100
		4	4.34	0.14	3.93	6.78	84.80	100

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

TABLE A9

Employment mobility between 2014-2015 (in %)

			Year 2015					
		Unemployed	Skill level				Total
			1	2	3	4	
	Unemployed	79.65	3.09	12.93	1.91	2.42	100
Year 2014	Skill level	1	8.75	78.51	11.41	0.27	1.06	100
		2	4.04	2.29	90.48	2.09	1.10	100
		3	2.79	0.37	14.71	70.95	11.17	100
		4	1.07	0	2.15	4.83	91.95	100

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

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TABLE A10
*The distribution of occupations ISCO (in %)*

Occupational categories	2011b	2012	2012b	2013	2013b	2014	2014b	2015	2015b	2016	2016b	2017	2017b	2018	2018b	2019
Managers	8.3	5.9	5.5	3.2	3.4	2.1	1.8	1.5	1.6	1.6	1.9	3.5	4.0	4.2	4.6	4.6
Professionals	13.4	13.1	14.2	14.5	17.6	17.3	18.1	18.8	17.7	17.5	15.9	16.7	17.0	16.8	16.2	16.5
Technicians	6.4	5.8	5.8	6.9	8.0	8.3	8.5	8.3	8.5	8.1	6.8	6.1	5.6	6.0	5.8	6.1
Clerks	10.5	11.6	12.7	11.6	12.3	11.3	11.7	11.5	10.6	10.4	11.5	11.8	11.5	11.3	11.0	10.7
Service workers	16.9	19.2	19.5	22.1	21.5	23.0	23.0	22.9	24.1	25.2	26.5	24.4	23.5	23.8	22.7	22.4
Skilled workers	15.4	15.2	13.5	13.4	10.4	10.1	10.1	10.4	11.3	11.6	12.0	12.0	12.8	12.7	13.8	13.8
Craft workers	14.8	14.0	13.9	13.4	12.9	12.6	12.0	11.1	10.4	10.3	10.0	10.0	10.5	10.7	11.1	11.3
Plant operators, etc.	6.7	6.3	6.6	6.0	5.6	5.7	5.8	5.7	5.8	6.2	6.2	6.6	6.5	6.5	6.1	6.3
Elementary occupations	8.3	8.9	8.2	8.9	8.2	9.5	9.0	9.8	10.0	9.1	9.1	8.9	8.6	7.9	8.8	8.3
Obs.	3,501	3,501	3,511	3,511	4,614	4,614	5,912	5,912	9,894	9,894	13,967	13,967	14,901	14,901	11,395	11,395

Note: b *represents the distribution of professions at the end of each year.*

Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).
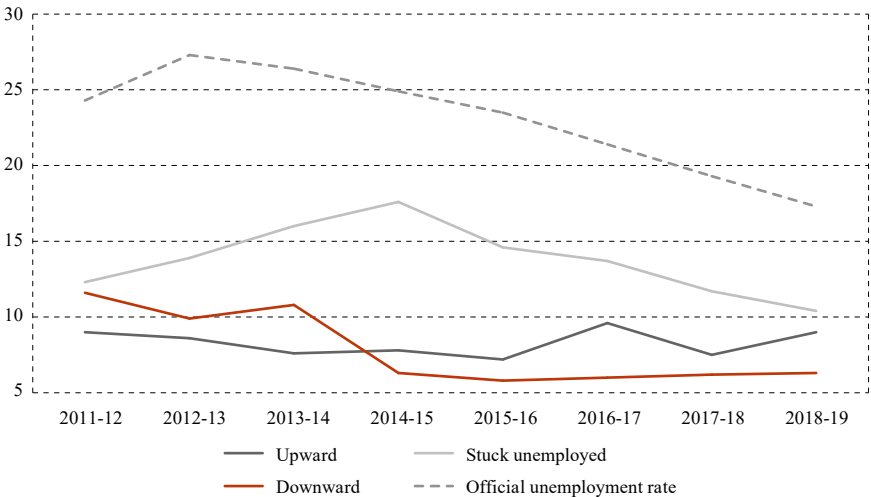
FIGURE A1

Absolute occupational indices for people between 30-60 years old (in %)
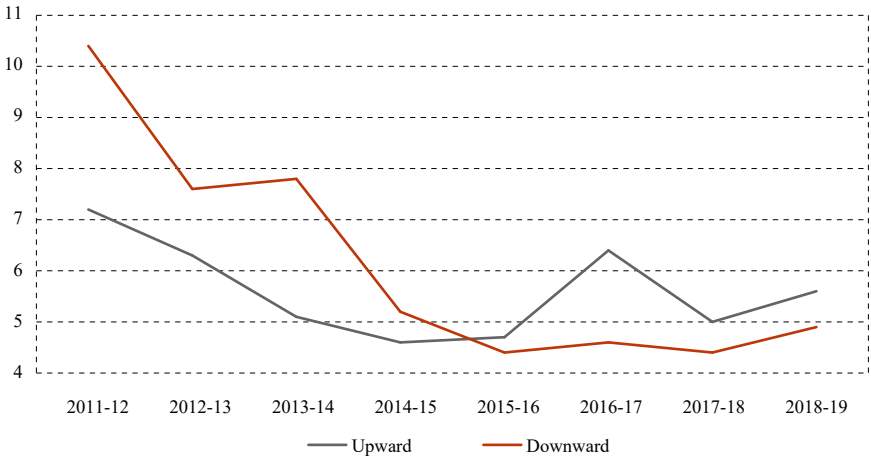
Source: Analysis of cross-sectional and longitudinal microdata from the EU-SILC survey (authors' calculations).

FIGURE A2

Absolute employment indices for people between 30-60 years old (in %)

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

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TABLE A11

Multinomial logistic regressions results on the middle skill levels

	Remaining in the same level							
	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Marital	0.010	**-0.022**	**-0.022**	0.002	0.010	-0.001	0.005	0.008
Female	0.009	0.009	0.010	-0.007	0.000	**-0.016**	**-0.007**	**-0.027**
Tertiary	-0.200	-0.150	-0.169	-0.109	-0.050	-0.105	-0.062	-0.121
Underqualified	-0.220	-0.189	-0.152	-0.098	-0.041	-0.072	-0.056	-0.048
Qualified(ref)								
Overqualified	**0.032**	0.008	**0.059**	**0.038**	**0.032**	**0.043**	0.009	**0.049**
Years of experience	**0.003**	**0.001**	**0.001**	**0.001**	**0.002**	0.001	**0.001**	**0.001**
Current education	**0.105**	-0.017	0.019	0.017	0.024	-0.013	-0.002	**-0.032**
Young (17-30)	**0.053**	-0.011	0.020	**0.025**	**0.016**	0.004	0.008	0.011
Middle (31-50) ref.								
Old (50-67)	0.007	0.009	0.016	0.008	**-0.017**	0.002	**-0.012**	-0.007
	From upper skilled level to middling or lower							
Marital	-0.005	0.002	**0.020**	-0.005	-0.005	-0.001	0.000	**-0.007**
Female	-0.009	-0.005	**-0.017**	0.000	0.002	0.001	-0.003	**0.014**
Tertiary	0.145	0.097	0.108	0.045	0.033	0.048	0.036	0.056
Underqualified	**0.247**	**0.225**	**0.190**	**0.102**	0.057	0.096	0.077	0.078
Qualified(ref)								
Overqualified	-0.043	-0.048	-0.052	-0.039	-0.033	-0.036	-0.023	-0.032
Years of experience	-0.003	-0.001	-0.001	-0.002	-0.001	-0.001	-0.001	-0.001
Current education	-0.073	-0.021	-0.035	-0.022	-0.025	-0.015	-0.021	0.008
Young (17-30)	**-0.036**	0.010	-0.005	-0.011	**-0.010**	0.001	-0.004	**-0.008**
Middle (31-50) ref.								
Old (50-67)	-0.003	-0.011	**-0.021**	-0.002	0.009	0.007	0.003	0.006
	From lower skilled level to upper							
Marital	-0.005	**0.021**	0.002	0.003	-0.005	0.002	-0.005	-0.001
Female	-0.001	-0.003	0.008	0.007	-0.001	**0.015**	**0.010**	0.013
Tertiary	0.055	0.053	0.062	0.065	0.017	0.057	0.026	0.065
Underqualified	**-0.027**	**-0.035**	**-0.038**	-0.004	**-0.016**	**-0.024**	**-0.021**	-0.030
Qualified(ref)								
Overqualified	0.011	**0.040**	-0.007	0.001	0.001	-0.007	**0.014**	**-0.018**
Years of experience	0.000	0.000	0.000	0.000	0.000	**0.001**	0.000	0.000
Current education	-0.032	**0.038**	0.016	0.005	0.001	**0.028**	**0.022**	**0.024**
Young (17-30)	**-0.017**	0.001	**-0.015**	**-0.014**	**-0.006**	-0.004	-0.004	-0.003
Middle (31-50) ref.								
Old (50-67)	-0.004	0.002	0.005	-0.005	0.008	-0.008	**0.008**	0.001

Notes: Bold coefficients are significant at the 10 percent level or better.

Dependent variable: mobility between skilled levels.

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

FIGURE A3

The evolution of high-skilled occupations and tertiary graduates during 2008-2020 for people between 25-64 years old (in %)
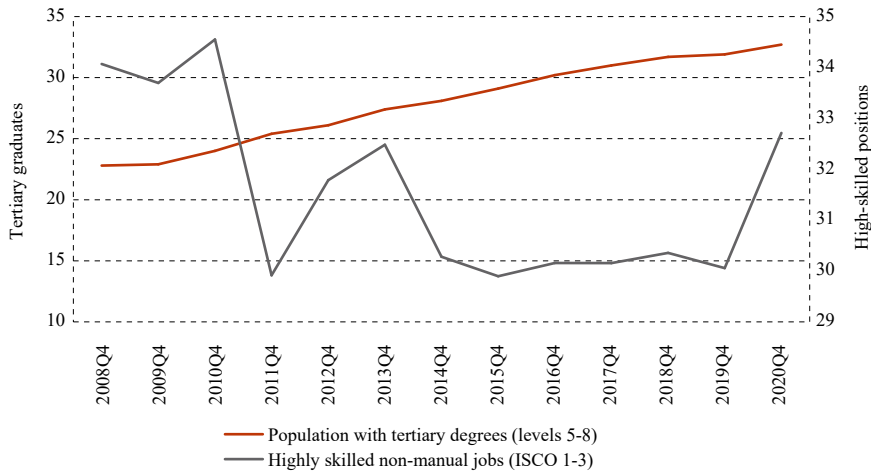
Source: Eurostat.

TABLE A12

The percentages of each skill level of occupation and the proportion of graduates from each educational level

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Skill level 1	8.1	8.2	8.8	9.9	10.4	9.3	8.9	8.4	8.4
Primary	19.3	18.3	14.8	14.1	13.8	13.7	13.8	13.1	14.6
Mismatch in low level	-11.2	-10.1	-6.0	-4.2	-3.4	-4.4	-4.9	-4.8	-6.3
Skill level 2	62.6	66.4	63.3	63.1	62.8	65.7	64.4	63.6	64.1
Secondary-Post Secondary	53.8	54.5	54.2	54.0	53.9	54.3	54.9	55.4	54.5
Mismatch in medium level	8.8	11.9	9.1	9.1	8.9	11.4	9.4	8.2	9.7
3rd – 4th level	29.2	25.3	27.8	26.9	26.8	25.0	26.7	28.0	27.5
Tertiary	26.8	27.0	31.0	31.4	31.5	31.3	30.5	30.4	29.9
Overeducation in high level	2.4	-1.7	-3.2	-4.4	-4.8	-6.3	-3.7	-2.3	-2.4

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

Fiscal policy burden accruing from public debt accumulation: theoretical effect on growth and empirical evidence

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Abstract

The study investigates how fiscal policy burden accruing from public debt affects economic growth in Sub-Saharan African countries over the period 1990-2022. It employs the generalized method of moments and auto-regressive distributed lag methodologies, which reveal that fiscal policy burden significantly impaired economic growth during the period. The results, therefore, support the view that the growth benefits of fiscal policy are constrained by large accumulations of public debt, validating the concern raised by multilateral institutions about the economic consequences of large and excessive debt accumulation. Furthermore, the results corroborate the Classical theory prediction of stagnation in long-run growth when existing public debt is too large for fiscal policy to accommodate. Therefore, interventions are required to contain the fiscal policy burden, in order to foster economic growth. Such policy interventions should aim at reducing the level of public debt and increasing the fiscal revenue from non-tax sources.

Keywords: fiscal policy, public debt, economic growth, developing countries

1 INTRODUCTION

Fiscal policy is one of the macroeconomic policies used by government to manage and direct the economy towards the desired goal of strong and sustainable growth. Public debt is important for effective operation of fiscal policy by providing a channel for supplementary resources to fill the funding gap. The reliance of fiscal policy on debt for effective operation is a highly contentious issue in economic development. Over the past three decades, the issue of fiscal policy and public debt remained a prominent feature of the development process in most developing countries, particularly Sub-Saharan Africa countries (OECD, 2020). These countries are largely characterized by low levels of fiscal revenue and large public debt accumulation, which is considered a critical challenge facing fiscal policy operation. A low level of fiscal revenue is generally attributed to a weak tax system and a poor non-tax revenue base, while a high level of public debt is linked to scarcity of resources and the strong desire of governments to achieve rapid growth through borrowing (Rahman and Giessen, 2017; Sagdic and Yildiz, 2020). This situation has persisted for a long period of time, raising serious concerns about the burden it imposes on fiscal policy, a burden that is likely to slow down the economy due to debt servicing obligations. According to Easterly (2009) and Deaton (2013), in such a situation, in which fiscal policy is saddled with the servicing of a huge debt, rapid growth remains unattainable. This argument was supported by Kwemo (2017) and Park (2019) who asserted that accumulation of public debt constitutes a burden that makes fiscal policy ineffective in fostering rapid economic growth. Debt augurs well for fiscal policy when resources are well utilized, but poses serious dangers when they are mismanaged (Lyons, 2014; Phiri, 2017; Ojong and Bessong, 2017).

