Discussion Papers

DP/121/2024

The Impact of Labour Costs on Prices in Bulgaria

Daniel Kasabov

BULGARIAN NATIONAL BANK

145 YEARS

BULGARIAN NATIONAL BANK

145 YEARS

DISCUSSION PAPERS
DP/121/2024

The Impact of Labour Costs on Prices in Bulgaria

Daniel Kasabov

2024

ISBN 978-619-7409-32-1 (online)

Send your comments and opinions to:
The Research and Publications Council
Bulgarian National Bank
Website: www.bnb.bg

Contents

Abstract: In light of the strong wage growth in Bulgaria over recent years and the acceleration of inflation since mid-2021, this paper examines the relationship between wages and prices in Bulgaria, addressing two key questions. First, what is the extent of the pass-through from rising labour costs to consumer prices? Second, how has the sensitivity of prices to changes in labour costs evolved over time? To answer these questions, three analytical approaches are employed. Firm-level data on the cost structure of enterprises is used to estimate the impact of labour costs on prices from a supply-side perspective. These micro-based estimates and their assumptions are then compared with results from input-output tables, which provide an alternative dataset on firms' cost structures and sectoral interdependencies. Finally, the pass-through and its time-varying nature are analyzed using a single-equation Phillips curve model. The various estimates yield consistent results, indicating that a 1% increase in nominal unit labour costs led to a 0.21–0.24% rise in the price level in 2019. According to econometric findings, the impact of labour costs on prices has strengthened in recent years, with a 1% increase in nominal unit labour costs resulting in a 0.30% cumulative rise in HICP as of mid-2023.

Keywords: *Labour cost pass-through; Firm-level data; Phillips curve; Consumer prices; Input-output analysis*

JEL classification: D24; D57; E31; E37;

Daniel Kasabov, Economic Research and Forecasting Directorate, Bulgarian National Bank, kasabov.d@bnbank.org

Acknowledgment:
I would like to thank the members of the Economic Research and Forecasting Directorate and the editorial board of the Bulgarian National Bank for their valuable contribution, comments and suggestions.

1. Introduction

Central banks closely monitor labour cost developments, as they provide an early indication of sustained price pressures in the economy, consistent with the cost-push view of inflation (Bobeica et al., 2019). Additionally, the interaction between wages and prices influences the likelihood of an economy entering a wage-price spiral. The motivation for this paper initially emerged in 2019, driven by the substantial nominal wage growth of approximately 9.0% per year in Bulgaria between 2017 and 2019. This increase stemmed from a combination of cyclical and structural factors, including a tightening labour market amid adverse demographic trends and strong GDP growth. Other contributing factors included declining labour market matching efficiency (Ivanov et al., 2019), rising public sector wages, increases in the nationwide statutory minimum wage, and higher social security contributions. As a result, unit labour costs (ULC) rose, coinciding with a moderate uptick in inflation, reaching 3.1% at the end of 2019.

The outbreak of the COVID-19 pandemic and the subsequent decline in economic activity in Bulgaria in 2020 temporarily eased labour market tightness and reduced price pressures, bringing inflation down to 0% in December 2020. However, inflation began accelerating again in 2021 and continued rising throughout 2022, peaking at 15.6% in September 2022. The return to a high-inflation environment reflected the buildup of multiple pro-inflationary factors on both the demand and supply sides. Labour market developments, in particular, played a key role in strengthening the feedback loop between wages and prices and increasing inflation persistence.

Initially, the rise in consumer prices in Bulgaria in 2021 was largely driven by strong base effects, as factors that had dragged down prices during the pandemic in 2020 gradually faded. As a result, at the beginning of 2021, price increases were observed in HICP groups that had been severely affected by the COVID-19 pandemic, such as air transport, accommodation, and restaurant services. The rebound in global economic activity, supported by large expansionary monetary and fiscal policies, along with emerging global supply-chain bottlenecks, added further pressure on import prices of consumer goods. Rising transportation costs, extended delivery times, and shortages of key inputs for certain production activities further amplified price pressures related to non-energy industrial goods. In the second half of 2021, international commodity prices–especially crude oil, natural gas, and electricity–rose well above their pre-pandemic levels. This surge fueled new inflationary pressures by increasing firms' production costs, leading to broad-based price increases.

Throughout 2022, inflation continued to accelerate due to sharp increases in natural gas, oil, and food commodity prices, driven by supply and uncertainty shocks stemming from the Russian invasion of Ukraine. As Bulgaria has the highest energy intensity per unit of GDP in the EU, the energy shock triggered broad-based direct and second-round effects across the economy, leading to heightened inflation perceptions and expectations among economic agents. At the same time, consumer demand remained strong, and labour market tightness continued to deteriorate. These conditions likely strengthened workers' bargaining power, making it easier for them to demand higher wages to recover lost purchasing power[1] and protect against future price increases. Additionally, government policies aimed at raising the incomes of low-wage workers and public servants further contributed to the risk of a wage-price spiral. As a result, while inflation was primarily concentrated in food and energy products at the end of 2021, price increases gradually spread across the HICP basket, pushing core inflation to 11.9% by December 2022. In the HICP services group, which represents the most labour-intensive sector of the economy, inflation surged to 13.9% by the end of 2022. Simultaneously, wages in the services sector, as measured by compensation per employee (CPE), rose cumulatively by 27.1% over 2021–2022.

At the beginning of 2023, the Bulgarian government amended the Labour Code to introduce an automatic mechanism for adjusting the minimum wage based on the gross average wage. Under the new rule, "the minimum wage for the upcoming calendar year will be set by September 1 of the current year at 50% of the average gross wage over the preceding 12 months."[2] This mechanism establishes a sustained feedback loop between the minimum wage, skilled labour wages, the gross average wage in the country, and prices.

In light of the aforementioned developments, this paper aims to investigate the role of wage dynamics in driving consumer price inflation, focusing on the evolving relationship between wages and inflation over time. The main research questions addressed in the study are: (1) What is the magnitude of the labour cost pass-through to consumer prices? (2) How has the sensitivity of prices to changes in labour costs evolved over time? To address these questions, three analytical approaches are employed. Information from firm-level data and input-output tables for Bulgaria is used to estimate the impact of labour costs on prices from a supply-side perspective. After that, the labour cost pass-through and its time-varying manner are analysed through a Phillips curve model. The

[1] Compensation per employee declined in real terms on an annual basis during the fourth quarter of 2021, as well as in both the first and third quarters of 2022.

[2] In addition, the adopted rule does not allow for a decrease of the minimum wage, effectively introducing a downward wage rigidity in the economy. For more information refer to Article 244 of the Labour Code.

Phillips curve relationship is studied through a single equation model with time-varying parameters, capable of capturing price pressures driven by both supply and demand. In a historical perspective, the various estimates suggest that in Bulgaria the elasticity of HICP to changes in labour costs has been, on average, in the range of 0.21–0.24. Econometric findings from the Phillips curve suggest a strengthening effect of wage increases on prices in recent years, with the size of the pass-through reaching 0.30 in the first half of 2023.The research methods employed in the current study are most closely related to the work on labour cost pass-through of Deutsche Bundesbank (2019), Hviid and Renkin (2020), Bobeica et. al. (2019), Ciccarelli and Osbat (2017), and Bobeica and Jarocinski (2019), Eurostat (2008). Specifically, the methodology outlined by Deutsche Bundesbank (2019) and Hviid and Renkin (2020) is followed to investigate the relationship between labour cost share of firms and prices using micro-level data. Additionally, insights from Eurostat (2008) are drawn to explore the implications of input-output table data for labour cost pass-through. The remaining studies have inspired the proposed econometric approach, particularly the Phillips curve model, used to analyse the impact of labour costs on prices.

The structure of this paper is as follows: Section 2 provides a review of the relevant theoretical and empirical literature on the relationship between wages and prices, focusing on studies that employ methodologies similar to those used in this paper and in past studies on Bulgaria. Section 3 presents data on the macroeconomic environment for firms in Bulgaria at the time of writing, along with long-term trends, and analyzes the impact of labour costs on consumer prices using national accounts data. Section 4 employs firm-level data to assess the link between labour costs and prices. The results of the micro-based analysis and its assumptions are then compared with estimates from input-output tables, which are detailed in Appendix 2. Section 5 analyzes the elasticity of prices to wages through a Phillips curve model, elabourating on its specification, estimation, and key findings. Finally, Section 6 concludes by synthesizing the main results, providing a comparative perspective on the methodologies used, and discussing the policy implications of the findings.

2. Literature Review

This section reviews the economic literature and methodologies used to analyze the wage-price relationship. The empirical evidence highlights that this relationship is multifaceted, state-dependent, and varies considerably across different periods and countries. Alongside insights from studies conducted in other countries, the section presents key findings from research specific to

Bulgaria. It concludes by summarizing these results and proposing hypotheses on the factors influencing wage-price dynamics in the Bulgarian economy.

A critical strand of the literature investigates the causal relationship between wage inflation and price inflation. Post-Keynesian theories posit that excess wage growth over productivity drives price inflation, while neoclassical theory argues that prices dictate nominal wage adjustments to preserve real wages. Empirical studies offer mixed conclusions. For instance, Granger causality tests often find that price inflation leads wage growth (e.g., Hu and Toussaint-Comeau, 2010; Emery and Chang, 1996; Sbordone, 2002), though some research reports no clear causality or suggests mutual interdependence (e.g., Hess and Schweitzer, 2000; Gordon, 1988). Interestingly, Banerji (2005) identified cyclical dynamics, with wages lagging prices at troughs and leading at peaks, while Rissman (1995) observed sectoral differences, with wages driving prices in manufacturing and trade services.