Sub-Saharan countries accumulated large public debts from bilateral and multilateral sources in the 1980s, leading to loan default and the imposition of restrictions

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by creditors that resulted in these countries being frozen out of global financial markets. The situation necessitated an IMF/World Bank intervention in the 1990s, through a debt relief program that brought the accumulated debt down to a sustainable level, and enabled the countries to regain access to global financial markets in the mid-2000s. The restoration of access once again enabled these countries to embark on the accumulation of public debt while the level of fiscal revenue remained low. The resurgence of debt accumulation prompted multilateral institutions (IMF and World Bank) to raise their concerns about the risk of allowing a large debt to impose a burden on fiscal policy that hampers its effectiveness in economic management (IMF, 2017). This concern aligns with the classical theory postulation that large public debt inhibits the capacity of fiscal policy and impairs growth in the long-run. In view of this, Aldasoro and Seiferling (2014) advocated that a large public debt combined with a low level of fiscal revenue should be avoided in the pursuit of economic growth. This position was reiterated by Rodden, Eskelund and Litvack (2003) and Crivelli, Leive and Stratmann (2010), who asserted that the issue of fiscal policy effectiveness is paramount in the pursuit of economic growth.

More work therefore needs to be done to provide a deeper and more rigorous insight into how fiscal policy burden imposed by public debt accumulation has affected growth in Sub-Saharan countries. The concerns about the large accumulations of debt in these countries when the level of fiscal revenue is too low to service the debt obligations cannot be ignored. These issues were reiterated by Coulibaly, Gandhi and Senbet (2019), Gosh and Anna (2021), etc., who stated that fiscal policy in the face of large public debt cannot drive the economy along a rapid growth path. Broner et al. (2014) also contended that the situation can only lead to the classical theory outcome of large debt accumulation impeding long-run growth. It is thus pertinent to carry out further study to determine whether the impact of fiscal policy burden on economic growth was actually unfavourable in Sub-Saharan African countries, and hence validate/invalidate concerns about the burden.

This current study, therefore, investigates the pertinent issue in a sample of 45 Sub-Saharan African countries, within the period 1990-2022, depending on data availability. The period was characterized by changes in fiscal revenue and public debt that created uncertainties and raised concerns about the risk of fiscal policy failure. The investigation is carried out by employing the techniques of the generalized method of moments (GMM) and auto-regressive distributed lag (ARDL). The employment of two methodologies ensures robustness and consistency of estimation results. The study is structured into five sections comprising introduction, literature review, methodology and data, empirical results, policy implications, and conclusion.

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2 LITERATURE REVIEW
2.1 THEORETICAL REVIEW

The theory of growth offers diverse explanations on how growth is influenced by certain fundamental economic factors. The classical growth theory, comprising the Malthusian and Ricardian models, postulated that economic growth will decrease with an increasing population and limited resources, unless there is cheap importation from abroad to supplement domestic resources. Bucci and Torre (2009) resonated this theory by stating that along the balanced growth path, population change affects economic growth, depending on whether physical and human capital are complementary or act as substitutes. If physical and human capital complement each other, increase in population will drive rapid growth, but the growth will be slow when physical and human are substitutes. The slow growth is due to the high cost of producing a unit of physical capital to support the increase in human capital (Albelo, 1999). The theory was also re-stated by Narasimhuiu (1977) who believed that growth can be restored through international trade, when population increases and domestic resources are limited. The major limitation of classical theory is that it ignored the role of technical progress in fostering growth.

On the other hand, neo-classical growth theory outlined how a steady growth results when the forces of labour, capital and technology come into play, in contrast to classical theory postulation. The simplest and most popular neo-classical growth model is the Solow-Swan model (Solow, 1956; Swan, 1956). The model argued that capital accumulation and how a country makes use of it determines economic growth. It further claims that how capital and labour are combined in production also affects growth, while technology facilitates growth by augmenting labour productivity. The endogenous growth theory differs from the classical and neo-classical theories by stating that growth is generated by endogenous and not by exogenous forces (Lucas, 1988; Romer, 1989). It provides insight into the role of government policies in stimulating knowledge, research, innovation, and technological progress that help to drive growth. Keynesian theory also emphasized the role of fiscal policy in controlling the factors that determine growth (Elmendorf and Mankiw, 1999). It posited that government spending is used to stimulate capital investment that has a multiplier effect on growth, provided the spending is not financed with excessive borrowing (Ncanywa and Masoga, 2018). This view suggests that fiscal policy can be effective in managing growth if debt does not impose a heavy burden on it (Broner et al., 2014; Driessen and Gravelle, 2019). High levels of debt can lead to repayment obligations that channel fiscal resources away from investment and render fiscal policy ineffective (Saungweme and Odhiambo, 2019).

2.2 EMPIRICAL REVIEW

Several empirical studies have attempted to investigate growth in relation to certain factors, using different methodologies. The link between population and per capita GDP growth was investigated in Uganda by Klasen and Lawson (2007).

The country has one of the highest population growth rates in the world due to increasing birth rate that is likely to persist for a long time. The study used an econometric approach to discover that increasing population growth put a considerable pressure on the economy and slowed per capita GDP growth. Furthermore, the level of poverty increased, making most households unable to sustain their demand for goods and services produced. Befkadu and Tafa (2022) also carried out empirical investigation on the role of population growth rate in economic growth in Ethiopia, using an auto-regressive distributed lag (ARDL) approach. The study found that population growth had significant positive impact on growth, complemented by other control variables such as FDI, inflation, and capital formation. The study therefore recommended that government needs to implement policies that attract capital inflows for the economy to grow faster than population.

The influence of physical and human capital on economic growth is probably the dominant trend in empirical research on growth. Ding et al. (2021) investigated the contributions of human and physical capital to economic growth in a sample of 143 countries within the period 1990-2014. The results showed that the elasticity of growth with respect to human capital is greater than that of physical capital. In particular, the economic growth among the countries showed that countries became less dependent on physical capital as the level of economic growth increased, but depended more on human capital. The study by Altiner and Toktas (2017) also alluded to the prominence of human capital in economic growth in an investigation of 32 developing countries, using panel data covering the period 2000-2014. The results showed that human capital affected growth significantly as compared to the lower effect of physical capital and labour. In another study, Bunyamin (2022) used auto-regressive distributed lag (ARDL) methodology to investigate the impact of physical and human capital on growth in Indonesia, within the period 1970-2017. The important finding was that human and physical capital shaped the economic growth pattern in the country, the significant effect of human capital being largely spurred by an increase in tertiary education. The effect of physical capital was significant, particularly in the long-run, suggesting that the country needs to focus on long-term infrastructure investment to sustain growth.

Several studies have investigated the role of fiscal policy and produced different effects on growth in developing countries. In one of the studies, Lau and Yip (2019) provided evidence on the fiscal policy and economic growth nexus in ASEAN countries, using annual data for the period 2001-2015, which witnessed the global financial crisis. The study found that fiscal deficit negatively affected growth before the crisis, and growth-enhancing in the post-crisis period. It was also discovered that inflation complemented fiscal policy in the impairment of growth in the pre-crisis period, while the exchange rate and FDI complemented policy to accelerate growth in the post-crisis period. In the same vein, Tung (2018) examined the effect of fiscal policy on economic growth in Vietnam, a country that is considered one of the most dynamic emerging economies, facing large fiscal deficits however. The study employed the methodology of error correction model

and quarterly data covering the period 2003-2016. The empirical results strongly indicated a co-integrating relationship between fiscal deficit and economic growth, in which fiscal deficit had a harmful effect on economic growth in both the short and the long run. Furthermore, the study revealed that fiscal deficit was harmful to domestic private investment, foreign direct investment, and exports. In view of these adverse effects, the study recommended that fiscal deficits need to be considerably reduced in order to achieve sustainable economic growth.

Hussain and Haque (2017) investigated the relationship between fiscal balance and economic growth in Bangladesh, within the period 1994-2016, using the techniques of the vector error correction model. The results showed a positive and significant effect of fiscal expenditure on economic growth, which supported the Keynesian prediction that fiscal policy can effectively drive economic growth. The fiscal expenditure was largely financed through debt, which contradicts the classical theory postulation that debt is harmful to economic growth in the long run. The study, therefore, advocated that the government must strive to maintain the level of fiscal expenditure and debt in order to avoid crowding out private sector investment. Furthermore, Rana and Wahid (2017) carried out an econometric study of the impact of government budget on economic growth in the same country, Bangladesh, using the techniques of ordinary least squares, vector error correction, and Granger causality. The findings revealed a significant negative impact of government spending on economic growth before and after the year 2000, suggesting that fiscal policy was ineffective and needed to be reviewed, by broadening the tax revenue base and ensuring monetary policy provides necessary support.

One problem with fiscal policy is the burden of public debt, which makes it ineffective in facilitating growth. However, only a few attempts have been made in the literature to investigate this issue. Manasseh et al. (2022) examined how reliance of government expenditure on borrowing influenced growth in thirty selected Sub-Saharan countries, over the period 1997-2020. The dynamic model of the generalized method of moments was employed and revealed that borrowing to finance fiscal expenditure had only a short-term positive impact on economic growth. The study, therefore, recommended that these countries should endeavour to avoid accumulating excessive debt, in order to avoid the danger of using limited income to service loans. Similarly, Osinubi and Olateru (2006) investigated how the use of debt to finance budget deficit affected economic growth in Nigeria, within the period 1970-2003. The results revealed that the relationship was positive and linear, and concluded that financing fiscal deficit through public debt should take into consideration the optimum level of debt that would still not impair growth. In another study, of 59 developing countries, covering the period 2004-2015, Van et al. (2020) investigated the effect of budget deficit financed through borrowing. The two-step GMM method was adopted, which revealed that the effect on economic growth was negative, suggesting that the countries need to reduce the reliance of fiscal policy on borrowing.

3 METHODOLOGY AND DATA

3.1 THEORY OF FISCAL POLICY AND GROWTH

Theoretically, the effect of fiscal policy on growth works through fundamental determinants such as physical capital, human capital, labour supply, and population trend (IMF, 2015). In other words, these factors intermediate between fiscal policy and economic growth, hence they cannot be excluded from the framework for analysing the effect of policy on growth. Any fiscal policy measure that decreases/increases tax tends to encourage/discourage growth through a rise/fall in physical capital formation at the household and corporate levels. In the same vein, a fiscal policy measure that decreases/increases government expenditure tends to decrease/increase growth through a decrease/increase in public capital formation (De Mooij, 2011). The models of Rebelo (1991), Devereux and Love (1994), etc. also demonstrated how lower tax can encourage investment in physical capital and boost long-term economic growth. Similarly, the endogenous growth model (Lucas, 1988; Barro, 2001) showed how lower tax and higher fiscal spending policies lead to growth by raising human capital stock and promoting technical progress. The endogenous growth model was also used by King and Rebelo (1990) and Pecorino (1993) to show how income tax reduction facilitates growth through human capital accumulation and returns on investment.

Fiscal policy also affects growth through labour supply, when tax-benefit and social security transfers encourage participation in the labour market. This channel of impact is particularly important when the population in the lower income bracket, comprising women and older workers, is large (IMF, 2014; OECD, 2011). Devereux and Love (1994), Turnovsky (2000) and others also used endogenous growth models to show how labour tax cuts can lift long-term growth by inducing a positive labour supply response. Furthermore, a fiscal policy that emphasizes social security benefits may affect growth through increased population growth, but the growth effect is constrained by the available resources (Bucci and Torre, 2009). The argument is that along a balanced growth path, population change may have a positive, negative or neutral effect on growth, depending on the degree to which physical and human capital are complementary.

Fiscal policy can also affect growth of the economy through investment multiplier, as postulated by Keynesian theory, and other related growth theories (Elmendorf and Mankiw, 1999; Broner et al., 2014). If a fiscal policy involves tax cuts and increased spending, it can lead to an increased investment multiplier that fosters growth. It is also argued that when there is simultaneous increase in tax and government spending, the positive effect of government spending on investment will outweigh the negative impact of the tax increase, leading to economic growth (Alesina et al., 2002).

Fiscal policy also relies on borrowing (debt) for effectiveness in managing growth to achieve the desired goal in the classical theory. However, the theory asserts that large debt accumulation may be such a burden on fiscal policy as to impair its

effectiveness in regulating economic growth (Broner et al., 2014; Saungweme and Odhiambo, 2019). This can result from government borrowing crowding out private investment, as well as using large amounts of public resources to repay debt at the expense of capital investment.

3.2 GENERALIZED METHOD OF MOMENTS MODEL (GMM)

The preceding section highlighted some fundamental theoretical determinants of economic growth, which can be included in a simple model for analysing the fiscal policy burden and economic growth. The model shows the relationships between growth and all the variables as follows.

$$EG_{it} = f[FT_{it}, FD_{it}, PC_{it}, HC_{it}, TP_{it}, PG_{it}] \qquad (1)$$

$$EG_{it} = \alpha_0 + \sum_{j=1}^{6} \alpha_j X_{it} + \mu_{it} \qquad (2)$$

Equation (1) shows how the fiscal policy burden and other control variables affect economic growth, while equation (2) shows the empirical version with the parameters α_j and μ_{it} representing impact coefficient and error term, respectively. The endogenous variable is EG_{it} (economic growth), while j denotes the explanatory variables comprising FT_{it} (fiscal policy burden accruing from total public debt), FD_{it} (fiscal policy burden accruing from the domestic component of total public debt), PC_{it} (physical capital), HC_{it} (human capital), TR_{it} (trade), and PG_{it} (population growth). The vector X_{it} contains all the explanatory variables, while the parameters α_j (j = 1, 2, ..., 6) stand for the coefficient of individual explanatory variable.

The simple model is extended to include more parameters that transform it into a GMM model, as proposed by Arellano and Bond (1991) and revised by Blundell and Bond (1998). The GMM model relating growth to all the explanatory variables and own lags is presented below.

$$EG_{it} = \beta_0 + \sum_{j=1}^{6} \beta_j X_{it} + \beta_6 EG_{it-1} + \tau_{it} + \varepsilon_{it} \qquad (3)$$

$$EG_{it} = \lambda_0 + \sum_{j=1}^{6} \lambda_j X_{it} + \sum_{k=7}^{N} \lambda_k EG_{it-n} + \omega_{it} \qquad (4)$$

The moment conditions are:
1) $\mathcal{E}(w_{it}) = \mathcal{E}[F(EG_{it}, X_{it-1}, \lambda)] = 0$
2) $\mathcal{E}(N'w_{it}) = \mathcal{E}(N'w_{it}, \lambda) = 0$
3) $V(\lambda) = w_{it}(\lambda)'Q[Q'\Sigma(\lambda)X]^{-1} Q'w_{it} (\lambda)$, where Q represents instrumental variables, and V is value of normally distributed parameter $(\lambda)X$.

The moment conditions indicate that the expected values of residuals in exogenous variables and expected value of residuals in instrumental variable(s) should be zero. The unknown parameter λ determines whether the expected residuals are significantly close to zero or not. There is the optimum parameter λ^* that ensures expected residuals become zero.

In equation (3), the GMM model relates the endogenous variable (EG_{it}) to the explanatory variables, including one lagged endogenous variable, and unobserved country effect (τ_{it}). In equation (4), the number of lagged endogenous variables is increased to two based on Akaike information criterion (AIC), and used as instrumental variables to minimize serial correlation and endogeneity bias in the model. The total number of explanatory variables is therefore denoted as N. The unobserved country effect is minimized by estimating the model in first differences. The optimizing conditions of the model are presented as *the moment conditions,* which prescribe that the expected values of random error in explanatory and instrumental variables should be zero.

3.3 AUTO-REGRESSIVE DISTRIBUTED LAG MODEL (ARDL)

The dynamic relationships between growth and all the explanatory variables are also represented in an auto-regressive distributed lag model (ARDL), which relates economic growth to all explanatory variables and own lag. The framework of this model was proposed by Pesaran, Shin and Smith (1999). The lagged first differences of explanatory variables, denoted by the symbol Δ, are included to eliminate serial correlation and endogeneity, as presented below.

$$EG_{it} = \partial_0 + \partial_1 EG_{it-1} + \sum_{j=2}^{6} \partial_j Z_{it} + \sum_{j=7}^{11} \partial_j \Delta Z_{it-1} + \eta_{it} \tag{5}$$

Where:
1) ∂_j = impact of explanatory variables (j = 2, 3, ..., 6)
2) Long-run multiplier = $\dfrac{1}{1-\partial_j}$ (j = 2, 3, ..., 6)
3) Normality conditions: EG_{it} = max ($\Sigma\Delta EG_{it}$, 0) and Z_{it} = max ($\Sigma\Delta Z_{it-1}$, 0).

The normality conditions require that aggregate values of each variable equate the sum of first differences, with zero expected error. The panel estimators, mean G=group (MG) and pooled mean group (PMG), are used to determine the impact of each explanatory variable on the dependent variable.

3.4 ESTIMATION TECHNIQUES AND DATA

The first estimation procedure involves the test for stationary status of all variables in the model. This is to ensure that the variables are stationary in levels or first differences, in order to enhance the policy relevance of the estimation results. According to Engle and Yoo (1987), if non-stationary variables are used in the estimation, the parameter estimates may be biased and inconsistent. The standard approach for investigating the stationary status of variables consists of panel unit root tests (LLC, IPS, and HD), proposed by Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003), and Hadri (2000). The second procedure involves the use of the generalized method of moments (GMM) and auto-regressive distributed lag (ARDL) to estimate the effect of fiscal policy burden and other control variables on economic growth. The ARDL consists of mean group (MG) and pooled mean group (PMG) estimators, which are used to check for consistency in GMM. All

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the techniques are used in this study because of their strong capacity to eliminate serial correlation and endogeneity bias (Lee and Wang, 2015).

The variables are measured as economic growth (real GDP growth rate), fiscal policy burden accruing from public debt (ratio of debt service to total fiscal revenue), physical capital (gross fixed capital formation as percentage of GDP), human capital (adult literacy rate), trade (export plus import as percentage of GDP), and population growth (annual growth rate of population). The data for economic growth, physical capital, human capital, trade, and population growth were mainly sourced from World Bank Open Database (https://data.worldbank.org), and augmented with data from World Bank Development Indicators (https://databank.worldbank.org), and IMF International Financial Statistics (https://data.imf.org). The data for fiscal policy burden were computed from data on total public debt, domestic component of public debt, and total fiscal revenue sourced from the World Bank Open Data. The data covers a sample of 45 Sub-Saharan countries, listed in table 1.

TABLE 1

List of eligible Sub-Saharan African countries

Angola	Djibouti	Madagascar	Sierra Leone
Benin	Equatorial Guinea	Malawi	Somalia
Botswana	Eswatini*	Mali	South Africa
Burkina Faso	Eritrea	Mauritania*	South Sudan*
Burundi	Ethiopia	Mauritius	Sudan
Cameroon	Gabon	Mozambique	Tanzania
Cape Verde	Gambia	Namibia	Togo
Central African Rep.	Ghana	Niger	Uganda
Chad	Guinea	Nigeria	Zambia
Comoros	Guinea-Bissau*	Rwanda	Zimbabwe
Congo DRC	Kenya	Sao Tome & Principe	
Congo Rep.	Lesotho	Senegal	
Cote d'Ivoire	Liberia*	Seychelles	

Not included in study sample due to lack of complete data.
Source: World Bank Open database.

The data also cover the period 1990-2022, with descriptive statistics presented in table 2. The statistics play important role in the evaluation and inclusion of variables in the model estimation. The mean value of all the variables falls within the range 2.6-61.4 with standard deviation 0.33-23.7, while the median is within the range 2.5-60.4. The non-negative mean values indicate that all the variables have moved largely in a positive direction. The data have moderate positive skewness as shown by the Pearson coefficients that are generally less than unity but greater than 0.5. The kurtosis of the data shows values that are mostly above the standard normal distribution kurtosis of 3.0, indicating a moderate presence of outliers in the data set. Therefore, the distribution is light-tailed with high peak. The Jarque-Bera test produced coefficients that are not significantly different from zero, hence

the data set does not remarkably deviate from normal distribution. These statistics provide an insight into the quality of the variables used in the model.

TABLE 2
Descriptive statistics of data

Sample size = 45 countries
Estimation period = 1990-2022
Observations = 1,485

	Statistic							
Variable	**Mean**	**Median**	**Max.**	**Min.**	**Std. dev.**	**Skewness (Pearson coefficient)**	**Kurtosis**	**Jarque-Bera test**
EG	3.3	2.87	6.1	-2.1	4.3	0.55	3.9	0.16
FT	56.1	55.3	78.6	31.2	23.7	0.59	4.6	0.22
FD	42.3	40.1	60.4	26.6	17.1	0.61	3.7	0.09
PC	23.2	22.5	25.5	17.3	4.7	0.56	3.2	0.18
HC	61.4	60.4	68.3	52.1	8.2	0.53	2.5	0.11
TR	33.9	42.3	59.7	27.5	19.4	0.34	2.8	0.14
PG	2.6	2.5	2.9	2.2	0.33	0.52	4.9	0.27

Variables: EG = economic growth, FT = fiscal policy burden from total debt, FD = fiscal policy burden from domestic component of total public debt, PC = physical capital, HC = human capital, TR = trade, PG = population growth.

Source: Authors' computer estimation.

4 EMPIRICAL RESULTS

4.1 PANEL UNIT ROOT TEST RESULTS

A preliminary investigation was conducted to confirm that variables in the model possess the desirable empirical attribute that makes them suitable for GMM and ARDL estimations. In order to avoid spurious results, the variables are required to have unit root property I(0) or I(1), which ensures they are integrated in levels or first differences. The unit root test results for all the variables are reported in table 3. The estimates LLC (3.14), IPS (2.88) and HD (1.31) show that only economic growth is integrated in levels, that is I(0). All other variables are integrated in first differences, that is I(1). Therefore, all the variables are stationary and suitable for estimation.

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TABLE 3

Panel unit root test results

Sample size: 45 countries					
Estimation period: 1990-2022					
Unit root test					
Variable	**Level**			**First difference**		
	LLC	**IPS**	**HD**	**LLC**	**IPS**	**HD**
EG	3.14*	2.88*	1.31*	–	–	–
FT	1.23	1.03	2.99	2.64*	3.22*	1.34*
FD	1.16	1.09	2.74	2.57*	2.83*	1.19*
PC	1.11	1.07	3.03	2.79*	2.44*	1.21*
HC	1.18	1.15	2.87	3.05*	2.58*	1.06*
TR	1.09	1.21	3.11	2.64*	3.01*	1.11*
PG	1.12	1.16	3.06	2.55*	2.39*	1.17*
Critical values: LLC = 2.06, IPS = 1.95, HD = 1.87					

*Variable is stationary.

Note: LLC = Levin-Lin-Chu test, IPS = Im-Pesaran-Shin test, HD = Hadri test. In LLC and IPS, larger statistics indicate more stationary variables. In HD, smaller statistics indicate more stationary variables.

Source: Authors' computer estimation.

4.2 GENERALIZED METHOD OF MOMENTS ESTIMATION RESULTS

The GMM estimation results are reported in table 4, which show that the fiscal policy burden from total debt and the domestic debt component (FT and FD) had a significant adverse impact of -0.61 and -0.52, respectively, on growth at the 5 percent level. It suggests that fiscal policy burden slowed economic growth, which can be attributed to large budgetary allocations to debt servicing in Sub-Saharan countries over the years. Similarly, population growth (PG) produced a negative impact of -0.34 to complement the adverse impact of fiscal policy burden, though not significantly. However, physical capital (PC) had a significant positive impact of 0.64, followed by human capital (HC) with 0.56, and trade (TR) with of 0.50, all significant at the 5 percent level. The results suggest that although the fiscal policy burden was not favourable to economic growth, three key variables performed well in conformity with positive expectations of the growth theory. In spite of the high level of imports and narrow export base in Sub-Saharan African countries, trade was still able to exert a considerable impact on growth. The significant effects of the instrumental variables (EG-1 and EG-2) show that they were strong and able to minimized serial correlation and endogeneity. This is due to the optimal selection of instrumental variables based on the Akaike information criterion statistic value of 12.06. In the period 1990-2022, therefore, the fiscal policy burden played an adverse role in economic growth in Sub-Saharan Africa, which confirms the concerns raised by multilateral institutions that fiscal policy is ineffective in driving growth when there is a large public debt in the economy. The unfavourable role also confirms the classical theory postulation that large existing debt inhibits fiscal

policy and stagnates economic growth in the long-run, which was given emphasis by Saungweme and Odhiambo (2019) and Broner et al. (2014).

The diagnostic estimates show a chi-square statistic of 2.01 and p-value of 0.019, which is significant at the 5 percent level, indicating a robust goodness-of-fit, that is, the model fits well into the set of observed data. Therefore, the null hypothesis of no good fit is rejected. The p-value of Sargan statistic also falls within the critical range, hence the null hypothesis of no correlation between instrumental variables and error terms cannot be rejected. Similarly, the p-values of A-B statistics fall within the critical range, indicating that the null hypothesis of no serial correlation in residuals cannot be rejected. The estimates from the GMM model are, therefore, unbiased and reliable.

TABLE 4
Estimation results (GMM)

Dependent variable	Explanatory variable							
	FT	FD	PC	HC	TR	PG	EG-1	EG-2
EG	-0.61*	-0.52*	0.64*	0.56*	0.50*	-0.34	0.49*	0.47*
	(-3.17)	(-2.13)	(3.33)	(2.28)	(2.13)	(-1.02)	(2.04)	(1.99)

Diagnostic test

Pearson chi-square test for goodness of fit (critical p-value = 0.05)	Sargan test (0.05 < p ≤ 1)	A-B 1st order correlation test (0 < p < 0.1)	A-B 2nd order correlation test (0.25 < p ≤ 1)	Akaike (AIC)
2.01	6.92	2.32	1.24	12.06
(0.019)	(0.38)	(0.07)	(0.36)	(Minimum)

Significant at 5%, t-values in parenthesis. In diagnostic test p-values are in parenthesis. A-B stands for Arellano-Bond.

Variables: EG = economic growth, FT = fiscal policy burden from total debt, FD = fiscal policy burden from component of total public debt, PC = physical capital, HC = human capital, TR = trade, PG = population growth, EG-1 and EG-2 = lagged dependent variables (instrumental variables).

Source: Authors' computer estimation.

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The robustness test is used to determine the resilience of explanatory variables in driving growth. This was done by excluding some variables to find out whether the impacts produced from the GMM estimation will change significantly or not, following Blundell and Bond (1998), Matemilola, Bany-Ariffin and Azman-Saini (2012), etc. The test results in table 5 show that all variables, particularly fiscal policy burden, maintained their respective impact, regardless of the small differences. Sargan test indicates no serial correlation in instrumental variables. The results therefore indicate that effects of the variables are resilient and cannot be easily disturbed, which augurs well for policy making.

TABLE 5

GMM estimation results (robustness check)

Independent variable	Dependent variable: EG			
	FD excluded		**FT excluded**	
	Coefficient	**t-value**	**Coefficient**	**t-value**
Intercept	2.11	8.73	1.94	1.99
FT	-0.57*	2.31	–	–
FD	–	–	-0.39*	2.17
PC	0.60*	3.11	0.58*	2.86
HC	0.51*	2.31	0.46*	2.19
TR	0.43*	2.08	0.50*	2.28
PG	-0.24	0.97	-0.27	1.07
EG-1	0.40*	2.01	0.38*	2.12
EG-2	0.46*	2.22	0.41*	2.09
Sargan test		3.03		2.56
$(0.05 < p \leq 1)$		(0.29)		(0.41)

Significant at the 5% level.