Building on these insights into causality, another significant strand of the literature examines the predictive power of wages and the feedback dynamics between wages and prices. Gali (2011) re-examines the Phillips curve, emphasizing its usefulness in explaining the feedback loop between wages and prices. He demonstrates that nominal wage rigidities can intensify the wage-price spiral, particularly in tight labour markets, underscoring the critical role of wage dynamics in shaping inflationary pressures. However, studies such as Stock and Watson (2008) and Knotek and Zaman (2014) suggest that wages often add limited value to inflation forecasts when other indicators, including past prices, are considered. In some instances, including wages in predictive models reduces forecasting accuracy. This finding aligns with evidence that wage movements are not always reliable signals of inflationary trends, particularly in low-inflation environments, highlighting the complex and state-dependent nature of the wage-price relationship (see also Bidder (2015)).

Several studies highlight the time-varying nature of the pass-through from wages to prices. For example, Peneva and Rudd (2017) show a near-zero pass-through of unit labour costs to core inflation in the U.S. since the 1980s, attributing this to better-anchored inflation expectations stemming from improved conduct and credibility of monetary policy. Other explanations include the changing constellation of shocks that hit the economy, increased trade openness, and the rise in firm market power (Bobeica (2021a, 2021b)). Similar trends are observed in Europe. Knotek and Zaman (2014) document declining cross-correlations between wages and prices, while studies like Mehra (2000) and Zanetti (2007) suggest that the wage-price link is stronger in high-inflation periods. Nevertheless, regional differences persist; for instance, IMF

(2018) finds significant labour cost pass-through in EU15 countries, and Dees and Guntner (2014) highlight sectoral variation within the euro area. Often these studies employ VAR models or reduced-form Phillips curve models with time-varying parameters (see Nickel (2019)). Panel data methods are another popular approach for capturing cross-country or cross-industry variations in labour cost pass-through.

Micro-level studies represent another strand in the literature. They examine firm-level or industry-level data and offer additional insights into how changes in labour costs affect pricing decisions. Carlsson and Nordström Skans (2012) use Swedish manufacturing data to estimate the pass-through of idiosyncratic wage shocks to output prices. Similarly, Deutsche Bundesbank (2019) examines the wage-price relationship in Germany, highlighting industry-specific variations in the degree of pass-through. In particular, the authors of the study employ both firm-level data and input-output data to calculate the labour cost share of firms in Germany, which is used as proxy for the wage pass-through. Furthermore, Eurostat (2008) highlights the relevance of input-output tables in assessing the broader implications of labour cost changes on price dynamics, providing methodological guidance for such analyses.

The European Central Bank's Wage Dynamics Network (WDN) projects further contribute to this area by offering extensive cross-country microeconomic evidence on labour cost adjustments and their effects on prices. Based on firm-level surveys conducted across EU countries, these studies reveal significant heterogeneity in wage and price-setting behaviours, driven by factors such as firm size, market structure, and labour market institutions. For instance, Babecký et al. (2012) use WDN data to identify the prevalence of downward nominal and real wage rigidities, highlighting how institutional settings shape firms' responses to shocks. Druant et al. (2012) provide evidence that the frequency of price adjustments varies with the nature of cost shocks, with labour cost changes being more likely to prompt price revisions in less competitive industries. Izquierdo et al. (2017) extend this analysis, emphasizing the influence of collective bargaining systems and employment protection laws on wage flexibility and their indirect effects on inflation dynamics. The results derived from microdata are often utilized to calibrate the deep parameters of New Keynesian DSGE models, enabling researchers to explore the macroeconomic implications of firms' price- and wage-setting patterns.

Recent analyses emphasize the role of economic shocks in shaping the wage-price nexus. Gumiel and Hahn (2018) argue that the transmission mechanisms depend on the type of shock (e.g., demand versus wage mark-up shocks) and can be obscured by overlapping channels. For example, demand shocks may

lead to different responses in wages and prices, particularly during recessions versus expansions. Hahn (2019) confirms this shock dependence, showing that the wage-price pass-through weakens during recessions due to subdued profit margins and competitive pressures. This nonlinearity contributes to disinflation puzzles and reflects broader structural changes in labour markets and monetary policy regimes.

While the broader literature provides valuable insights into the wage-price relationship across different contexts, a distinct body of research focuses specifically on Bulgaria, shedding light on the unique characteristics and dynamics of wage and price adjustments within the country. A survey conducted among non-financial enterprises in Bulgaria[3] in 2009 pointed to a comparatively weak link between wages and prices (Lozev, Vladova and Paskaleva, 2011). At the time of the survey the most common pricing practice in Bulgaria was "following the competitors' policy". This strategy was used by 40 percent of the firms, while 34 percent of them tended to set prices based on a certain pre-defined mark-up over costs. With respect to the cost structure, the managers stated that the cost of raw materials and the improved quality of offered goods and services had the most significant contributions to the increase in prices that was observed in the period prior to the Global financial crisis (2008–2009). Labour costs had a significantly lower contribution to price increases as compared, for instance, to the euro area countries, where they were one of the major drivers of price changes. The survey also studied the adjustment strategy of firms after a wage shock. When asked how they would react to an unexpected permanent increase in wages (i.e. due to a minimum wage rise) affecting all corporations in the market, only 43 percent of the firms replied that they will raise prices (for comparison on average for the EU countries such a reaction was declared by 60 percent of the corporations). Nevertheless, the full extent of higher wages being passed on to prices appeared unlikely, as 56.2 percent and 65.4 percent of the firms indicated they would also explore strategies to cut other costs and profit margins, respectively.

In 2015, the European System of Central Banks (ESCB) initiated a network of experts to investigate the underlying causes of low inflation in the euro area and explore its policy implications. The BNB participated in this initiative[4] with an analysis for Bulgaria, and the research findings indicated that during the period

[3] The survey was commissioned by the Bulgarian National Bank and its design followed the questionnaire of the Wage Dynamics Network (WDN) project of the Eurosystem. The survey covered 504 enterprises in industry, trade and services (with about 20,000 employed).

[4] Most of the research for Bulgaria was conducted from March 2015 to June 2016 and included data for the 2001-2014 period. For more information, please refer to:
https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_lift.en.html

2012–2014, inflation in Bulgaria remained subdued primarily due to declining international commodity prices, with weaker domestic economic activity and a slowdown in wage growth playing a secondary role (Ciccarelli and Osbat, 2017). Although inflation expectations of consumers decreased over the 2012–2014 period, econometric results did not suggest lowering of inflation expectations to be a major driver of price dynamics. Furthermore, the data available at that time did not provide conclusive evidence regarding a change in the slope of the Phillips curve, specifically, the coefficients related to labour costs or the output gap in the various model specifications.

The interaction between inflation, output and unemployment in a multivariate framework was studied in 2017 by Kasabov, Kotseva, Vassilev and Yanchev. The authors used an unobserved components model, which was estimated with Bayesian methods on quarterly data from 1999 to 2015, to assess the cyclical developments in unemployment and output, and to identify the main drivers of inflation over that period. The inclusion of external supply-side shocks to affect directly inflation and the use of model-consistent inflation expectations were important features of the model. The authors found that in a historical perspective shocks in oil prices and other international commodity prices were more important for inflation dynamics than demand shocks. According to a historical decomposition of inflation dynamics, cost-push shocks other than commodity prices, which were not explicitly included in the model, had a significant positive contribution to inflation during episodes of high inflation. These cost-push shocks were likely to be related to spill-over effects from changes in administrative prices, as well as changes in labour costs.

The third wave of the Wage Dynamics Network (WDN3) project for the ESCB[5] countries provided firm-level evidence on the patterns of price and cost adjustment strategies of Bulgarian firms over the period 2009–2013. Based on the collected data, Kasabov and Paskaleva (2018) found that in the explored period firms' price- and cost-setting decisions were mostly the result of changes in the macroeconomic conditions and the types of shocks that were affecting firms. According to the survey results, the wage-price link was relatively weak with some indications that the link has strengthened compared to the previous WDN2 round. The wage-price link in the WDN3 survey was explored directly by the questions on the incidence of inflation indexation, the relevance of wage costs for price changes, as well as by the question on firms' reaction to minimum wage and minimum social security threshold increases.

[5] For more information, please refer to:
https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_wdn.en.html

The questions in the survey explored the behaviour of firms in two periods: the period prior to 2010 and the period from 2010 to 2013. According to the WDN3 results, the role of inflation for setting nominal wages, measured by the degree of inflation indexation in Bulgaria, was still low compared to the results of the WDN2 study. Around 25.6% of firms applied some form of inflation indexation in the period prior to 2010 according to WDN3 data and this outcome was very similar to the WDN2 results (around 24%) (Lozev, Vladova and Paskaleva, 2011). In the low-inflation period 2010–2013 inflation indexation practices became more widespread and 29.2% of the firms stated to have aligned their wage growth with inflation (Paskaleva, 2016). In regard to the price-setting practices, around 40% of the companies followed competitors' prices, whereas another one third used "the mark-up over costs" policy for setting prices. Moreover, changes in minimum wages and social security thresholds were among the main institutional drivers of wage increases in the economy over the 2009-2013 period. Even though WDN3 survey results indicated that for 2013 the employees earning the minimum wage comprised around 20% of all employees and those at the social security thresholds – around 40%, there were some indications for spillover effects to wages of higher paid employees. As indicated by previous surveys, wage costs were not the main factor behind price changes. Only around 23% of the firms reported wage costs as 'very relevant' for price changes. For comparison, input prices, changes in demand and competitors' prices were reported as "very relevant" for price setting by a higher share of firms (around 40% of firms). The WDN3 survey also explored which combinations of strategies firms applied to offset the effects of minimum wage/minimum social security threshold increases on their profits in the period 2010–2013. Around 37% of the firms managed to compensate the effects of minimum wage (social security threshold) increases by raising prices (see also Bodnár et al., 2018).