Source: Authors' computer estimation.

4.3 AUTO-REGRESSIVE DISTRIBUTED LAG ESTIMATION RESULTS

The two ARDL estimators (MG and PMG) produced the results reported in table 6, showing the role of each explanatory variable in economic growth. The estimates from both estimators indicate that fiscal policy burden from total public debt (FT) had significant negative impacts of -0.59 and -0.53, at the 5 percent level. Similarly, fiscal policy burden from the domestic debt component (FD) had significant negative effects of -0.55 and -0.50. This again suggests that the burden of debt impaired the effectiveness of fiscal policy in fostering economic growth, which confirms the concerns raised by World/IMF and classical theory advocates. Population growth (PG) had negative but insignificant impacts of -0.29 and -0.31, thus exacerbating the unfavourable effect of the fiscal policy burden. On the other hand, physical capital (PC) helped to foster economic growth as shown by its significant impacts of 0.66 and 0.60, which are significant at 5 percent. The significant impacts of physical capital are complemented by human capital (HC) with the estimates of 0.58 and 0.54, and trade (TR) with estimates of 0.49 and 0.56. It is, therefore obvious that the fiscal policy burden stalled growth, but that three of

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the explanatory variables were very effective in driving growth. These results are buttressed by the long-run multiplier coefficients of the MG and PMG estimators showing that the multiplier effects of all the variables fall within the absolute range of 1.40-2.94, which indicates appreciable multiplier effect on growth. The lag economic growth (EG-1), with estimates of 0.44 and 0.51, is significant, suggesting that growth responded fairly well to its own lag. The ARDL results are largely similar to the GMM results, which indicate that the effect of the fiscal policy burden and the other control variables are consistent and reliable.

The Wald test results show statistics with p-values that are significant at the 5 percent level, which indicates rejection of the null hypothesis of no relationship between dependent variable and the set of independent variables. Therefore, the independent variables are collectively significant in explaining growth. The Hausman test was used to determine the reliability of estimates from the MG and PMG estimators. The results indicate there is no substantial evidence of heterogeneity (H0) in estimated results, which makes the PMG estimator more reliable than the MG estimator.

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TABLE 6
Estimation results (ARDL)

Dependent variable	Explanatory variable	MG estimator			PMG estimator		
		Coefficient	t-value	Long-run multiplier coefficient	Coefficient	t-statistic	Long-run multiplier coefficient
	Intercept	1.52	5.02	–	2.07	5.07	–
	EG-1	0.44*	1.97	–	0.51*	2.11	–
	FT	-0.59*	-2.76	-2.43	-0.53*	-2.11	-2.13
	FD	-0.55*	-2.53	-2.22	-0.50*	-2.06	-2.00
EG	PC	0.66*	3.29	2.94	0.60*	3.02	2.50
	HC	0.58*	2.72	2.38	0.54*	2.21	2.16
	TR	0.49*	1.99	1.96	0.56*	2.42	2.27
	PG	-0.29	-1.01	-1.40	-0.31	-1.04	-1.44
Wald test				3.92			4.33
(Critical p-value = 0.05)				(0.009)			(0.006)

Hausman test (H0 = PMG, H1 = MG): t-statistic = 0.89, p-value = 0.13 (critical p-value = 0.05).

* *Significant at 5 %.*

Variables: EG = economic growth, FT = fiscal policy burden from total debt, FD = fiscal policy burden from component of total public debt, PC = physical capital, HC = human capital, TR = trade, PG = population growth, EG-1 = lagged dependent variable.

Source: Authors' computer estimation.

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5 POLICY IMPLICATIONS

5.1 STRUCTURAL STABILITY

Long-run estimation results are considered useful for policy making when there is structural stability. The maximum likelihood estimator was employed to test for structural stability in the model. It involved splitting the entire period of study into two sub-periods by choosing a suitable break point as proposed by Yu, Jong and Lee (2008). The break-point period of 2007 was chosen because of the global financial crisis that led to economic downturns in all developing countries. The crisis was the major economic shock within the study period, hence it is used as a basis for splitting the period of study, for the purpose of carrying out stability test. The maximum likelihood test results in table 7 show that estimates in the total period and sub-periods are not significant at 5 percent. Again, the estimates of variables in sub-period 1 are not significantly different from those in sub-period 2. The maximum likelihood test, therefore, indicates acceptance of the null hypothesis of no structural break, hence the model and estimated results may be considered suitable for policy making. Furthermore, the reliability estimates in table 8 show insignificant variation in values of Rho 1 and Rho 2 parameters, normalized bias statistic, standard deviation and root mean square error, which indicate that the test results are unbiased and reliable.

TABLE 7

Maximum likelihood structural stability estimates

Exogenous variable	Total period (1990-2022)		Sub-period 1 (1990-2007)		Sub-period 2 (2008-2022)	
	Coefficient	Asymptotic t-statistic	Coefficient	Asymptotic t-statistic	Coefficient	Asymptotic t-statistic
Intercept	0.28	1.18	0.32	1.20	0.30	1.15
FT	0.23	1.06	0.26	1.13	0.24	1.08
FD	0.24	1.08	0.25	1.12	0.21	1.01
PC	0.30	1.16	0.31	1.17	0.22	1.06
HC	0.29	1.14	0.29	1.19	0.32	1.20
TR	0.31	1.19	0.27	1.15	0.29	1.18
PG	0.25	1.11	0.30	1.16	0.27	1.16
EG-1	0.27	1.16	0.28	1.14	0.31	1.19

Endogenous variable: EG

Variables: EG = economic growth, FT = fiscal policy burden from total debt, FD = fiscal policy burden from domestic debt, PC = physical capital, HC = human capital, TR = trade, PG = population growth, EG-1 = lagged dependent variable.

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TABLE 8

Maximum likelihood reliability estimates

Alternative break point	Structural break parameter estimate		Normalized bias statistic	Standard deviation (SD)	Root mean square error (RMSE)
	Rho 1	Rho 2			
1997	0.05	0.06	0.31	0.15	0.22
1998	0.07	0.04	0.29	0.13	0.25
1999	0.06	0.05	0.32	0.11	0.27
2000	0.09	0.10	0.30	0.16	0.23
2001	0.08	0.07	0.34	0.14	0.20
2002	0.05	0.09	0.33	0.10	0.21
2003	0.11	0.08	0.36	0.12	0.24

Note: Alternative break points are distributed evenly around the year 2000.

5.2 POLICY OPTIONS

The estimation results clearly revealed that the fiscal policy burden exerted significant negative impact on growth. The results were evaluated, using different measures, and found to be reliable, hence some policy options are proffered as follows:

a) The significant negative effect of the fiscal policy burden on economic growth confirms the concern of multilateral institutions and classical theory advocates that unsustainable public debt is inimical to fiscal policy effectiveness and economic growth. Therefore, it is imperative for policy makers and executives to ensure that the level of debt is reduced to conform with IMF/World Bank prescribed minimum debt ratio of 40 percent for developing countries. In addition, efforts should be intensified to increase the level of fiscal revenue from non-tax sources.

b) Physical and human capital were used as control variables, and found to have significant impacts on growth. These findings imply that the performance of these variables also needs to be supported in order to ensure rapid economic growth is achieved. In this regard, tax on personal and corporate income should be reduced to enable household and firms to save and invest in physical and human capital. In addition, long-term interest rates should be reduced to enable investors to take out loans to invest in capital projects.

c) Trade and population growth were also used as control variables. Trade was found to have a significant positive impact on growth, while population growth had an insignificant negative effect on growth. These findings imply that trade needs to be supported by minimizing trade restrictions, while population can be made more productive by raising the level of healthcare.

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6 CONCLUSION

Fiscal policy burden accruing from public debt accumulation was investigated in this study, with the aim of determining its effect on growth in Sub-Saharan African countries. This is sequel to the high level of public debt accumulation in these countries, and its potential risk of inhibiting effectiveness fiscal policy in driving economic growth, which was put on the front burner by IMF and World Bank. This concern aligns with the classical theory postulation that large public debt inhibits the effectiveness of fiscal policy and impairs growth in the long run. The empirical model also included fundamental determinants of growth such as physical capital, human capital, trade, and population growth, as control variables. The investigation was carried out by employing the techniques of the generalized method of moments (GMM) and the auto-regressive distributed lag model (ARDL). A sample of 45 Sub-Saharan countries was used in the study, covering the period 1990-2022.

The estimation results revealed that the fiscal policy burden had a significant negative effect on growth, which confirms the concerns of multilateral institutions and classical theory advocates regarding the long-run effect of accumulating large debt. Population growth also played a negative role in economic growth. However, the results revealed that physical and human capital had a significant positive impact on growth, which was complemented by the effect of trade. These findings are quite revealing, and thus require some policy measures that can enhance performance of the variables. The recommended policy measures include a reduction in the public debt ratio to 40 percent as prescribed by IMF/World Bank, reductions in taxes and the long-run interest rate to enhance physical and human capital formation, relaxation of trade restrictions to encourage trade flows, and raising the level of healthcare to improve productivity of the population. Finally, this study is expected to motivate further research works on the role of fiscal policy burden in economic growth in other developing regions, such as Middle East and North Africa (MENA) and South East Asia (SEA).

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Do fiscal deficits cause inflation? Evidence from Suriname

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Abstract

This study examines the impact of the fiscal balance on headline inflation in Suriname. Historically, Suriname coped with multiple episodes of high inflation. A structural vector autoregression (SVAR) framework with annual data from 1961 to 2022 is used to assess the transmission of fiscal shocks to consumer prices. In addition, the analysis takes into account commodity prices, money supply, the exchange rate, and output growth. The empirical analysis reveals that exchange-rate shocks are the primary driver of inflation. Energy commodity price shocks also induce price pressures, in contrast to non-energy commodity price shocks. Fiscal shocks do not affect inflation directly. Nonetheless, there is evidence that these shocks do affect the exchange rate substantively. The results of this study emphasize the importance of exchange-rate stability, while fiscal discipline can alleviate exchange-rate and inflationary pressures.

Keywords: inflation, fiscal balance, money supply, SVAR

1 INTRODUCTION

Inflation is known to cause more harm than good. Excessive and persistent price increases are known to impair economic growth, increase the costs of borrowing and discourage investments. Inflation is widely deemed a monetary phenomenon, often accompanied by changes in monetary aggregates. While monetarists have ascribed inflation primarily to changes in the money supply, some studies posit that fiscal policy is also decisive for inflation outcomes. Sargent and Wallace (1981) show that excessive government spending causes demand-pull pressures, overheating the economy. When excessive government expenses are not balanced by tax income, fiscal deficits need to be financed by some form of debt. Woodford (1995) argues that the way in which debt is financed instigates price pressures. Catao and Terronnes (2005) provide empirical evidence that fiscal deficits induce price pressures, particularly in developing countries. Banerjee et al. (2022) add to this that the degree to which fiscal deficits induce inflationary pressures depends on the degree of fiscal dominance – a regime characterized by a government that does not adjust the primary balance to stabilize public debt and a central bank with a low degree of independence.

This paper aims to assess empirically the transmission of fiscal balance shocks to inflation in Suriname, a small open, resource-rich economy. The country is situated on the northern coast of South America. It has been heavily dependent on the production and export of alumina, oil, and gold, making it susceptible to global commodity-price cycles. Since its independence in 1975, Suriname has experienced multiple episodes of high inflation. Between 1993 and 1995, inflation even cumulated to over 1,000 percent. The Surinamese fiscal sector – around 10 percent of GDP and employing 30 percent of the labour force – seems to be dominant in and often deemed the culprit for inflation (Braumann and Shah, 1999; Ooft, 2024). Historically, public debt averaged 40 percent of GDP. However, in recent years, this figure ballooned beyond 60 percent of GDP on the back of widening

fiscal deficits. These deficits resulted from expansionary policy amidst dwindling fiscal revenues (Ooft, 2024).

The present research uses an SVAR framework, impulse response functions, and variance decomposition to derive the relationship between fiscal deficits, money, the exchange rate, real GDP growth, and inflation in this country. The model also incorporates commodity-price shocks, accounting for imported price pressures arising from energy and non-energy commodity prices. As far as can be ascertained, this study is the first in recent history to model the transmission of fiscal shocks to inflation in Suriname using econometric models.

The remainder of this paper is structured as follows. Section 2 presents a review of the literature on fiscal deficits and inflation. Section 3 presents the proposed SVAR methodology and the expectations, while section 4 presents the main results and residual diagnostics. Section 5 concludes and presents policy recommendations.

2 FISCAL DEFICITS AND INFLATION: A BRIEF LITERATURE REVIEW

Economic theory often ascribes inflation to monetary factors or output gaps. Nonetheless, some studies suggest that fiscal deficits are a critical factor in shaping inflation dynamics, particularly in developing countries (see for instance Woodford, 1995; Catao and Terronnes, 2005; Fakher, 2016; Olubiyi and Bolarinwa, 2018).

For instance, Woodford's (1995) fiscal theory of price level (FTPL) claims that it is not only monetary policy but also fiscal policy that affects the price level. Moreover, choices in the governments' debt financing – factored into the government's intertemporal budget constraint – have a significant effect on inflation. Leeper and Leith (2016) suggest that both monetary and fiscal factors determine the price level. A regime-switching framework highlights the interaction between monetary and fiscal policy. Particularly after the 2007-2008 financial crisis, many economies saw their sovereign debt mount due to fiscal stimuli. The authors suggest that rising interest rates can exacerbate sovereign debt issues even further, pushing countries to fiscal limits.

Cochrane (2023) presents a comprehensive analysis of the FTPL. The author explains that the FTPL refers to the price level adjusting so that the nominal value of government debt equals the present value of actual primary surpluses. Hence, taming inflation can be cumbersome when governments face high borrowing costs. A pivotal element of the FTPL is the society's perception of the government's ability to service its debt, depending on future fiscal surpluses. The author demonstrates that sovereign rates can raise interest costs and lower the present value of surpluses. To guarantee price stability, the FTPL suggests that governments establish institutions and exhibit policy credibility.

Some studies have questioned the FTPL. Kocherlakota and Phelan (1999) show that the FTPL only applies in cases where the government is able to implement non-Ricardian[1] policies. Buiter (2002), however, argues that the FTPL fails to provide a clear distinction between budget restrictions and equilibrium conditions. The author demonstrates that equilibria are either inconsistent or impacted by irregularities, such as the ability to value money in a cashless system. In the presence of government defaults, governments resort to Ricardian regimes, obscuring the validity of the FTPL, given the assumption that governments set nominal interest rates.

2.1 EMPIRICAL STUDIES

Catao and Terronnes (2005) investigate the relationship between fiscal deficits and inflation using an autoregressive distributed lag (ARDL) framework. The study provides evidence that fiscal deficits induce inflation, a one percent decrease in the fiscal balance causing prices to accelerate by half a percentage point. On the other hand, fiscal spending is found to spur economic growth in the short run, although in the long run, public expenditures bring about inflation. The study samples 107 countries[2] – both industrialized and developing countries – from 1960 to 2001. Corroborating Catao and Terronnes' findings, Lin and Chu (2013) come across an inflationary effect of fiscal deficits. The study samples 91 countries over a period of 40 years. Employing dynamic panel quantile regression, the findings of the study show that in high-to-medium-inflation episodes, fiscal deficits translate into inflation, particularly via unexpected monetary shocks. Also, the exchange rate is found to have a statistically significant effect on inflation.

There is a vast amount of evidence showing that fiscal deficits cause inflation in developing countries. Braumann and Shah (1999) is one of the few studies that discuss this phenomenon in Suriname. Using an analytical model, the authors suggest that high inflation in Suriname during the nineties resulted from large fiscal deficits. Ezeabasili, Mojekwu and Herbert (2012) show that inflation in Nigeria is caused by monetary rather than fiscal factors. Increases in the money supply disproportionally affect inflation. The impact of the fiscal deficit on inflation is positive, though not statistically significant. The study employs a two-staged Engle-Granger approach using annual data from 1970-2006. Nguyen (2015) assesses the relationship between fiscal deficits, money supply, and inflation in Asian economies, using the general method of moments technique with annual data from 1985-2012. Fiscal deficits unanimously induce inflation in the selected economies, while broad money supply affects prices in most of the countries. Government expenditures and interest rates are also found to trigger price pressures in the selected Asian economies. Using ARDL models, Olubiyi and Bolarinwa (2018) show that fiscal deficits induced inflation in the short run in Nigeria and South

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[1] Non-Ricardian fiscal policies refer to policies where the government is not committed to finance its debt. The government may even opt to default upon its debt obligations, or the central bank may deflate the debt by printing money, inducing inflation.

[2] The sample does not include Suriname.

Africa within the period 1994-2015. In the long run, fiscal deficits also affected inflation in Egypt, Kenya, and Mali. Eita et al. (2021) find empirical evidence that fiscal deficits caused inflation in Namibia, using quarterly data between 2002 and 2017 in an ARDL framework. Particularly over the long run, the impact of fiscal deficits on inflation is evident.

Bordo and Levy (2021) review the effect of expansionary fiscal policies on inflation in advanced countries, using data from the past two centuries. The authors have evidence that monetary financing of fiscal deficits reflected in fiscal dominance can be considered one of the root causes of price pressures. Particularly during periods of war, this link became clear. Historically, countries that resorted to monetary financing of military spending, i.e. printing money, during wartime experienced elevated inflation. Moreover, the study suggests that central bank independence is one of the key ingredients in the taming of inflation.

De Alwis, Dewasiri and Sood (2023) examine the impact of fiscal deficits on inflation in Sri Lanka. The study uses an ARDL framework with annual data from 1977 to 2019. The research provides evidence that fiscal deficits are a statistically significant driver of Sri Lanka's inflation in the short and in the long run. In addition, nominal wages and imports also seem to induce inflationary pressures.

Banerjee et al. (2022) study the inflationary effects of fiscal deficits in 21 advanced economies. In contrast to Catao and Terrones (2005), this paper focuses on the short-term impact of inflation and its dependence on the fiscal-monetary policy regime. The study also accounts for the unexpected inflation surge in advanced economies following the COVID-19 pandemic. The authors establish that under fiscal dominance, elevated fiscal deficits have a five-fold more substantial impact on present and future inflation, in contrast to regimes that exhibit monetary dominance. The fiscal-inflation relationship varies across the conditional inflation distribution, with more pronounced effects at the right tail. Moreover, inflation risks also seem to erupt from elevated public debt levels. The findings also suggest that post-COVID inflation has been consistently evident in fiscal dominant regimes. Hence, countries with a prudent fiscal authority and an independent central bank have a lower inflation risk, while the opposite holds for countries where fiscal dominance prevails.

Kwon, McFarlane and Robinson (2009) use panel VARs, GMM, and FMOLS to ascertain the impact of fiscal policy on inflation using a sample of 71 countries over 43 years. The study provides evidence that increases in public debt are inflationary in heavily indebted countries with substantial public debt ratios of over 54 percent of GDP. The study also shows that money growth is a statistically significant driver of inflation, while real GDP growth eases inflation. Furthermore, the empirical results suggest that fiscal shocks transition to inflation via the money supply. Enhancing the study's granularity, the research subsamples Latin American and Caribbean countries. In these countries, lagged inflation, money growth,

and debt growth are among the main drivers of inflation as well. The study provides evidence that floating exchange-rate regimes are associated with higher inflation rates than fixed exchange-rate regimes.

3 METHODOLOGY AND VARIABLES

This study uses an SVAR model to assess the impact of various shocks on inflation. While some studies use the ARDL approach, a multi-equation (e.g. VAR) framework offers the possibility to assess interrelationships between economic variables, accounting for structural relationships.

Stock and Watson (2001) point out that VAR frameworks are particularly useful for modelling multivariate time series. VAR models regress each variable on lags of other endogenous variables considered in the model. Therefore, each variable is a linear combination of all variables, estimated by OLS. VAR models also offer the possibility of determining the impact of shocks through impulse response functions and forecast error variance decomposition. The standard VAR model is of the following form:

$$y_t = \Gamma + A_1 y_{t-1} + A_2 y_{t-2} \ldots\ldots + A_q y_{t-q} + \epsilon_t \tag{1}$$

where $y = (y_1, y_2, ..., y_k)$, a vector of "k" endogenous variables, Γ represents the vector of constants, A_1 up to A_q are the matrices of coefficients to be estimated for a particular lag of the endogenous variables, and ϵ_t is the vector of unobserved residuals.

3.1 THE SVAR MODEL

The standard or reduced-form VAR model has limitations. For instance, shocks to equations in the VAR model have no economic implication embedded. Hence, impulse responses in reduced form VAR models could either emanate from contemporaneous relationships or arise from fundamental shocks. SVAR models are relatively easy to interpret, compared to conventional large-scale macro-econometric models. SVAR permits the imposition of either short-run or long-run restrictions on the coefficient matrix and the residual covariance matrix. The SVAR framework enables one to set structural constraints based on economic theory while permitting contemporaneous feedback between variables. Usually, SVARs are estimated using least squares or maximum likelihood methods (Lütkepohl, 2013).

An SVAR model can be specified as follows:

$$Ay_t = A_1^s y_{t-1} + \ldots + A_p^s y_{t-p} + \Gamma^s x_t + Bu_t \tag{2}$$

where the structural coefficients are Γ, A^s and A. Moreover, u_t is a matrix of orthonormal unobserved structural errors with $E(u_t, u_t') = I_k$. Rearranging the SVAR as a VAR, based on the assumption that A is invertible, yields:

$$y_t = A^{-1} * \left(A_1^s y_{t-1} + \ldots + A_p^s y_{t-p} + \Gamma^s x_t + B u_t \right) =$$
$$A_1 y_{t-1} + \ldots + A_p y_{t+p} + \Gamma x_t + \epsilon_t \tag{3}$$

Now, the lag matrices in reduced form become $\Gamma = A^{-1} \Gamma^s$ and $A_i = A^{-1} A_i^s$, while the errors in reduced form become:

$$\epsilon_t = A^{-1} B u_t = S_{ut}$$

$$\text{with } E\left(\epsilon_t \epsilon_t' \right) = \Sigma_\epsilon = A^{-1} B B' A^{-1'} = SS' \qquad \text{and } S = A^{-1} B \tag{4}$$

Rearranging the terms yields:

$$A \epsilon_t = B u_t \tag{5}$$

The SVAR also presents the possibility of imposing long-run restrictions. These are the restrictions on the cumulated impulse responses.

To identify an SVAR, one needs to impose at least $\dfrac{k(k-1)}{2} = \dfrac{k^2 - k}{2}$ restrictions to estimate k^2 coefficients (Killian, 2013). Restrictions can be imposed either on the short-run or the long-run model, while the estimation $\hat{\Sigma}_\epsilon$ is obtained from the short-run covariance relationships and the long-run restrictions imposed.

3.2 VARIABLES AND SVAR RESTRICTIONS

The variables used in the empirical analyses are commodity price indices, the fiscal balance scaled to GDP, the narrow money supply scaled to GDP, the nominal market USD/SRD exchange rate, real GDP growth, and the headline inflation rate[3]. As the analysis entails six variables, at least 15 restrictions need to be imposed to be able to estimate the SVAR model. Commodity prices are measured by the Energy Price Index as calculated by the World Bank[4]. A robustness check is conducted with non-energy prices, as Suriname has been a net exporter of non-energy commodities for decades already[5]. Table A1 presents the measurements and sources of used variables.

In the SVAR, the ordering of the variables defines the model's causal structure. Ordering is usually conducted based on economic theory and expert judgment. The variables used are a commodity price index, the fiscal balance, the money supply, the foreign exchange rate, output growth, and inflation, ordered from most exogenous to most endogenous.

The empirical analysis uses a unit triangular A matrix. In the estimated SVAR, contemporaneous shocks are denoted by $\left[u^{XE}, u^{FBGDP}, u^{M1GDP}, u^{ER}, u^{GR}, u^{INFL} \right]'$,

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[3] As Suriname has no policy interest rate, this variable is omitted from the empirical analysis.
[4] The Energy Price Index contains prices of coal, crude oil, natural gas, and liquefied natural gas.
[5] Non-Energy Price index contains prices of agricultural products, fertilizers, metals, and minerals.

while structural shocks become $\left[\varepsilon^{XE}, \varepsilon^{FBGDP}, \varepsilon^{M1GDP}, \varepsilon^{ER}, \varepsilon^{GR}, e^{INFL} \right]$ based on the identified restrictions. The relationship between u_t and ε_t can be stated as follows:

$$
\begin{bmatrix}
u^{XE} \\
u^{FBGDP} \\
u^{M1GDP} \\
u^{ER} \\
u^{GR} \\
u^{INFL}
\end{bmatrix}
=
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 \\
a_{21} & 1 & 0 & 0 & 0 & 0 \\
a_{31} & a_{32} & 1 & 0 & 0 & 0 \\
a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\
a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\
a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1
\end{bmatrix}
*
\begin{bmatrix}
\varepsilon^{XE} \\
\varepsilon^{FBGDP} \\
\varepsilon^{M1GDP} \\
\varepsilon^{ER} \\
\varepsilon^{GR} \\
\varepsilon^{INFL}
\end{bmatrix}
\tag{6}
$$

These restrictions imply that commodity price shocks are mostly exogenous since surprises in local macroeconomic variables on global commodity prices are negated. Inflation is the most endogenous variable. The fiscal balance is ordered as the second most exogenous variable to enable this variable to exert an impact on other local macroeconomic variables in the model. As Suriname can be characterized as a country with fiscal dominance (Braumann and Shah, 1999) the fiscal balance is ordered as the second most exogenous variable followed by the money supply. The central bank started targeting the money supply as of 2021. Moreover, external commodity price movements, fiscal deficits, money supply, exchange-rate movements, and output growth are potential drivers of inflation within this framework. As outlined by Ooft, Bhaghoe and Franses (2024), changes in the money supply induce exchange-rate shocks, justifying the order of the exchange rate. Consequently, output growth is ordered before inflation rate, which is in line with the rationale behind the Phillips curve.

3.3 EXPECTATIONS

This section explains the potential channels through which shocks in the variables used may pass through to other variables used in the SVAR framework (table 1). One of the main hypotheses of this study is the inflationary consequences of fiscal deficits. As presented in section two, there is a broad consensus in the literature, particularly for developing countries, that fiscal deficits may induce inflation. For instance, unsound or expansionary fiscal policies can elevate inflation expectations. On the other hand, fiscal policy may affect the availability of loanable funds (e.g., crowding out), leading to credit crunches. Mungroo and Tjon Kie Sim-Balker (2020) present evidence that budget deficits in Suriname are often financed by debt. This finding supports our expectation that fiscal deficits in Suriname are inflationary.

The SVAR model exhibits both Keynesian and monetarist characteristics. According to Keynesian theory, government expenses fuel economic growth, which in turn could lead to demand-pull pressures. Particularly during periods of recession, increased fiscal expenditures could expedite an economic recovery (Huidrom, Kose and Ohnsorge, 2018; Banerjee et al., 2022). Monetarists, on the other hand, deny the role of fiscal policy in economic stability. Monetarists argue that

government spending could trigger money growth, inducing inflation. This view emphasizes the importance of controlling the money supply.

TABLE 1

Expectation matrix

	Commodity-price shock	Fiscal shock	Money shock	Exchange rate shock	Output shock	Inflation shock
Fiscal balance	+/-	+	0	0	0	0
Money supply	+/-	–	+	0	0	0
Exchange rate	+/-	–	+	+	0	0
Output growth	+/-	+	-	–	+	0
Inflation	+/-	–	+	+	+	+

Note: The expectation matrix presents the expected effects of upward shocks in column variables on variables used in the SVAR.

Source: Author's elaboration.