In summary, existing research on Bulgaria reveals a historically weak link between wages and prices, with factors such as input costs, competition, and broader economic conditions playing more significant roles. While labour costs have contributed to price adjustments, their pass-through has typically been low during periods of subdued economic activity or declining commodity prices, such as between 2009 and 2014, underscoring the state-dependent nature of labour cost pass-through in Bulgaria. Building on these findings, this paper presents the hypothesis that the wage-price relationship has strengthened since 2021 due to heightened economic uncertainty, strong household demand, expectations of sustained wage growth, and commodity-driven increases in production costs, which have constrained firms' ability to absorb wage increases as they did in earlier periods.

3. Descriptive evidence on the relationship between inflation and wages

3.1. Dynamics of unit labour costs in Bulgaria

Bulgaria has experienced a continuous increase in wages and labour costs[6] ever since 1999. This has often been seen as a consequence of the low initial wage level in the country and the ongoing process of nominal and real (in terms of productivity) convergence to the EU average. Moreover, higher wages have been considered to be a natural market mechanism to stimulate labour force participation against the background of aging population. As a result, on a macroeconomic level the Bulgarian labour market stands out compared to other EU countries by its sustained nominal and real wage growth during both economic downturns and upturns, while adjustment to (negative) economic shocks has primarily occurred through employment. Bulgaria, for instance, was severely affected by the Global financial crisis of 2008–2009, with GDP contracting by -3.3% in 2009 and registering only a modest recovery during the subsequent years. At the same time, employment declined cumulatively by 10.3% over the period 2009–2013 and the unemployment rate more than doubled from about 5.6% in 2008 to 12.9% in 2013[7]. Average nominal compensation per employee, however, continued to increase, though at a slower pace of around 8.3% per year over the period 2009–2013 compared to double-digit growth rates prior to the crisis. In real terms[8], CPE grew by 5.8% annually between 2009 and 2013.

The Bulgarian labour market improved significantly from 2014 to 2019, with the unemployment rate decreasing to a historical low of 4.2% in 2019. During that period, Bulgaria also experienced an increase in employment and a gradual acceleration of the growth rate of wages across different measures. Compensation per employee, for example, grew at an annual average rate of around 9.0% over the period 2017–2019, with a real term increase of 6.8%. Economists started to draw increasingly more attention to wage dynamics in 2017–2019 for four main reasons. First, the government announced the implementation of wage-increasing measures (mostly for the education, army and police servants) for several consecutive years. Second, the growth rate of real compensation per employee exceeded significantly that of productivity, driving an increase in unit labour costs and the share of total compensation of

[6] In the following sections, unless otherwise noted, we will refer to wages as *nominal compensation per employee (CPE)* and to labour costs as *compensation per employee adjusted for productivity* (i.e. unit labour cost, ULC). Data about the selected indicators is based on *national accounts* and is available both across sectors and on average for the economy on a quarterly basis since 1995.

[7] Data is from the Labour force survey and refers to the people aged *15* or above.

[8] CPE is adjusted for inflation using the HICP.

employees in gross value added[9]. Third, after a period of deflation from mid-2013 to 2016, inflation turned positive in 2017 and accelerated afterwards, albeit modestly. Fourth, in 2018, the output gap turned positive, primarily driven by the unemployment rate falling below the estimated natural level. These macroeconomic developments were a crucial precondition for strengthening of the link between wages and prices.

In 2020, following the onset of the COVID-19 pandemic, labour market pressures in the private sector on prices eased temporarily due to a rise in the unemployment rate. The government's job retention scheme[10] played a crucial role in limiting job losses by allowing a temporary transition towards short-time work schemes. The accommodation and food services sectors experienced the most significant share of job losses. Additionally, as some individuals who lost their jobs did not immediately start seeking new employment, inactivity rates rose. Despite the deteriorating labour market conditions, compensation per employee in the private sector continued to increase, albeit at a more moderate pace. This was influenced by hikes in both the minimum wage and minimum insurance thresholds. Concurrently, total compensation per employee across the economy experienced a slight acceleration, propelled by wage hikes in the public sector. Starting from the second half of 2021, increased economic activity in the aftermath of the pandemic resulted in a renewed tightening of the labour market, which steadily reduced the unemployment rate to 4.4% by the second quarter of 2023. Despite the shift back to full-time work and an increase in participation rates, the labour market and wage pressures were only partially alleviated. The labour market situation enhanced significantly the bargaining power of employees, resulting in wage growth significantly outpacing both consumer price increases and productivity gains.

Figure 1 depicts the year-on-year growth rate of the economy-wide ULC and HICP, with the correlation between the two series being 0.29 over the period Q1 2000 – Q2 2023. The acceleration of the ULC growth rate in Q1 2017 – Q2 2023 was driven by the stronger increase in compensation per employee relative to that in productivity (see Figure 2). National accounts data suggests that across economic sectors the increase in compensation per employee was due

[9] Across sectors, the excess real wage growth was most pronounced in the 'Construction' and 'Manufacturing' sectors as well as the services subsectors related to 'Real estate activities', 'Financial and insurance activities' and 'Public administration, defense, education, human health and social work activities'.

[10] Labour market policies focused on maintaining employment by subsidising part of the compensation of employees, with the key measure being the "60/40" employment retention scheme (in force until June 2022).

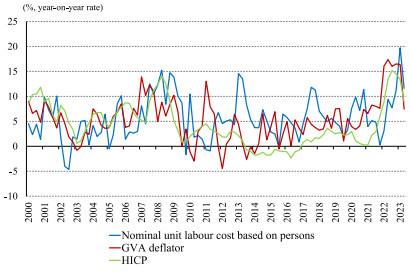
both to the private and public sectors[11] (see Figure 4). In respect to the private sector, the subsectors of "industry" and "trade, transport, accommodation and food service activities" contributed most to the upward dynamics of total compensation per employee[12]. The annual statistics on employment and labour cost, which provides a more precise distinction between the private and public sectors, also point to a simultaneous rise in wages in both sectors, with the growth rate of earnings in the public sector outpacing that in the private sector in the period 2019–2021. The common pattern of the growth rate of wages and CPE across various sectors after 2017 can be attributed, at least partially, to institutional factors. These include increases in all of the following: the minimum statutory wage (MSW) level (see Figure 5), pension contribution rates, minimum social security thresholds[13] and the maximum limit for social security contributions. Since 2017, the share of minimum wage earners varied from 17% to 22% and the statutory minimum wage increased on average by 9.3% each year. Survey data about the reaction of firms to wage shocks (see Section 2) reveals that an increase in the statutory minimum wage affects directly the minimum wage earners and indirectly the compensation of the remaining workers as some firms adhere to a certain wage-to-MSW ratio for the qualified staff. Across sectors, the share of minimum wage earners in 2017–2022 was on average 22.9% in "agriculture", 23.9% in "industry", 23.5% in "trade, transport, accommodation and food service activities", 8.7% in "public administration, defence, education, human health and social work activities" and 17.5% for the remaining subsectors of services. Figure 6 illustrates that the increase in wages following the COVID-19 pandemic was likely influenced by tight labour market conditions in the country, alongside strong economic activity as reflected by the positive output gap.

[11] National accounts statistics provides data both for the wage and compensation per employee indicators. The public sector is proxied by *'Public administration, defense, education, human health and social work activities'* sector according to the A10 breakdown of the statistical classification of economic activities (NACE).

[12] In the long run period, part of the changes in the level of compensation per employee can be attributed to compositional effects due to the shift towards knowledge society. In 2008, for instance, according to Eurostat data, employment in high- and medium-high technology manufacturing sectors and knowledge-intensive service sectors was 31.4%, compared to 35.9% in 2022.

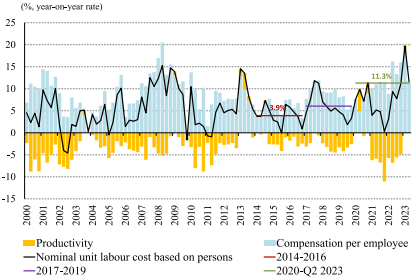
[13] In Bulgaria, the base for paying social security contributions cannot be below a certain threshold. The minimum thresholds vary across economic sectors and occupations. For each year these thresholds are agreed between social partners or, in case that no agreement is reached for some sectors, the thresholds are administratively set by the government.

Figure 1: **Unit labour costs, gross value added (GVA) deflator and HICP, year-on-year percent change**



Source: NSI

Figure 2: **Breakdown of ULC growth rate into compensation per employee and productivity**

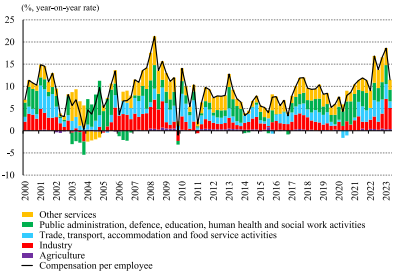


Source: NSI, own calculations

Figure 3: **Nominal wage growth based on annual statistics on employment and labour cost, year-on-year percent change**

Source: NSI

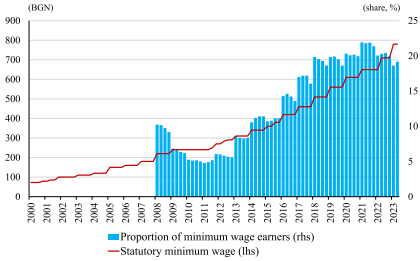
Figure 4: **Sectoral breakdown of the growth rate of nominal compensation per employee (based on national accounts data)**



Note: The sectors correspond to the A10 breakdown of the statistical classification of economic activities (NACE)

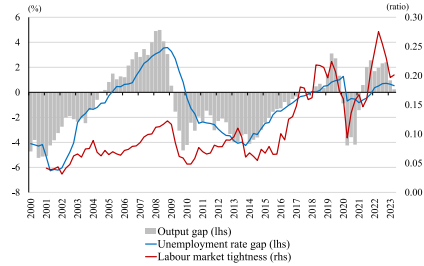
Source: NSI, own calculations

Figure 5: **Statutory minimum wage and proportion of minimum wage earners**



Source: NSI

Figure 6: **Selected labour market indicators**



Note: Positive values of the unemployment rate gap indicate that the natural rate of unemployment is above the unemployment rate.
Labour market tightness indicator is the ratio of vacancies to unemployed and theoretically the indicator should increase during an expansionary part of the cycle because there are more vacancies and fewer unemployed than in a downturn.