The impact of commodity-price shocks depends on whether the shock emanates from energy prices or non-energy prices. During the sample period, the country was mostly a net energy importer. Therefore, an energy-price shock is expected to aggravate the fiscal balance, increase the money supply, depreciate the exchange rate, hamper output, and induce inflationary pressures. On the other hand, non-energy price shocks, which include alumina and gold prices, are expected to affect the fiscal balance positively due to improved government revenues. The money supply is expected to diminish while economic growth will decelerate. Moreover, the exchange rate is expected to appreciate while inflation is expected to slow down due to non-energy price shocks.

An upward fiscal shock should be interpreted as an improvement in the budget balance, either through increased income or lower public expenditure. Hence, these shocks are expected to appreciate the exchange rate, spur economic growth, and dampen inflation; see for instance Nguyen (2015), Olubiyi and Bolarinwa (2018), and Eita et al. (2021). Money shocks are expected to cause an upward pressure on the exchange rate, which is aligned with the findings of Ooft, Franses and Bhaghoe (2023), but also induce demand-pull inflation as outlined in monetarism (Ooft, Bhaghoe and Franses, 2024). Both money shocks and exchange rate shocks are presumed to hamper economic growth and trigger inflation. Output shocks are assumed to trigger demand-pull inflation as found in Ooft, Fraser and Harangi-Narain (2022).

4 DATA ANALYSIS AND RESULTS

The empirical analysis is conducted with annual data between 1961 and 2022, primarily retrieved from the General Bureau of Statistics Suriname (GBS) and the Centrale Bank van Suriname (CBvS). I considered quarterly data, but an extensive time series of quarterly data is unavailable for some of the indicators used in the model, such as the fiscal balance and GDP. Figure 1 graphically presents the used indicators, while tables A1 and A2 in the appendix present the metadata and the descriptive statistics.

Suriname experienced three periods of high inflation. The first occurred from 1993 to 1995, resulting from the build-up of macro-fiscal imbalances and political instability during the 80s. Downturns in export earnings and fiscal revenues caused substantive budget deficits during the late 80s (Ooft, 2019). As a result, deficits were monetarily financed, inducing monetary overhang and, ultimately, exchange-rate depreciation and inflation. The second episode of high inflation occurred from 1999 to 2001 when fiscal deficit and exchange-rate pressures re-emerged. As of 2015, exchange-rate depreciations and price pressures re-emerged amidst a global commodity price downturn and expansionary fiscal measures. Moreover, the COVID-19 crisis exacerbated the already precarious macroeconomic environment (Ooft, 2024).

Effectively, the (S)VAR models are estimated with 58 observations. Following standard procedures, the variables are tested for unit roots. The study employs an augmented Dicky-Fuller test (Dickey and Fuller, 1979) and the Phillips-Perron test for unit roots (Phillips and Perron, 1988). The fiscal balance to GDP, inflation and growth seemed to be integrated of the order zero I(0). However, since the variables M1 to GDP, the exchange rate and commodity prices are integrated of the order one, I(1), these are transformed into first differences. Tables A3 and A4 present the unit root test results. Only stationary variables are used in the regression model to avoid serial correlation.

FIGURE 1

Graphs of variables (in %)
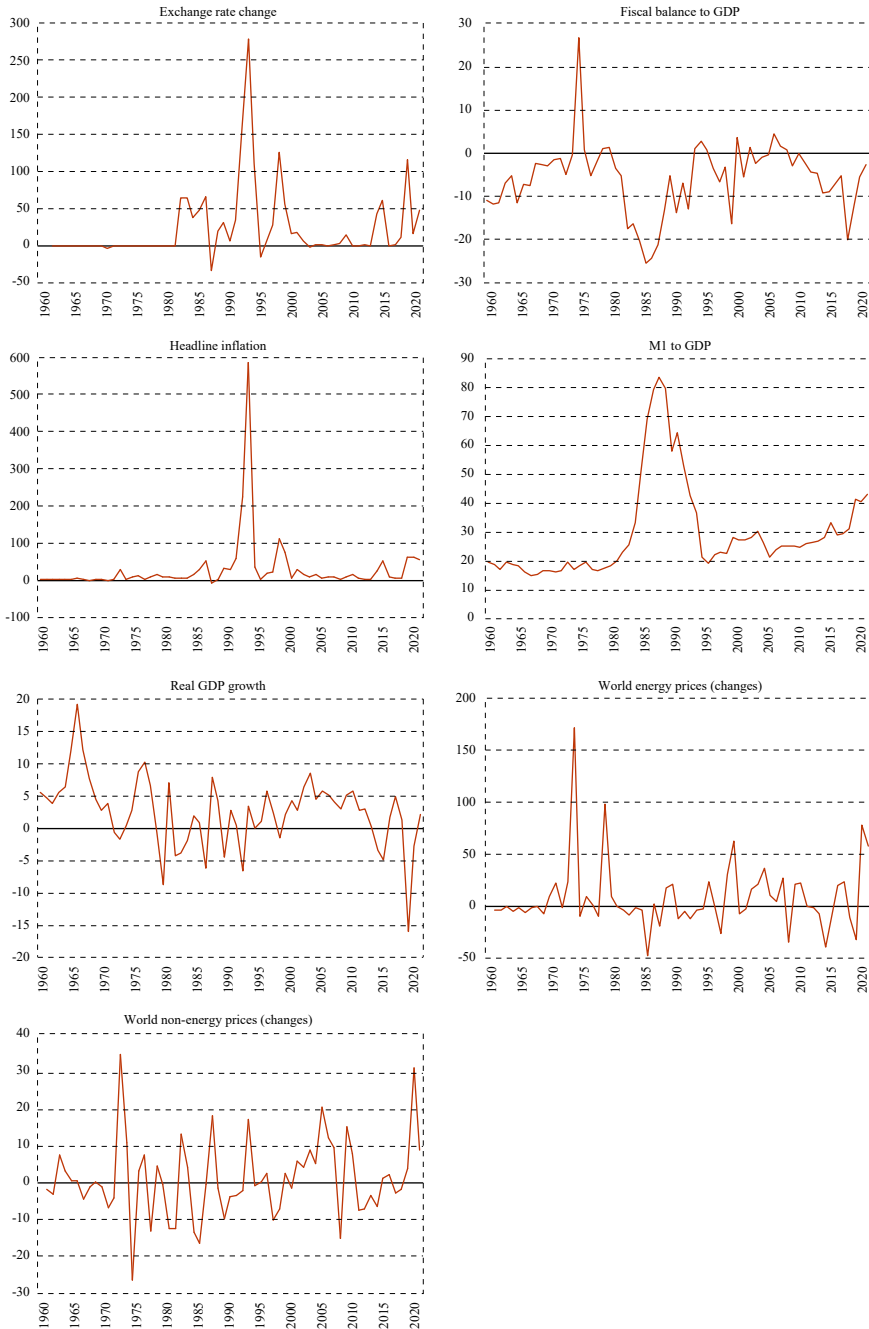
Note: Changes reflect year-on-year changes. The market exchange rate entails the USD/SRD exchange rate on the parallel market. This data is gathered from the CBvS, foreign exchange bureaus, and local newspapers. In the years before the parallel market emerged, the market exchange rate equalled the official exchange rate.

*Sources: Author using data from the CBvS, GBS, Ministry of Finance Suriname, World Bank.*

Dummy variables are added to the model in periods with extreme outliers in inflation, accounting for structural adjustments or political instability. The lag length of the VAR models is determined by the lag order selection criteria. The lag order criteria results reveal that a VAR with two lags is appropriate. The estimated SVAR models are just identified and achieve convergence.

4.1 IMPULSE RESPONSES

Impulse response functions are widely used to determine the impact of structural shocks in SVAR models. Primarily, this investigation focuses on the responses of inflation to shocks in the variables that entered the SVAR. The present impulse response analysis features one model that includes energy prices and one that includes non-energy prices as most exogenous variables. Figures 2 and 3 present the impulse responses of inflation[6].

Fiscal shocks are not observed to affect inflation directly. However, looking more closely at the transmission of these shocks, fiscal deficits are found to induce exchange-rate depreciations (appendix, figure A1). This is particularly relevant to Suriname, as the exchange-rate passthrough is close to one (Ooft, Fraser and Harangi-Narain, 2022). Moreover, a negative sign of a fiscal shock on money supply implies that a deterioration in the budget balance is associated with money overhang. This result is in line with the monetarists' view. In addition, the study finds no statistically significant impact of fiscal shocks on GDP growth – though the coefficient is positive, as presumed.

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[6] Some mean impulse responses seem to oscillate and not approach the steady state in the medium term. This could result from outliers. Nonetheless, the models are just specified and free from serial correlation.

FIGURE 2
Responses of inflation: model with energy prices (in %)
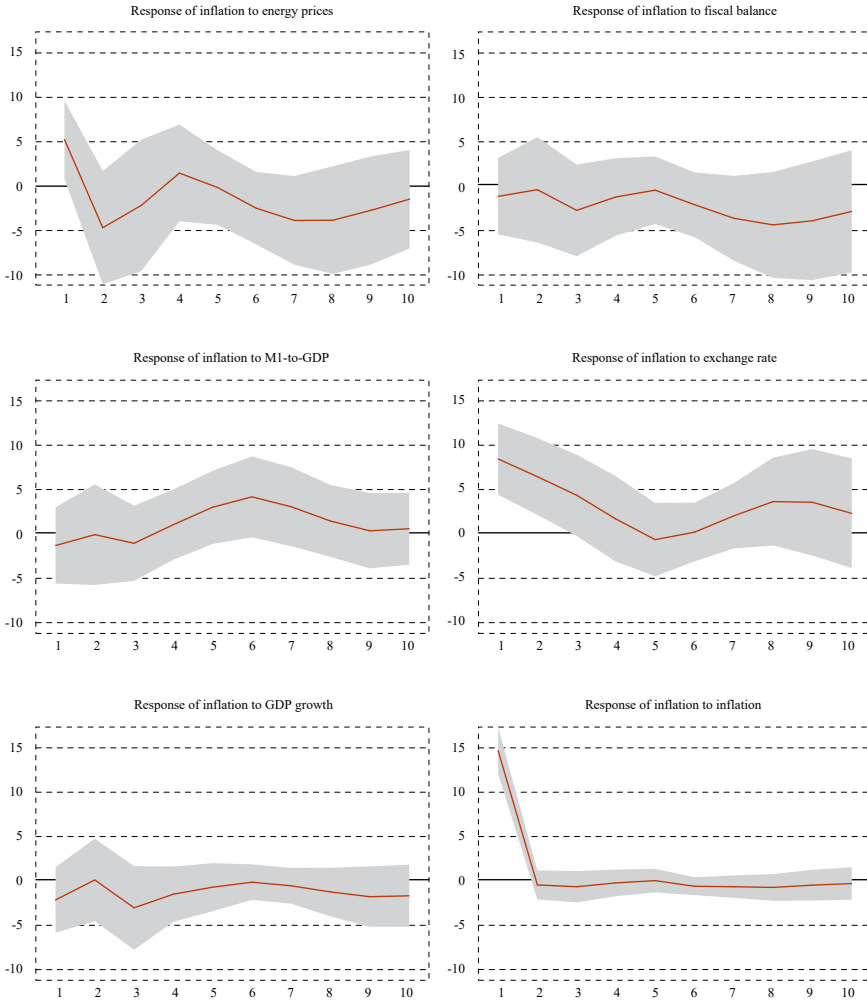
Note: The impulse responses depict responses to SVAR innovations with 95% confidence intervals using analytical asymptotic standard errors.

Source: Author's calculations.

FIGURE 3

Responses of inflation: model with non-energy prices (in %)
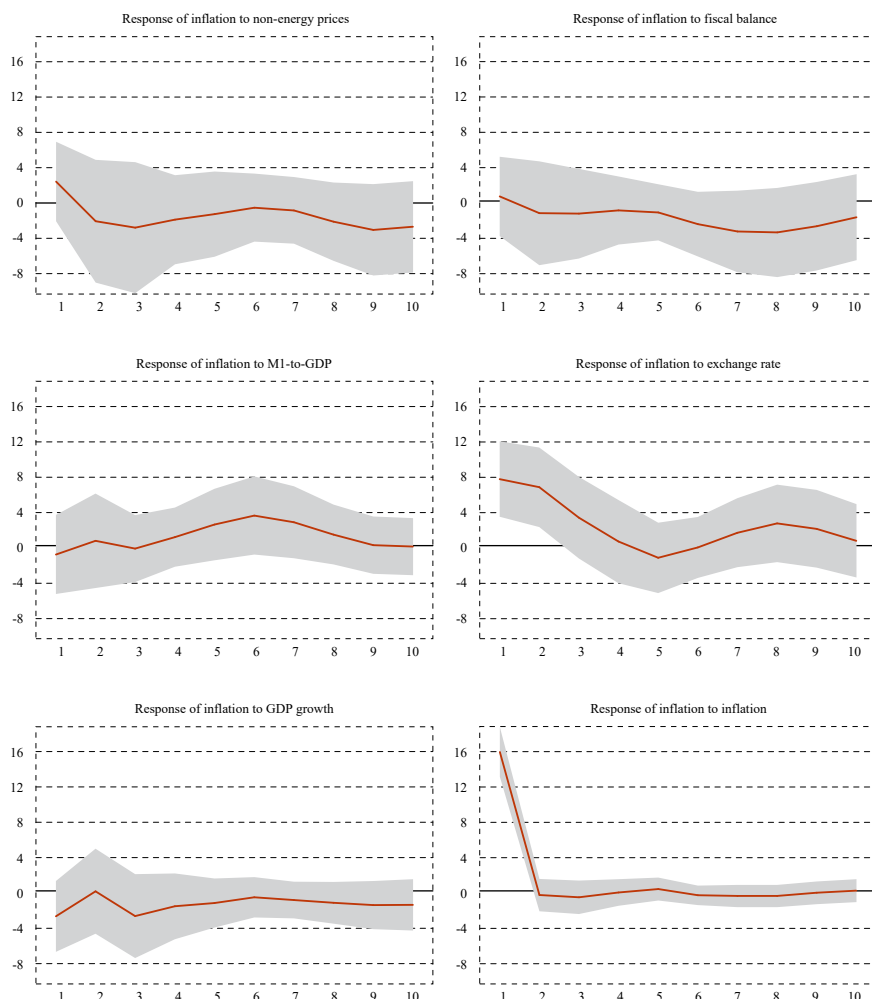
Note: The impulse responses depict responses to SVAR innovations with 95% confidence intervals using analytical asymptotic standard errors.
Source: Author's calculations.