Source: NSI, Employment Agency, own calculations

3.2. Using national accounts data to assess price pressures

A common approach to analyzing the interaction between price and cost developments at the aggregate economy level is to use national accounts identities to decompose the dynamics of the final demand and private consumption deflators (see Figures 7–10). Through accounting-type decompositions, these dynamics can be attributed to external and domestic price pressures. The contribution of unit labour costs, as part of domestic price pressures, to both deflators serves as a conventional measure of the impact of wages on prices. More details on the accounting methodology used can be found in Appendix 1. The analysis highlights that although labour cost pressures steadily increased during 2017–2019, their impact on consumer prices may have been relatively limited or less discernible, given the influence of other factors. This could be attributed to the sectoral composition of ULC growth, the structure of the consumer basket, and subdued profit dynamics, which have helped firms absorb rising labour costs. However, from 2021 to mid-2023, the influence of labour costs on prices intensified. Wage growth consistently outpaced productivity, particularly in sectors producing goods and services for final consumption. In an environment of rising uncertainty over firms' input costs and strong domestic demand, firms not only passed higher labour costs onto consumer prices but also increased mark-ups.

The final demand deflator serves as the broadest indicator of price pressures in the economy. It can be decomposed into import components including the effects from changes in the nominal effective exchange rate, NEER) and GDP components, providing insights into whether price pressures originate externally or domestically. GDP can then be further broken down into the various components of income in order to attribute domestic price pressures to changes in ULC, mark-ups, and taxes (less subsides on production and imports). Alternatively, decomposing the GDP deflator by expenditure components–such as private consumption (which behaves similarly to HICP), investment, and government consumption–helps establish a relationship between the private consumption deflator and income components.

Starting with the final demand deflator, Figure 7 gives an idea of the significant impact of external factors on domestic prices. This could be explained by the small size of the Bulgarian economy and the large share of foreign products, which are either directly consumed or are embodied in domestically produced goods and services. Considering a longer-term historical perspective, the Global financial crisis and the subsequent 2009 recession resulted in a substantial decline in international commodity prices, particularly oil and food products. This, in turn, contributed to a noticeable reduction in import prices and consequently, the final demand deflator. Although overall price pressures in Bulgaria were held up by the easing of international commodity prices, the other components of the final demand deflator exhibited divergent dynamics. In particular, domestic pressures remained strong as unit labour costs[14] and profits per unit of output rose significantly over the course

[14] In 2009 higher wage growth, especially in the services subsector, was not matched by corresponding improvements in labour productivity and ULC rose by 7.2% on average for the economy.

of 2009 and contributed 5.1 p.p. and 3.1 p.p. to the change of the final demand deflator, respectively. The recovery of commodity prices in 2010–2012 drove up temporarily the final demand deflator but did not lead to a significant build-up of price pressures as the impact of import prices was partly neutralized by the unwinding of domestic pressures. The weakening of domestic pressures, which was marked by the subdued dynamics of the GVA deflator (Figure 8), reflected a moderation of ULC growth and a decline in mark-ups[15] (measured by the drop in profits per unit of output). On average, during the period 2013–2016, the combination of subdued import prices, the appreciation of the nominal effective exchange rate (NEER), and eased domestic price pressures collectively resulted in the final demand deflator remaining flat. It should be noted that the period after the Global financial crisis contrasts significantly with the one before the crisis in terms of the dynamics of profits per unit of output. The decrease in mark-ups throughout a significant portion of the post-crisis period is one of the key factors that could explain the decoupling of inflation (measured either by the private consumption deflator or HICP) from the ULC dynamics (see Figure 1)[16]. These developments, among other factors, likely reflected the heightened uncertainty and the subdued growth in consumer spending in the aftermath of the Global financial crisis[17]. The period 2015-2016 also stands out by the marked difference between producer price developments and the GVA deflator (and the ULC component in particular), which was due primarily to the decreases in intermediate input costs. Lower input prices allowed firms to maintain profit mark-ups and at the same time to pass part of the decreases through to producer prices and HICP. As a result of that, the rate of change of the HICP was negative at that time against the background of growing labour costs.

According to the national accounts data, since 2017, both external and domestic price pressures have built up-except during the pandemic year 2020. Rising import prices drove external price pressures, with the NEER appreciation providing only mild relief. Meanwhile, domestic price pressures were primarily fueled by accelerating labour costs per unit of output. While mark-ups remained relatively stable in 2017–2018, they increased in 2019 and even more significantly from 2021 onward. As a result of these developments, the final demand deflator grew by 5.5% in 2017, slowed to around 3.3% in 2018–2019, nearly stagnated at 0.1% in 2020 due to the pandemic, and then surged to 18.3% in 2022. Figure 9

[15] Mark-ups declined in 2010 and 2012, while in 2011 they increased slightly.

[16] These developments mirror the steady increase of the wage share (measured by the compensation of employees) in gross value added – which is simply the inverse of the profit mark-up indicator – from around 40% in 2008 to 50% in 2019.

[17] The weakness in overall profit mark-up growth in the period from 2009 to 2013 appears to have stemmed in part from the construction sector, which underwent a prolonged adjustment process in terms of activity and prices of dwellings. More information about the overvaluation of house prices during that period can be found in Kotseva and Yanchev (2017). Another factor that possibly contributed to the subdued dynamics of mark-ups in the period after 2008 is the increased competition after EU accession (European Commission, 2009).

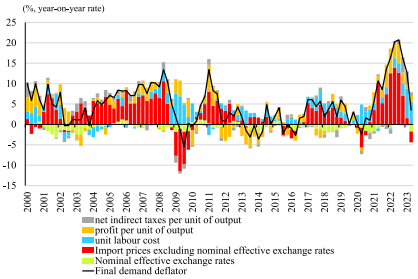
provides a sectoral breakdown of the GVA deflator, showing that domestic price pressures since 2017 have been primarily driven by the "industry" and "trade, transport, accommodation, and food services" sectors, followed by the public sector[18] and other service subsectors (such as "information and communication" and "professional, scientific, and technical activities; administrative and support service activities"). Since 2020, the "agricultural" sector has also contributed significantly to GVA deflator growth. Notably, some of the price pressures stemming from wage increases were linked to the production of goods and services that are not part of household consumption. While higher labour costs in agriculture, trade, transport, accommodation, and catering likely pushed up consumer prices, wage growth in sectors like construction and professional services mainly affected the GVA deflator rather than the private consumption deflator or HICP. However, higher wages in these sectors may have indirectly influenced consumer spending by increasing household purchasing power. Similarly, rising wages in the public sector contributed to the government consumption deflator and, consequently, the GDP deflator, without exerting direct upward pressure on firms' production costs and prices.

Figure 10 summarizes the impact of these compositional effects on the private consumption deflator under the component "compositional effects and prices for other aggregate demand components", which has consistently had a negative contribution since 2017, partially offsetting positive contributions from other factors. In 2022, import prices accounted for most of the surge in consumer prices, followed by rising profits and labour costs per unit of output. However, in the first half of 2023, the impact of labour costs intensified, while the influence of other factors declined.

In summary, Section 3 provides a descriptive analysis of the relationship between inflation and wages in Bulgaria. Since 1999, Bulgaria has experienced continuous wage and labour cost growth, driven by nominal and real convergence to EU levels and labour market adjustments to demographic changes. Despite economic downturns, including the 2008–2009 financial crisis and the COVID-19 pandemic, nominal wages continued to rise, though at varying rates. From 2017 onward, wage growth accelerated, outpacing productivity and contributing to rising unit labour costs. Institutional factors, such as minimum wage increases and social security changes, played a key role in wage dynamics. The tightening post-pandemic labour market further strengthened employees' bargaining power, leading to sustained wage growth. National accounts data indicate that both external and domestic price pressures have intensified since 2017, with labour costs playing a growing role in price formation. The sectoral analysis reveals that industries like trade, transport, and public services were major contributors to wage-driven price pressures, while compositional effects and external factors also influenced inflation trends.

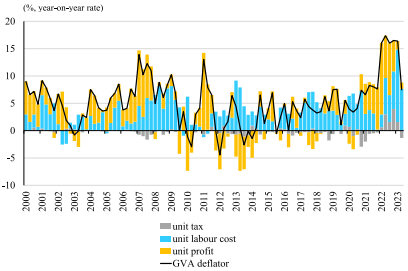
[18] '*Public administration, defence, education, human health and social work activities*' sector according to the A10 breakdown of the statistical classification of economic activities (NACE).

Figure 7: **Decomposition of the final demand deflator**



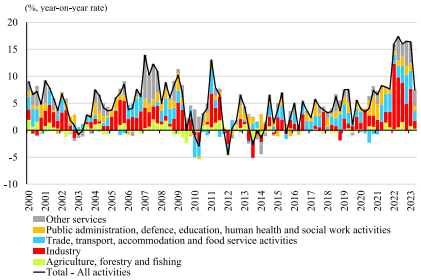
Source: NSI, own calculations

Figure 8: **Decomposition of the GVA deflator**



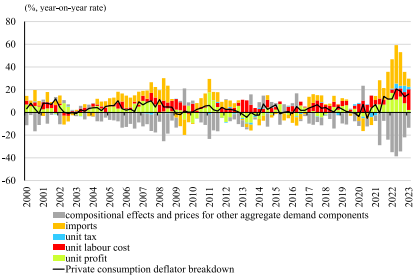
Source: NSI, own calculations

Figure 9: **Sectoral breakdown of the GVA deflator**



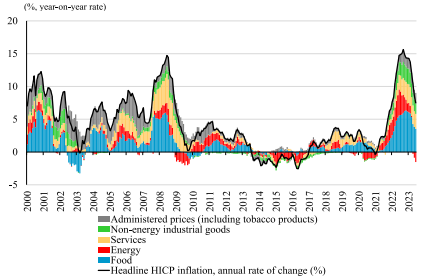
Source: NSI, own calculations

Figure 10: **Decomposition of the private consumption deflator**



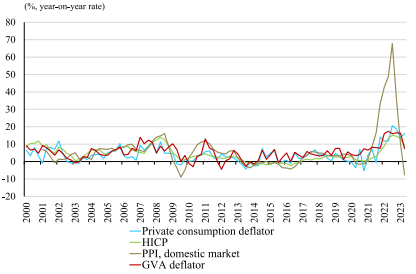
Source: NSI, own calculations

Figure 11: **HICP inflation and contribution of main groups**



Source: NSI, own calculations

Figure 12: **GVA deflator, private consumption deflator, PPI and HICP, year-on-year percent change**



Source: NSI, own calculations

4. The impact of wages on prices according to individual firms' cost structure data

It is a well-established result in microeconomics that, under certain theoretical assumptions, the labour cost shares of individual firms can be interpreted as a proxy for the elasticity of prices to changes in wages (from the perspective of the cost-push view of inflation). Although this theoretical framework is entirely rooted in microeconomic theory, economists often refer to it when using macro data on the cost structure of firms to estimate the broader impact of wage changes on prices. However, using macroeconomic data to assess production costs can lead to biased results, as some firms do not produce goods and services intended for household consumption (see also Section 3). Consequently, this section proposes a statistical method for calculating labour cost shares and constructing an aggregate metric that includes only those firms whose products are represented in the HICP. This approach is bottom-up, relying on firm-level data for Bulgaria obtained from the Orbis database[19]. The analysis is structured as follows: Section 4.1 presents the theoretical underpinning of the proposed statistical method; Section 4.2 presents the micro data obtained from Orbis database and summarizes the main characteristics of the firms in it; and Section 4.3 presents the analysis of the data and the main results – calculation of the 'wage content' of products included in the HICP.

The calculation procedure can be broken down into several steps. First, the products of the firms in the dataset are assigned to the relevant HICP components at the 4-digit level[20]. Second, firms that do not produce final goods and services, and whose products cannot be assigned to the HICP, are excluded from the dataset. Third, the labour costs for firms within the different HICP components are computed and weighted according to the structure of the consumer basket. The resulting labour cost share of the HICP serves as a proxy for the direct wage pass-through to consumer prices among Bulgarian producers on a macroeconomic scale. Finally, the indirect impact of wage expenses embedded in intermediate inputs, as well as the effects stemming from both domestic and international trade, is estimated.

[19] Orbis, (2023) Orbis. Bureau van Dijk. [Online]. Available at: https://www.bvdinfo.com/en-gb/our-products/data/international/orbis (Accessed: August 2023)

[20] HICP calculation is based on the ECOICOP classification – European Classification of Individual Consumption According to Purpose, adapted to the needs of the HICP, according Regulation (EU) 2016/792 of 11 May 2016 of the European Parliament and of the Council. It is hierarchical and is built on five levels: overall index, divisions, groups, classes, subclasses (5-digit).

4.1. Neoclassical Theory and Wage Pass-Through

This section provides the theoretical foundation for the analysis, starting with the long-term wage-price relationship derived from neoclassical production theory. Assuming a closed economy, the representative firm is characterized by the following production function with constant returns to scale:

$$Y_t = A_t L_t^{\alpha} Z_t^{1-\alpha}, \text{ with } \alpha \in (0,1)$$

where Y_t denotes production, A_t is total factor productivity, L_t is labour input and Z_t denotes all other factors of production (capital, intermediate goods and services). The cost of labour is represented by wages (W_t) while the composite price of the remaining production factors is denoted by $\mathrm{R_t}$.

Under the assumption of perfect competition and rational behaviour, firms solve the following optimization problem:

$$\max_{Y} P_t Y_t - W_t L_t - R_t Z_t,$$

where P_t is the price of domestically produced goods.

According to the first-order condition, the profit-maximizing competitive frim will choose its output to equate real marginal costs and marginal products across all factors of production. In regard to the labour input, the first-order condition is:

$$\alpha P_{\mathrm{t}} \frac{Y_t}{L_t} = W_t \iff P_{\mathrm{t}} = \frac{1}{\alpha} \frac{W_t L_t}{Y_t}$$

This result reveals that there is a long-run relationship between the prices set by firms and unit labour costs[21], with the latter being defined as total compensation per unit of output $\left(\frac{W_t L_t}{Y_t}\right)$. Taking the logarithm of both sides of the equation and then applying differences yields the following expression for inflation:

$$\pi_{\mathrm{t}} = \underbrace{\Delta \ln(W_t) - [\Delta \ln(Y_t) - \Delta \ln(L_t)]}_{\Delta \ln(ULC_t)}$$

where π_{t} represents inflation and ULC_t denotes unit labour costs. In other words, in the long-term neoclassical growth equilibrium, unit labour costs

[21] The equation also gives us the demand for the labour input as a function of the optimal output choice: $L_{\mathrm{t}} = \frac{\alpha P_t Y_t}{W_t}$. The demand for labour depends positively on the level of output and negatively on the factor price of labour.

and prices grow at the same rate. However, this holds true only if firms face limitations in substituting costlier inputs with more affordable alternatives. Put differently, the derived relationship depends on the marginal productivity of the production factors within the production function, which is influenced by factor prices.

The derived relationship between wages and prices is *conditional* on the marginal product of labour (MPL). At the same time, MPL depends on the dynamics of wages relative to the price of the other inputs, since the ratio between the two affects the demand for labour. When wages increase relative to the price of the other production factors, firms can substitute the relatively more expensive labour input with other production factors (imported goods and capital), which would increase the marginal product of labour. This substitution effect partly offsets the rise of marginal costs that would occur as a result of the wage hike at a fixed bundle of inputs. Therefore, the *unconditional pass-through* of wage increases to consumer prices will be smaller. The same logic can be applied to differentiate between the conditional and unconditional pass-through of intermediate product/capital prices to output prices. In order to calculate the unconditional pass-through, it's necessary to derive the supply function of the Cobb-Douglas firm. This requires inserting the optimal factor demands, obtained from the first-order conditions, into the Cobb-Douglas production function. After making some mathematical transformations, the following expression is derived:

$$P_{\mathrm{t}} = \frac{1}{A_{\mathrm{t}}}\left(\frac{W_t}{\alpha}\right)^{\alpha}\left(\frac{\mathrm{R_t}}{1-\alpha}\right)^{1-\alpha}$$

Taking the logarithm of both sides of the equation and applying first differences results in an expression for the inflation rate and changes in wages:

$$\pi_{\mathrm{t}} = -\Delta \ln(A_t) + \alpha \Delta \ln(W_t) + (1-\alpha)\Delta \ln(\mathrm{R_t})$$

As the parameter α takes a value between 0 and 1, the macroeconomic elasticity of inflation to changes in wages is practically less than 1. Assuming perfect competition and constant returns of scale, α can be shown to be labour's share of output[22]. This is the rationale behind using the enterprises' cost structure as

[22] In equilibrium wages are equal to the marginal product of labour (MPL). Therefore, total labour income is equal to the product of MPL and the amount of the labour input (L):

$$Total\ labour\ income = MPL * L = (\alpha A L^{\alpha-1} Z^{1-\alpha}) * L = \alpha * Y$$

The share of labour income in total income is therefore α, while that of the other production factors is $1-\alpha$.

a proxy for the size of the pass-through of wages. The equation is also frequently utilized in empirical studies that employ econometric time-series techniques to estimate the pass-through from production costs, drawing on macroeconomic data (see, for example, Bobeica et al., 2020).

The results above can change if we relax the assumption about the market structure under which firms operate. In the case of monopolistic competition, firms possess some degree of market power and have the ability to set prices as a mark-up over costs. Moreover, if the mark-up varies over time, then it can be expected that the pass-through from production costs to prices will also change. Departures from perfect competition in the product market are explored, among others, in Bentolila and Saint-Paul (2003). Nekarda and Ramey (2013) study the cyclicality of mark-ups in New Keynesian models conditional on various types of shocks.

4.2. Data

The dataset from Orbis database includes information for 1 797 042 enterprises in Bulgaria. For the purpose of the study, we limit the dataset to enterprises with more than 1 employee and more than 1 000 EUR of annual turnover. This reduces the number of active firms to 265 110 from agriculture, manufacturing, construction and services sectors. The composition of this dataset is presented in Table 1 and largely mirrors the distribution of firms across economic sectors, as reported by NSI data on the firm population. The Orbis database contains annual data for a rolling window for the past 10 years. The data used in the current study begins from 2012. Due to a substantial delay in data release and entry into Orbis for firms, as of 2022 information is available for 658 firms only, and thus 2022 is not covered in the analysis. For certain years data on employee compensation is missing for some firms in the dataset. During the cleaning process these firms are excluded from the dataset for the respective year. To avoid potential double counting, the dataset is subsequently filtered further to retain only firms with unconsolidated data.[23]

[23] The results are robust to the use of consolidated data only.