In both models, exchange-rate shocks are found to be the main driver of inflation in Suriname. This result aligns with Ooft, Fraser and Harangi-Narain (2022). The impact of an exchange-rate shock seems to persist for up to three periods ahead in the model with energy prices and two periods ahead in the model with non-energy prices. Output shocks are not found to determine the path of inflation.

There is evidence that energy-price shocks induce price pressures, though only in the contemporaneous period. Non-energy price shocks are found to dampen inflation over the medium run. This is as expected, since during the sampling period

Suriname's economy relied on the production and export of non-energy commodities – bauxite, alumina, gold, rice, and bananas. Moreover, commodity-price shocks are associated with periods of fiscal booms, causing the fiscal balance to improve significantly. However, the effect is not statistically significant.

4.2 BIAS-ADJUSTED IMPULSE RESPONSES
Bootstrap confidence intervals as proposed by Kilian (1998) could provide more reliable impulse response functions in the case of small sample sizes or when residuals are not normally distributed. These bias-corrected bootstrap confidence intervals explicitly take into account the bias and skewness of the impulse response estimators in small sample distribution. The bias-corrected confidence intervals (appendix, figures A2 and A3) point to a statistically significant impact of the exchange rate on inflation, in line with the results of the unadjusted confidence intervals. In contrast to the unadjusted confidence intervals, the bias-adjusted confidence intervals provide evidence that money supply shocks induce inflation, while commodity-price shocks lower inflation in the short run.

4.3 VARIANCE DECOMPOSITION
The variance decomposition analysis reveals that inflation persistence is prominent for explaining contemporaneous inflation (figures 4 and 5). However, as of t+1, the effect of the exchange rate and energy prices becomes more profound. In line with the findings of the impulse responses, variations in energy prices are more pronounced for variations in inflation compared to non-energy prices. The variation in inflation brought about by economic growth and the fiscal balance increases steadily over the medium run.
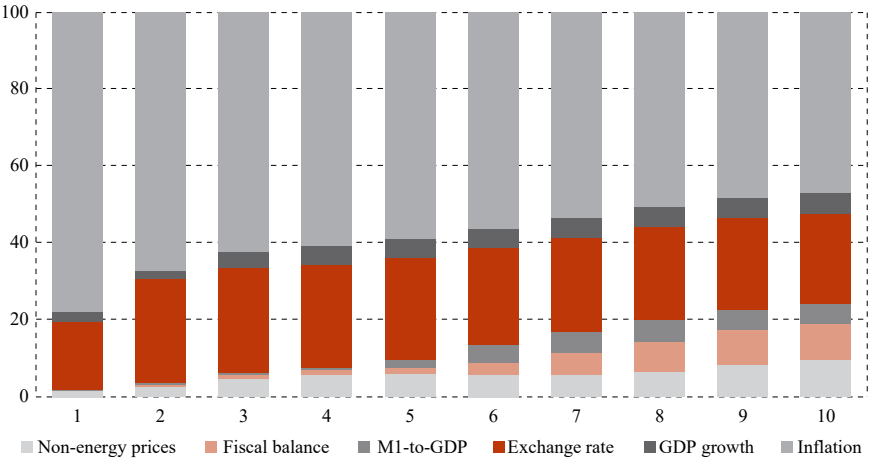
FIGURE 4
Variance decomposition of inflation: model with energy prices (in %)
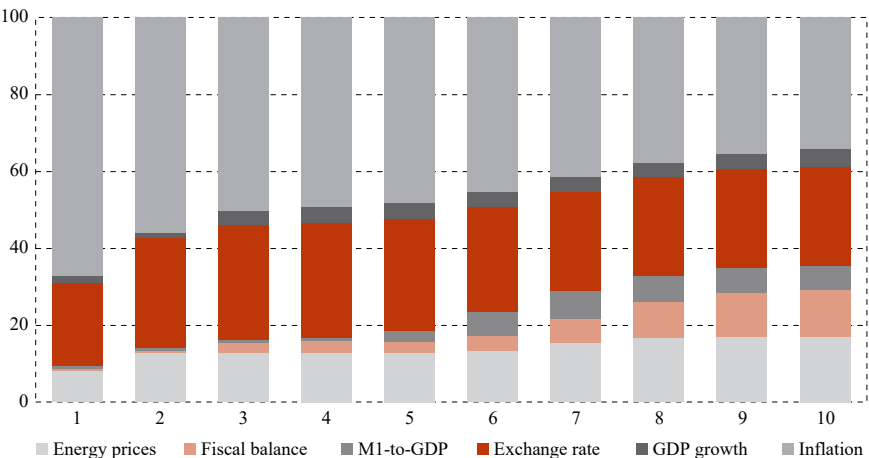
Source: Author's calculations.

FIGURE 5

Variance decomposition of inflation: model with non-energy prices (in %)

Source: Author's calculations.

4.4 DIAGNOSTICS TESTS

Lütkepohl (2013) explains that the residuals of reduced VAR models that underlie the SVAR model should pass autocorrelation and heteroskedasticity tests. The Portmanteau and Breusch-Godfrey-LM tests are often employed to assess for residual serial correlation in VAR models. The normality of residuals is not a pre-requisite for the validity of results in VAR models. However, if non-normality of residuals is encountered, this may point to possible structural changes or non-linearities in the underlying data (Lütkepohl, 2013). The residuals of the estimated VAR models pass the tests for serial correlation and heteroskedasticity. Although non-normality of residuals is not uncommon in VAR distributions, nonnormal distributed residuals may cause potential bias in impulse response functions' confidence intervals (Lanne and Lütkepohl, 2010).

As the residuals do not follow a normal distribution (table A5) due to several periods of high macroeconomic instability, the empirical analysis addresses this issue by employing bias-adjusted impulse response functions. The residual diagnostics are presented in table A5 and figure A6. Moreover, to account for variable selection bias, I estimated the models with fiscal expenditures[7] instead of the fiscal balance. Estimating the models with fiscal expenses yielded comparable results, as these expenses exhibit a correlation of around -60 percent with the fiscal balance.

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[7] Wages, goods & services, subsidies & transfers, interest expenses, and public investments.

5 CONCLUSIONS

This study primarily examines the passthrough of fiscal deficits to inflation in Suriname. It also sheds light on other drivers of inflation, namely global commodity prices, money supply, the exchange rate, and economic growth. Whereas macroeconomic literature attributes inflation primarily to monetary factors, there is empirical evidence that the fiscal balance may affect the inflation rate. For instance, fiscal deficits may cause price pressures via monetary financing by the central bank or by increasing demand beyond the economy's production capacity. Fiscal deficits are also associated with elevated uncertainty.

The present empirical research uses annual data between 1961 and 2022 in an SVAR framework. To ascertain the impact of fiscal deficits on inflation in Suriname, the empirical investigation tests whether the responses of inflation to the various shocks are statistically significant. Though the estimates reveal a negative relationship between the fiscal balance and inflation, this effect is not statistically significant. This result corresponds to the findings of Ezeabasili, Mojekwu and Herbert (2012). While the fiscal balance does not directly induce inflation, this analysis has found evidence that fiscal deficits do cause exchange rate depreciations and money supply expansions. The latter is in line with the monetarists' view.

The exchange rate is found to have the most pronounced impact on inflation in Suriname, as in the findings of Ooft, Fraser and Harangi-Narain (2022). Another finding is the statistically significant effect of energy-price shocks on inflation. However, these shocks seem to occur only contemporaneously. Moreover, money overhang induces price pressures in the medium run.

5.1 POLICY RECOMMENDATIONS

The findings of this study highlight the importance of exchange-rate stability, as exchange-rate shocks are mostly responsible for inflation in Suriname. Hence, policy measures to lower the exchange-rate passthrough could be considered. Lowering exchange-rate passthrough can be achieved by advancing trade openness, promoting macroeconomic stability, and furthering central bank independence. Furthermore, the results of this research suggest the importance of taming fiscal dominance in Suriname, as to keep exchange-rate depreciations and money overhang in check. They also suggest maintaining a healthy level of public debt. If fiscal deficits assume prominence, monetary policy itself is not sufficient to avoid inflationary pressures.

As Kwon, McFarlane and Robinson (2009) suggest, fiscal policy can override monetary endeavours in heavily indebted countries even with a high degree of central bank credibility. Hence, the results of the present research imply that price stability should be achieved by implementing institutional reforms that pursue fiscal consolidation and foster monetary policy independence.

Disclosure statement

The author has no conflict of interest to report.

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Table A1

Definitions and sources of variables

Indicator	Definition	Source(s)
ER	Year-on-year change in the market exchange rate (in %)	Newspapers, CBvS
FBGDP	Fiscal balance scaled to nominal GDP (in %)	Ministry of Finance Suriname, CBvS
GR	Volume growth of GDP (in %)	GBS, CBvS
INFL	Year-on-year change in the CPI (in %)	GBS, CBvS
M1GDP	Money supply scaled to nominal GDP (in %)	CBvS
XE	Energy commodity prices (year-on-year change, in %)	World Bank Prospects Group
XNE	Non-energy commodity prices (year-on-year change, in %)	World Bank Prospects Group

Source: Author's elaboration.

Table A2

Descriptive statistics

	ER	FBGDP	GR	INFL	M1GDP	XE	XNE
Mean	-2.58	-5.77	2.54	29.15	29.61	3.62	4.40
Median	-4.02	-5.00	2.80	8.40	25.05	3.61	4.44
Maximum	3.46	26.60	19.20	586.50	83.78	5.01	4.84
Minimum	-6.32	-25.50	-16.00	-7.60	14.88	2.12	4.01
Std. dev.	3.56	8.10	5.39	79.15	16.58	0.84	0.22
Skewness	0.19	0.29	-0.34	5.93	1.87	-0.39	-0.28
Kurtosis	1.31	6.17	5.13	40.95	5.84	2.03	1.97
Jarque-Bera	7.83	27.32	13.09	4148.86	57.90	4.05	3.58
Probability	0.02	0.00	0.00	0.00	0.00	0.13	0.17
Observations	63	63	63	63	63	63	63

Source: Author's calculations.

TABLE A3
ADF unit root test results

| Levels	ADF	FBGDP	M1GDP	ER	GR	INFL	XE	XNE
With constant	t-Stat	-4.18***	-2.77*	0.43	-4.95***	-5.39***	-1.07	-1.51
	Prob.	0.00	0.07	0.98	0.00	0.00	0.72	0.52
With constant & trend	t-Stat	-4.15***	-2.89	-2.16	-5.35***	-5.42***	-2.10	-0.72
	Prob.	0.01	0.17	0.50	0.00	0.00	0.54	0.97
First difference	**ADF**	**d(FBGDP)**	**d(M1GDP)**	**d(ER)**	**d(GR)**	**d(INFL)**	**d(XE)**	**d(XNE)**
With constant	t-Stat	-11.47***	-5.24***	-4.55***	-9.26***	-8.38***	-7.20***	-7.47***
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
With constant & trend	t-Stat	-11.38***	-5.20***	-4.73***	-9.17***	-8.31***	-7.13***	-7.63***
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: ADF denotes the Augmented Dickey-Fuller unit root test. (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.
Source: Author's calculations.

TABLE A4
PP unit root test results

Levels	PP	FBGDP	M1GDP	ER	GR	INFL	XE	XNE
With constant	t-Stat	-4.12***	-2.05	0.81	-4.88***	-5.33***	-1.07	-1.48
	Prob.	0.00	0.27	0.99	0.00	0.00	0.72	0.54
With constant & trend	t-Stat	-4.09**	-2.19	-1.95	-5.30***	-5.36***	-2.18	-1.09
	Prob.	0.01	0.49	0.62	0.00	0.00	0.49	0.92
First difference	**PP**	**d(FBGDP)**	**d(M1GDP)**	**d(ER)**	**d(GR)**	**d(INFL)**	**d(XE)**	**d(XNE)**
With constant	t-Stat	-14.83***	-5.37***	-4.48***	-17.43***	-35.37***	-7.20***	-6.97***
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
With constant & trend	t-Stat	-14.08***	-5.33***	-4.66***	-17.24***	-34.90***	-7.13***	-7.11***
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: PP denotes the Phillips-Perron unit root test. (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author's calculations.