Table 1: **Active Enterprises by economic activities**

Economic Sectors	Code	Population of firms, NSI 2020		Orbis dataset 2021	
		Enterprises	% of Total	Enterprises	% of Total
Agriculture, forestry and fishing	A			12,527	4.7%
Mining and quarrying	B	310	0.1%	255	0.1%
Manufacturing	C	29,872	7.5%	25,762	9.7%
Electricity, gas, steam and air conditioning supply	D	1,926	0.5%	1,022	0.4%
Water supply; sewerage, waste management and remediation activities	E	782	0.2%	652	0.2%
Construction	F	21,297	5.3%	16,507	6.2%
Wholesale and retail trade; repair of motor vehicles and motorcycles	G	138,125	34.5%	79,890	30.1%
Transportation and storage	H	22,422	5.6%	18,940	7.1%
Accommodation and food service activities	I	25,352	6.3%	21,419	8.1%
Information and communication	J	15,336	3.8%	8,930	3.4%
Financial and insurance activities excluding activities of holding companies	K [1]	4,386	1.1%	2,437	0.9%
Real estate activities	L	24,315	6.1%	10,090	3.8%
Professional, scientific and technical activities	M	46,649	11.6%	26,807	10.1%
Administrative and support service activities	N	11,604	2.9%	7,370	2.8%
Public administration and defence; compulsory social security	O			1	0.0%
Education	P	4,089	1.0%	3,059	1.2%
Human health and social work activities	Q	14,204	3.5%	10,752	4.1%
Arts, entertainment and recreation	R	5,660	1.4%	4,110	1.6%
Other service activities	S	34,163	8.5%	14,563	5.5%
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	T				0.0%
Not allocated to a specific sector				17	0.0%
TOTAL		**400,492**	**100%**	**265,110**	**100%**

Note: [1] NSI data does not include Class 64.2 (Activities of holding companies).
Source: National Statistical Institute (NSI), Orbis database

4.3. Methodology and Main Results

For the purpose of the study, all enterprises that do not produce final goods and services are taken out. In the dataset, enterprises and their products are assigned a code that corresponds to a specific sector from the Nomenclature of Economic Activities (NACE) (at a 4-digit level). At the same time, NACE activities are related to a specific CPA product[24]. Goods and services in HICP, on the other hand, are classified in accordance with the classification of individual consumption by purpose (COICOP). In order to match data from the two statistical classifications, we use a correspondence table from Eurostat, which establishes a link between the classification of products of firms by activity (CPA) and the classification of individual consumption by purpose (COICOP)[25]. Based on the information from the correspondence table, for 2021 the products of 71 646 firms are assigned to a specific HICP component (at a 4-digit level). For the rest of the enterprises either information for compensation of employees is missing, their balance sheets have been consolidated or a match has not been found, *i.e.* their products are not intended for household consumption or cannot be unequivocally linked to a particular HICP component[26], and these firms are removed from the dataset.

The Orbis database provides information on various cost components of firms, including the cost of materials (intermediate inputs), employee compensation, operating costs, depreciation, and interest expenses. Once firms and their products are assigned to a specific HICP component, employee compensation can be expressed as a percentage of nominal turnover. This enables the construction of a measure of labour cost shares for enterprises[27] producing goods and services classified under the respective HICP components (see Table 2 and Figure 13).

[24] The Statistical classification of products by activity, abbreviated as CPA, is the classification of products (goods as well as services) at the level of the European Union (EU).

[25] For more information please refer to Eurostat's Reference And Management Of Nomenclatures (RAMON) portal and table 'COICOP 1999 - CPA 2008' in particular.

[26] For example, this is the case for firms in the wholesale and retail sector.

[27] This corresponds to the 'labour's share of output' according to the terminology used in Section 4.1.

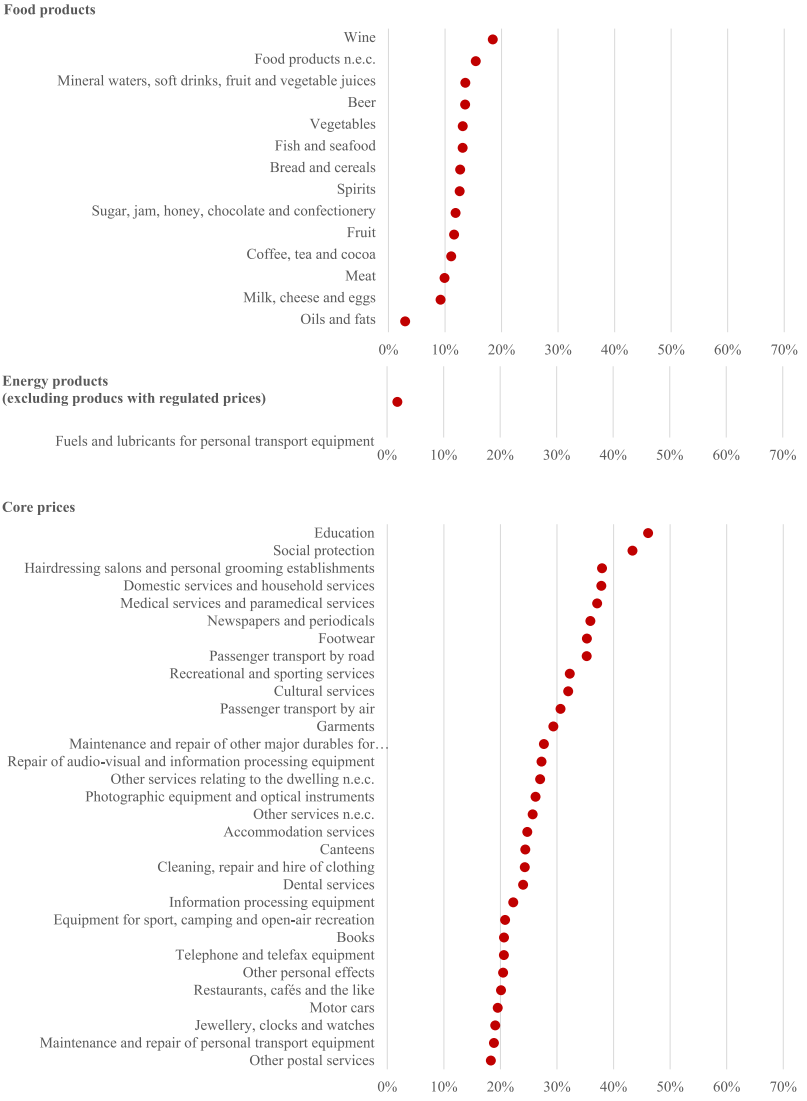
Table 2: **Labour cost shares of firms producing final goods and services (4-digit level of COICOP)**

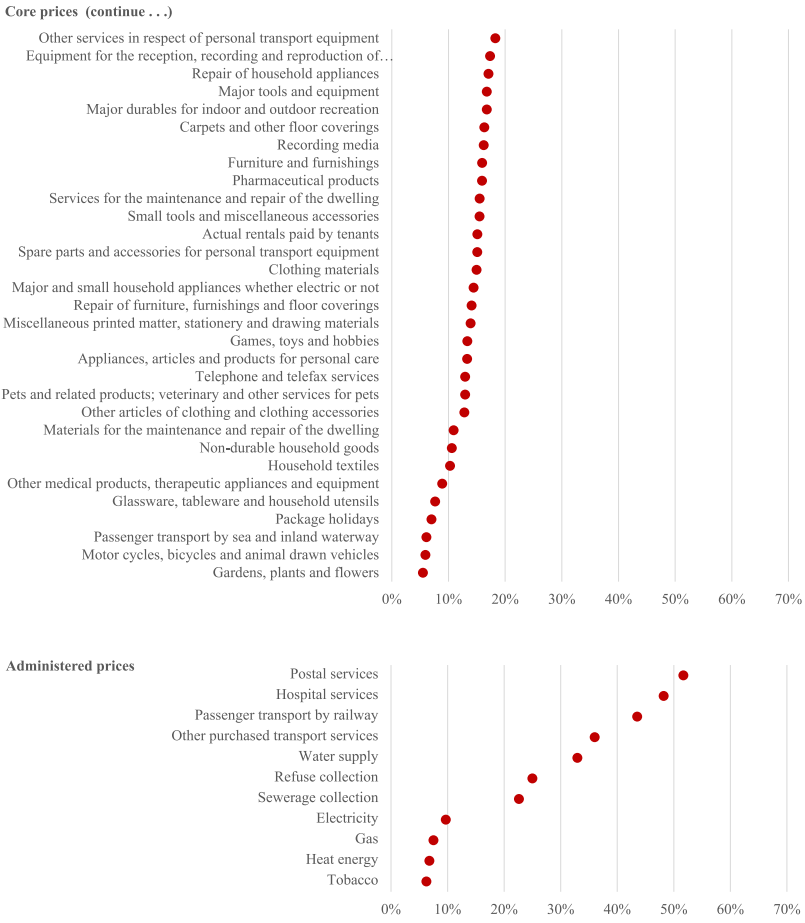
Category	Desription 4 digits	COICOP 4 digits	Active emterprises as of 2021	% of total enterprises	Labour costs share as of 2021	Share in HICP (in 2021)
FOOD	Bread and cereals	01.1.1	1,910	2.7%	12.7%	3.2%
	Meat	01.1.2	392	0.5%	9.9%	4.4%
	Fish and seafood	01.1.3	35	0.0%	13.1%	0.6%
	Milk, cheese and eggs	01.1.4	219	0.3%	9.2%	3.5%
	Oils and fats	01.1.5	46	0.1%	2.9%	0.8%
	Fruit	01.1.6	250	0.4%	11.6%	1.2%
	Vegetables	01.1.7	10	0.0%	13.1%	2.6%
	Sugar, jam, honey, chocolate and confectionery	01.1.8	144	0.2%	11.9%	2.0%
	Food products n.e.c.	01.1.9	398	0.6%	15.4%	3.5%
	Coffee, tea and cocoa	01.2.1	31	0.0%	11.1%	0.9%
	Mineral waters, soft drinks, fruit and vegetable juices	01.2.2	132	0.2%	13.6%	1.5%
	Spirits	02.1.1	44	0.1%	12.6%	1.1%
	Wine	02.1.2	144	0.2%	18.5%	0.4%
	Beer	02.1.3	28	0.0%	13.6%	0.7%
ENERGY	Fuels and lubricants for personal transport equipment	07.2.2	74	0.1%	1.8%	5.0%
CORE	Clothing materials	03.1.1	28	0.0%	15.0%	0.3%
	Garments	03.1.2	2,217	3.1%	29.4%	2.6%
	Other articles of clothing and clothing accessories	03.1.3	189	0.3%	12.8%	0.0%
	Cleaning, repair and hire of clothing	03.1.4	298	0.4%	24.3%	0.0%
	Footwear	03.2	223	0.3%	35.3%	0.9%
	Actual rentals paid by tenants	04.1	3,453	4.8%	15.1%	1.4%
	Materials for the maintenance and repair of the dwelling	04.3.1	1,512	2.1%	10.9%	1.2%
	Services for the maintenance and repair of the dwelling	04.3.2	6,456	9.0%	15.5%	0.6%
	Other services relating to the dwelling n.e.c.	04.4.4	1,210	1.7%	27.0%	0.2%
	Furniture and furnishings	05.1.1	2,005	2.8%	15.9%	1.7%
	Carpets and other floor coverings	05.1.2	269	0.4%	16.3%	0.2%
	Repair of furniture, furnishings and floor coverings	05.1.3	56	0.1%	14.1%	0.0%
	Household textiles	05.2	17	0.0%	10.3%	0.2%
	Major household appliances whether electric or not and small electric household appliances	05.3.1_2	168	0.2%	14.4%	1.1%
	Repair of household appliances	05.3.3	220	0.3%	17.1%	0.1%
	Glassware, tableware and household utensils	05.4	803	1.1%	7.7%	1.2%
	Major tools and equipment	05.5.1	81	0.1%	16.8%	0.2%
	Small tools and miscellaneous accessories	05.5.2	963	1.3%	15.5%	0.8%
	Non-durable household goods	05.6.1	401	0.6%	10.6%	1.1%
	Domestic services and household services	05.6.2	799	1.1%	37.8%	0.1%
	Pharmaceutical products	06.1.1	36	0.1%	15.9%	6.0%
	Other medical products, therapeutic appliances and equipment	06.1.2_3	412	0.6%	8.9%	0.3%
	Medical services and paramedical services	06.2.1_3	3,926	5.5%	37.1%	0.7%
	Dental services	06.2.2	2,027	2.8%	24.0%	0.2%
	Motor cars	07.1.1	17	0.0%	19.5%	1.6%
	Motor cycles, bicycles and animal drawn vehicles	07.1.2_34	28	0.0%	5.9%	0.0%
	Spare parts and accessories for personal transport equipment	07.2.1	364	0.5%	15.1%	2.4%
	Maintenance and repair of personal transport equipment	07.2.3	3,989	5.6%	18.9%	0.5%
	Other services in respect of personal transport equipment	07.2.4	1,604	2.2%	18.3%	0.4%

Category	Desription 4 digits	COICOP 4 digits	Active emterprises as of 2021	% of total enterprises	Labour costs share as of 2021	Share in HICP (in 2021)
	Passenger transport by road	07.3.2	1,445	2.0%	35.3%	1.8%
	Passenger transport by air	07.3.3	65	0.1%	30.6%	0.5%
	Passenger transport by sea and inland waterway	07.3.4	25	0.0%	6.1%	0.0%
	Other postal services	08.1.9	747	1.0%	18.3%	0.7%
	Telephone and telefax equipment	08.2.0	117	0.2%	20.6%	0.5%
	Telephone and telefax services	08.3.0	334	0.5%	12.9%	4.8%
	Equipment for the reception, recording and reproduction of sound and picture	09.1.1	51	0.1%	17.4%	0.5%
	Photographic and cinematographic equipment and optical instruments	09.1.2	22	0.0%	26.2%	0.1%
	Information processing equipment	09.1.3	178	0.2%	22.3%	1.4%
	Recording media	09.1.4	322	0.5%	16.2%	0.0%
	Repair of audio-visual, photographic and information processing equipment	09.1.5	872	1.2%	27.3%	0.0%
	Major durables for indoor and outdoor recreation including musical instruments	09.2.1_2	178	0.2%	16.8%	0.1%
	Maintenance and repair of other major durables for recreation and culture	09.2.3	201	0.3%	27.7%	0.0%
	Games, toys and hobbies	09.3.1	31	0.0%	13.3%	0.4%
	Equipment for sport, camping and open-air recreation	09.3.2	97	0.1%	20.8%	0.1%
CORE	Gardens, plants and flowers	09.3.3	41	0.1%	5.5%	0.2%
	Pets and related products; veterinary and other services for pets	09.3.4_5	324	0.5%	12.9%	0.6%
	Recreational and sporting services	09.4.1	1,444	2.0%	32.3%	0.3%
	Cultural services	09.4.2	1,087	1.5%	32.0%	0.8%
	Books	09.5.1	133	0.2%	20.6%	0.4%
	Newspapers and periodicals	09.5.2	125	0.2%	35.9%	0.2%
	Miscellaneous printed matter, stationery and drawing materials	09.5.3_4	399	0.6%	13.9%	0.2%
	Package holidays	09.6	580	0.8%	7.0%	0.5%
	Education	10	1,124	1.6%	46.1%	1.7%
	Restaurants, cafés and the like	11.1.1	9,635	13.5%	20.1%	4.3%
	Canteens	11.1.2	409	0.6%	24.4%	0.2%
	Accommodation services	11.2	2,631	3.7%	24.8%	1.3%
	Hairdressing salons and personal grooming establishments	12.1.1	4,453	6.2%	38.0%	0.3%
	Appliances, articles and products for personal care	12.1.2_3	278	0.4%	13.3%	1.6%
	Jewellery, clocks and watches	12.3.1	131	0.2%	19.1%	0.2%
	Other personal effects	12.3.2	535	0.7%	20.5%	0.6%
	Social protection	12.4	200	0.3%	43.3%	0.1%
	Other services n.e.c.	12.7	4,167	5.8%	25.7%	1.8%
	Tobacco	02.2	9	0.0%	6.3%	4.9%
	Water supply	04.4.1	55	0.1%	33.0%	0.8%
	Refuse collection	04.4.2	187	0.3%	25.0%	0.7%
	Sewerage collection	04.4.3	34	0.0%	22.6%	0.2%
	Electricity	04.5.1	597	0.8%	9.7%	4.7%
ADMINISTERED	Gas	04.5.2	36	0.1%	7.5%	0.3%
	Heat energy	04.5.5	21	0.0%	6.8%	0.6%
	Hospital services	06.3	311	0.4%	48.2%	1.0%
	Passenger transport by railway	07.3.1	1	0.0%	43.5%	0.5%
	Other purchased transport services	07.3.6	95	0.1%	36.0%	0.0%
	Postal services	08.1.1	1	0.0%	51.7%	0.1%
	TOTAL		71,356	100.0%		100.0%

Source: Orbis database, NSI, own calculations

Figure 13: **Distribution of labour cost shares of enterprises across various HICP components in 2021**





Source: Orbis database, own calculations

The distribution of labour cost shares in 2021 is quite spread out, ranging from 1.8% for firms producing transport fuels to 51.7% for firms in the education sector. The largest differences are observed for the enterprises whose products fall under the category of 'core' prices in the HICP (labour cost shares ranging from 5.5% to 46.1%) and 'administered' prices (ranging from 6.3% to 51.7%), reflecting varying degrees of labour intensity across economic activities within these categories. For the food products, labour cost shares are in the range of 2.9% – 18.5%.

The labour cost share (wage content) of various goods and services (at the 4-digit HICP level) can be weighted with their share in the consumer basket to derive a single measure of the labour cost share for domestically produced consumer goods and services. According to the results presented in Table 3, the wage content of the HICP was 16.2% as of 2021. As expected, the highest wage content is observed in the core components, accounting for approximately 20% of total costs. The labour cost share for products subject to administered prices was 15.1% in 2021, whereas for food and energy products, it stood at 11.9% and 1.8%, respectively. Taking a longer-term perspective from 2012 to 2021, there is a gradual increase in labour costs for firms (expressed as a share of nominal turnover), except for those with regulated prices. In 2012, the wage content at the HICP level was estimated at around 14.1%, rising to 16.2% in 2021. In the case of core and food components, the rise in wage content over time is more pronounced compared to the other HICP categories, indicating a gradual increase in their responsiveness to wage hikes.

Table 3: **Wage content of HICP and main components**

Wage content	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
HICP	**14.1%**	**14.2%**	**14.4%**	**14.9%**	**15.7%**	**15.7%**	**16.0%**	**16.6%**	**17.8%**	**16.2%**
Food	9.3%	8.8%	9.2%	9.3%	9.6%	9.7%	10.2%	11.0%	11.5%	11.9%
Energy (excl. products with administered prices)	0.9%	1.0%	1.2%	1.5%	1.5%	1.2%	1.1%	1.1%	1.8%	1.8%
Core prices	17.3%	17.6%	17.9%	18.3%	18.7%	19.1%	19.9%	20.5%	22.1%	20.0%
Administered prices	19.1%	19.6%	19.9%	19.3%	19.5%	19.0%	18.2%	17.9%	19.0%	15.1%

Source: Orbis database, own calculations

According to the above analysis, if higher wages are fully passed through to consumer prices–at least in the long term–then the elasticity of prices to wages can be expected to be around 0.16. However, this estimate should be interpreted with caution due to certain data-related limitations. First, the calculated elasticity reflects only the direct labour cost shares of producers of consumer goods, potentially underestimating the true impact of wage increases on prices, as it does not account for the labour cost shares of retail and wholesale firms or wages embedded in intermediate inputs. Second, the analysis does not incorporate effects from international trade. Since some consumed products are imported, and domestically paid wages likely influence their price only through transportation and trade costs, foreign trade is expected to dampen the impact of domestic wages on HICP.