FIGURE A1

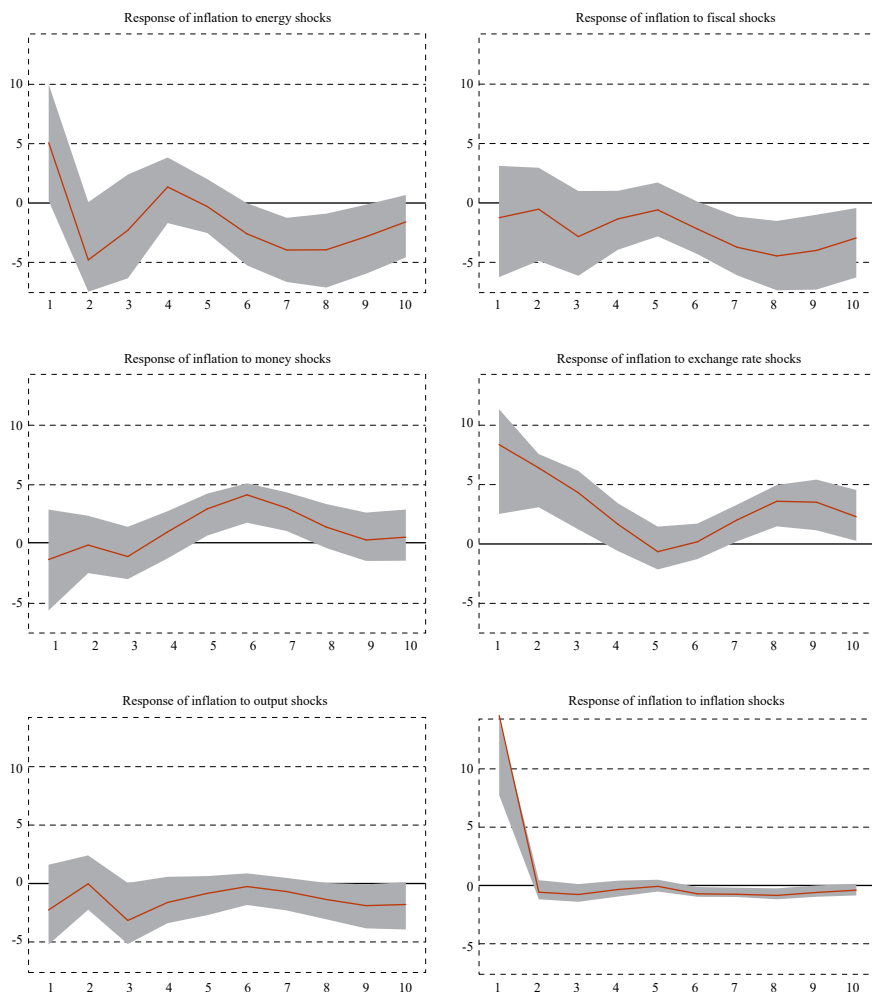*Impulse responses to fiscal shocks (in %)*
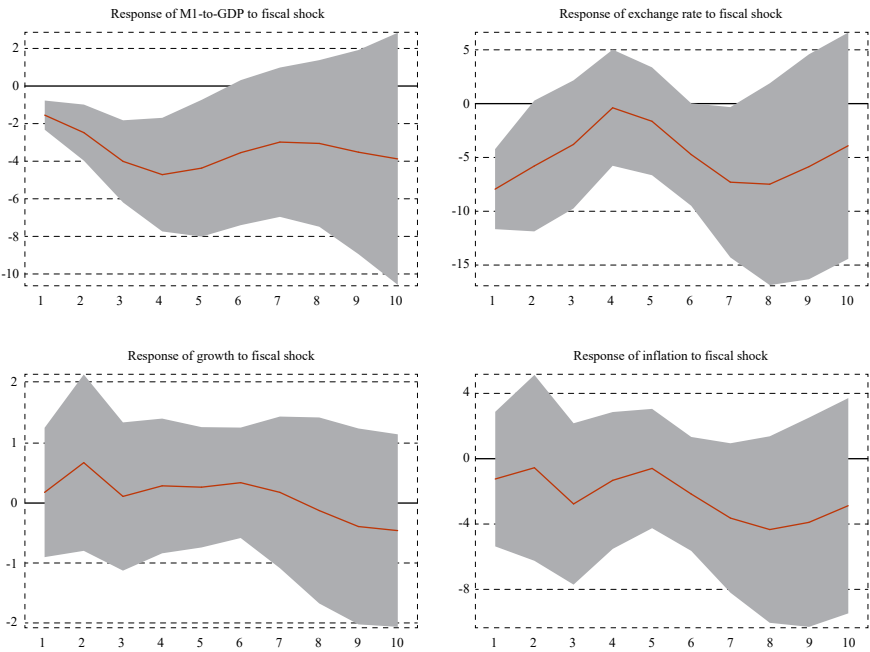
Note: The impulse responses depict responses to SVAR innovations with 95% confidence intervals using analytical asymptotic standard errors.

Source: Author's calculations.

FIGURE A2

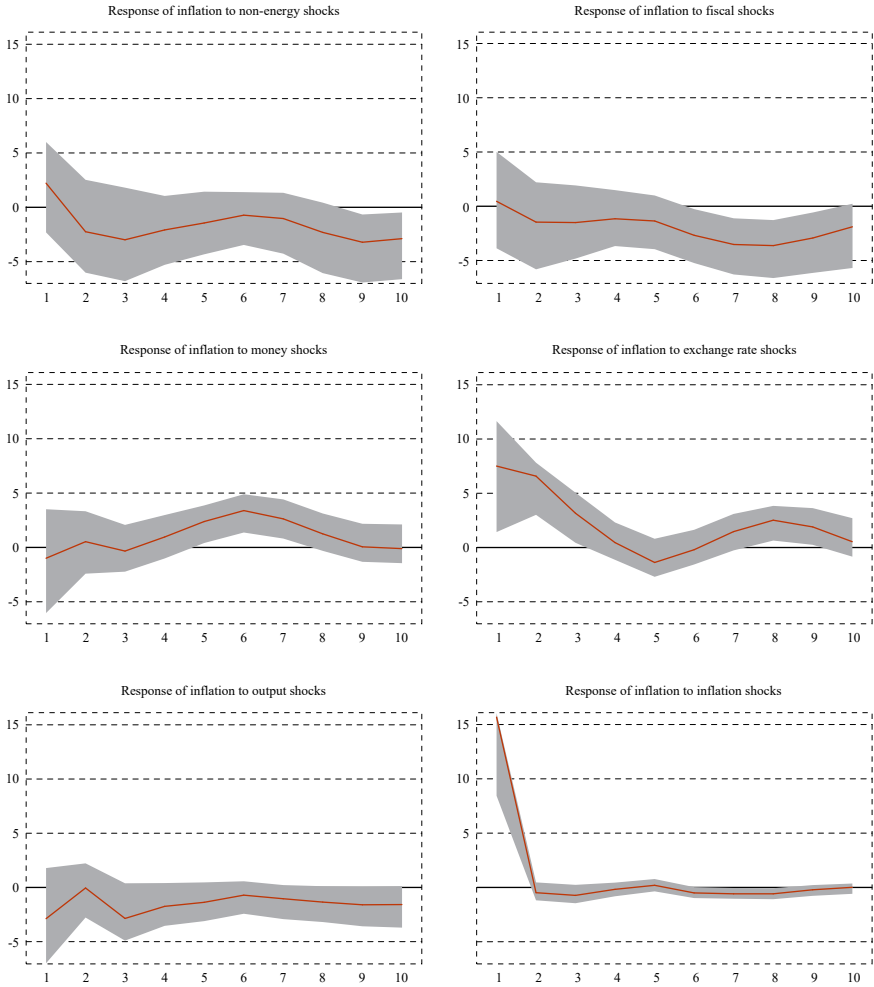*Bias-adjusted impulse responses with energy prices (in %)*

Response of inflation to energy shocks

Response of inflation to fiscal shocks

Response of inflation to money shocks

Response of inflation to exchange rate shocks

Response of inflation to output shocks

Response of inflation to inflation shocks

Note: The bias-adjusted impulse response functions present the responses of inflation to various shocks using Kilian's unbiased bootstrap with 500 bootstrap repetitions and 500 double bootstrap repetitions. The shaded area corresponds to a 95% confidence interval.

Source: Author's calculations.

FIGURE A3

Bias-adjusted impulse responses with non-energy prices (in %)

Note: The bias-adjusted impulse response functions present the responses of inflation to various shocks using Kilian's unbiased bootstrap with 500 bootstrap repetitions and 500 double bootstrap repetitions. The shaded area corresponds to a 95% confidence interval.

Source: Author's calculations.

FIGURE A4

Inverse roots of autoregressive characteristics polynomial
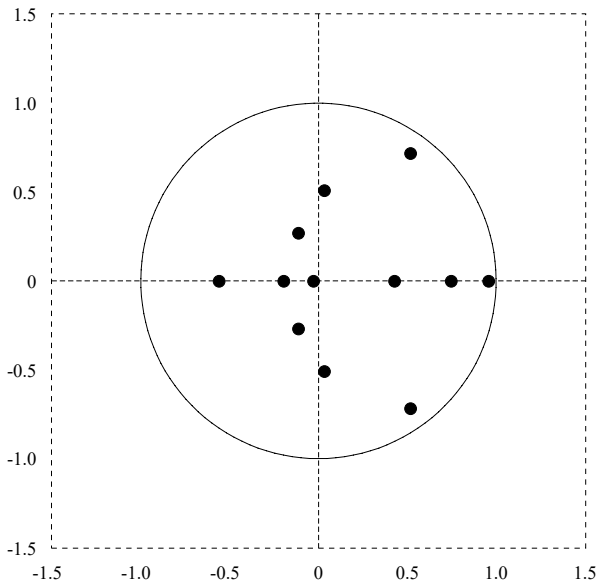
Source: Author's calculations.

TABLE A5

VAR residual normality tests

Null hypothesis: Residuals are multivariate normal

Equation	Jarque-Bera	df	Prob.
1	9.88	2	0.01
2	19.21	2	0.00
3	1.77	2	0.41
4	1.32	2	0.52
5	3.83	2	0.15
6	3.24	2	0.20
Joint	39.27	12	0.00

Source: Author's calculations.

A Taxing Journey –
How Civic Actors
Influence Tax Policy

Book review by FILIP BADOVINAC[**]
https://doi.org/10.3326/pse.49.1.7

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"A Taxing Journey – How Civic Actors Influence Tax Policy" is the result of a project funded by the Bill and Melinda Gates Foundation that brought together researchers, members of civil society groups, and tax practitioners. The editor, Paolo de Renzio, and project co-coordinator Jason Lakin note in the introduction that the book seeks to understand how civil society organisations have contributed to tax reforms in the past, and express the hope that the case studies they have compiled will contribute to motivating and guiding civic actors in their struggle to promote more equitable taxation. This is a work worthy of attention and will likely be a very useful source of information for civic actors, tax authorities and indeed all those interested in the subject.

Taxation, the most significant source of state revenue, ever since the establishment of the first polis, has almost always stirred negative emotions among the people. It has often been perceived as the irretrievable confiscation of what has been justly earned. While it is clear to most that without tax revenues the state cannot provide public goods and services, the negative perception of taxation nevertheless seems to have been eagerly passed down through the generations. Interestingly, we can find traces of this connotation throughout the history of civilization in various documents, arts and culture. For example, in the New Testament Jesus was criticised for dining with "tax collectors and sinners," the two groups thus being equated.

The book presents case studies that examine tax reform campaigns promoted by civic actors in seven countries: France, Guatemala, Kenya, Mexico, the Philippines, Uganda, and the United States. Most of the case studies are quite comprehensive, showcasing situations in which civil society organisations achieved varying degrees of success. Readers encounter stories of well-known movements such as the Yellow Vests (Gilets Jaunes) in France, and the less familiar ones such as the Justice Network Africa, or Tax Justice Alliance Uganda. By providing detailed case studies of the role of civic actors in tax reforms the book fills a big gap in the literature.

Although the story in each chapter is unique and interesting in its own way, I found the most compelling to be the case studies from Mexico, the Philippines, Uganda and the United States presented in chapters six to nine.

In chapter six, Israel Santos Flores from Mexico analyses a decade-long campaign by the civil society organisation Fundar aimed at increasing the transparency of tax amnesties. These allowed the cancellation of tax debts without disclosing information about the beneficiaries, raising concerns about injustice in the tax system. Fundar employed strategies such as legal actions and media campaigns to ensure the publication of beneficiaries' names. At the same time, it began to reveal connections of some of the suspected beneficiaries of tax amnesties to prominent public figures and corporations. The pressure from the public led the new government under President López Obrador to ban future amnesties and introduce constitutional amendments to enhance transparency. Fundar's campaign highlights how civil society can influence tax policy and promote tax justice through coordinated efforts.

Chapter seven, written by Kenneth Isaiah Ibasco Abante from the Philippines, deserves special attention: in addition to readers interested in public sector economics, it would be no less interesting to the fans of crime fiction. It tells the story of a successful civil society struggle against the powerful tobacco and beverage lobby in the Philippines. The organisation called Action for Economic Reforms led the campaign to raise excise taxes on tobacco and alcohol products, with the goal of funding national public health programs. And they succeeded! This case can serve as an excellent example of an orchestrated and sustained civic movement that was able to compete with industry lobbyists. Along with the compelling story this chapter provides a useful "cookbook" in the form of seven lessons essential to building an effective civil society movement for tax reform.

Another exciting story was written in chapter eight by Solomon Rukundo from Uganda. It discusses the introduction of two controversial taxes in Uganda, the Excise Duty (Amendment) Act 2018 known as the mobile money tax, and the "over-the-top" services tax commonly referred to as the social media tax. The government's rationale for these taxes was to expand the tax base, particularly targeting informal sector transactions through mobile money transactions, and to curb social media gossip. However, these taxes were widely seen as regressive, which led civil society organisations, including Tax Justice Alliance Uganda, to mobilise the population against their introduction. Their campaign led to a reduction of the mobile money tax from 1% to 0.5%, but failed to repeal the over-the-top services tax, which remained in place until 2021.

In chapter nine, Alan Essig analyses the efforts of civil society coalitions to implement higher taxes on the wealthy in Massachusetts, Maine, and Minnesota. The chapter shows that changes initiated by civic actors are possible even in the most developed countries of the world. The primary goals of the campaigns were to reverse falling incomes and improve public services. They used different strategies within the system, such as constitutional amendments and ballot initiatives. The campaigns in Massachusetts and Maine were not successful, but the one in Minnesota saw full implementation under a new democratic governor. The author identifies key challenges that civic actors face in achieving reforms of progressive taxation, which may be useful for readers in other countries.

Finally, a word of caution: if econometrics is your *fétiche* and you expect the application of advanced methodologies, this book might disappoint you. But if you are looking for a collection of practical examples, it should definitely find a place on your bookshelf. As eloquently described in the introduction to the seventh chapter, "in the absence of strong political parties, civil society movements can help push for policy reform continuity across administrations despite the unpredictable nature of political leadership". It remains to be seen whether a broader circle of civil society actors and authorities will heed the messages conveyed in these pages, or whether they remain just words on paper read by few enthusiasts.