Intermediate products that are used for the production of final goods and services contain certain wage expenses. According to the Orbis dataset employed in the current analysis, the share of intermediate products of domestic producers of consumer goods and services accounts for 38.8% of their nominal

turnover. This is depicted in Figure 14. To calculate the direct and indirect wage expenses that are contained in intermediate inputs, information regarding *the cost structure of intermediate goods producers* is necessary. This entails utilizing data from Orbis supplemented by information from input-output tables. According to the adopted definition, the group of intermediate goods producers includes all firms from the Orbis dataset that are in agriculture[28] and whose products are not intended for household consumption. For firms in industry,[29] as intermediate goods producers are considered all firms that do not produce consumer goods and at the same time comply with Eurostat's definition of intermediate producers[30]. On average, direct labour cost shares of intermediate goods producers amount to 9% of their nominal turnover, while inputs (material costs) account for 39.4% of sales (see Figure 14). If we assume that in the economy there is an infinite number producers of intermediate inputs that are vertically integrated, then the direct and indirect labour cost share of intermediate producers at all stages of production can be calculated as an infinite geometric series. In other words, the total share of labour costs of intermediate producers amounts to $\frac{0.09}{1-0.394} = 0.145$. The Orbis dataset does not account for the fact that some of the inputs used by Bulgarian firms are not produced domestically but are imported, meaning domestic wages do not impact their value. However, input-output tables for Bulgaria reveal that around 35.5% of the inputs used by intermediate producers are imported. This leads to a reduction in the estimated total share of labour costs of intermediate producers to: $\frac{0.09}{1-0.394*(1-0.355)} = 0.118$.

Now that we have an estimate about the total wage expenses of intermediate producers, we can insert it in the cost structure of consumer goods producers. Total labour costs of the latter are now equal to[31]:

$$\text{Total labour cost share} = \underbrace{0.162}_{\substack{direct \\ labour\ costs}} + \underbrace{0.388}_{\substack{share\ of \\ inputs}} * \underbrace{0.118}_{\substack{wage\ expenses \\ embodied\ in\ inputs}} = 0.208$$

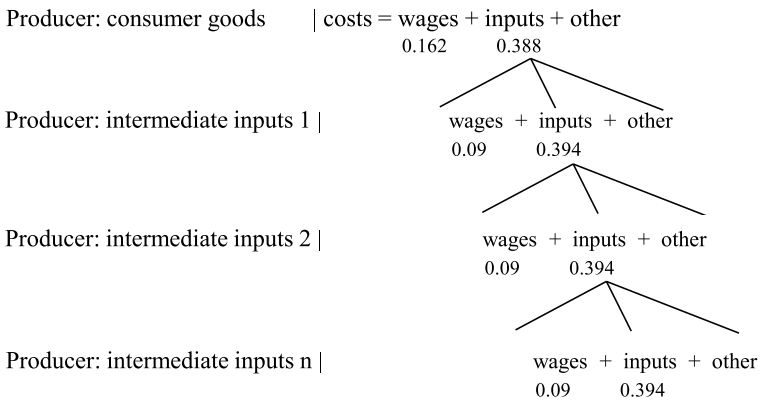
[28] According to NACE 2008 this is sector A.

[29] According to NACE 2008 these are sectors B, C and D.

[30] According to the Statistical Classification of Economic Activities (NACE 2008), as intermediate producers are classified firms in sectors with the following codes (NACE 2008): B07, B08, B09, C106, C109, C131 to C133, C16, C17, C201 to C203, C205, C206, C22, C23, C24, C255 to C257, C259, C261, C268, C271 to C274, C279.

[31] Here it is implicitly assumed that producers of consumer goods buy all their inputs from intermediate producers, which in turn are vertically integrated.

Figure 14: **Cost structure of domestic producers of consumer goods and intermediate products (in % of nominal turnover)**



Note: Costs are presented as a share of nominal turnover.
Source: Orbis database, own calculations

The adopted methodology for estimating the wage costs of intermediate producers draws upon the framework suggested by Deutsche Bundesbank (2019).

To summarise, direct labour cost shares were initially estimated for firms producing consumer goods and services at the HICP level (and HICP special aggregates). As a next step, domestic wage costs embedded in intermediate inputs used by consumer goods producers were added, along with those incurred by all downstream firms in the production chain (*i.e.*, intermediate input producers). The final step of the analysis involves accounting for wage expenses upstream the supply chain, predominantly associated with trade activities. The cost structure of firms in trade is relevant for the overall impact of wages on HICP because the index measures final consumer prices in retail trade. According to firm-level data from Orbis, the share of wage expenditures in nominal turnover for firms in the trade sector[32] is around 5%, which needs to be added to the labour cost shares of producers (see Table 4). Different labour cost components of domestically produced goods and services are depicted in Figure 15. If higher wages are fully passed through to consumer prices along the supply chain, then the elasticity of prices (of domestically produced products) with respect to wages can be expected to be around 0.257. It should be noted, however, that not all products that are included in the HICP are domestically produced. Input-output tables reveal that around 22.8% of household purchases are direct imports from

[32] According to NACE 2008 this is sector G.

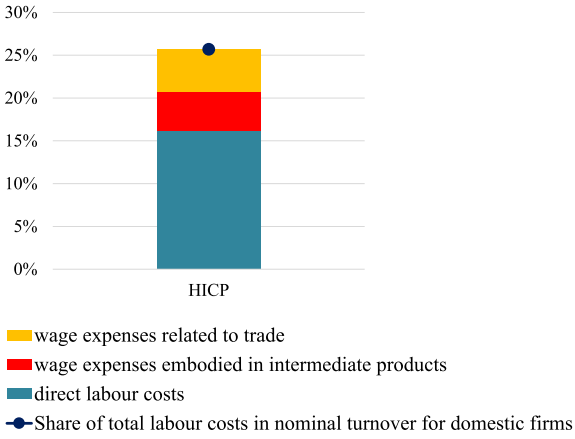
abroad[33] and domestically paid wages are likely to matter for their price only through trade-related activities. Accounting for this, the estimated elasticity of HICP to changes in wages decreases to 0.210 for 2021[34].

Table 4: **Labour cost shares of firms in trade**

Share of wage expenditure in nominal turnover for firms in trade	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Trade	**3.9%**	**4.1%**	**4.2%**	**4.4%**	**4.7%**	**4.8%**	**5.0%**	**5.1%**	**5.3%**	**4.9%**
Trade and repair of motor vehicles	6.0%	5.7%	5.7%	5.8%	6.4%	6.3%	6.0%	6.1%	6.5%	6.3%
Wholesale trade (except of motor vehicles)	2.9%	3.1%	3.2%	3.3%	3.6%	3.7%	3.8%	3.9%	4.1%	3.8%
Retail trade (except of motor vehicles)	6.1%	6.4%	6.5%	6.9%	7.4%	7.4%	7.7%	7.8%	7.8%	7.6%

Source: Orbis database, NSI, own calculations

Figure 15: **Breakdown of total labour cost share of domestic producers of consumer goods at all downstream and upstream stages of production (HICP level) for 2021**



Note: Costs are presented as a share of nominal turnover.
Source: Orbis database, own calculations

Micro data suggests that from the cost-push view of inflation wages have a non-negligible impact on domestic price developments. If an exogenous shock leads to a broad-based increase in wages by 1% and firms transfer it fully to

[33] According to estimates based on input-output tables, the total import content of household consumption in Bulgaria is 40%. A total of 23% of household consumption reflects direct purchases of goods from abroad, while 17% represents the imported materials used for the production of goods and services consumed domestically. Since wage expenses embedded in intermediate inputs have already been accounted for, only direct imports need to be considered here.

[34] For 2020, the estimated elasticity is 23.1%. The increase can be attributed to the impact of the COVID-19 pandemic, causing a decline in firms' turnover that was not matched by an equivalent decrease in labour costs. Consequently, this led to a rise in the share of labour costs in total expenses.

consumer prices, then the HICP is likely to increase by 0.21%. It is important to note that this type of micro analysis has a limitation – it doesn't offer insights into the timeline required for price pressures to accumulate. The pace at which firms adjust prices in response to a wage increase likely varies over time and is influenced by the prevailing macroeconomic conditions in the economy. This adjustment speed can be explored through econometric techniques, which is one of the purposes of the following section.

While micro-level data is optimal for analyzing firms' cost structure, the approach outlined above is based on certain assumptions regarding the relationship between producers at different production stages and retail trade firms. Therefore, it is important to validate the empirical relevance of these assumptions using other sources of information. Input-output tables offer an alternative source of information regarding the impact of wages on prices. The main advantages of input-output tables are that they inherently account for international trade, sectoral interlinkages and the structure of consumption expenditures. Their main disadvantages are related to the publishing lag of data and to data aggregation, which could lead to a bias in the calculation of the wage pass-through. Similarly to the micro approach, input-output analysis offers insights into prices before and after a simulated wage increase, but it does not provide information about the time it takes for the shock to propagate through the economy.

Calculations based on input-output tables for Bulgaria (with a breakdown of 45 sectors) reveal that the elasticity of prices to wages is 0.24, which is close to the measure obtained on the basis of micro data.[35] This implies that a 1% increase in wages in all economic sectors could end up in 0.24% higher consumer prices. In addition, input-output tables serve as a useful tool for simulating a wage shock originating from specific sectors of the economy. For instance, simulations with input-output tables demonstrate that a 1% increase in public wages alone results in a mere 0.03% rise in the consumer price level. The lower impact stems from the fact that while public wages constitute a significant portion of the total wage bill in the economy, they represent a negligible share of firms' production costs, thus exerting limited influence on price dynamics from a cost-push perspective[36]. The input-output data can be used further to evaluate the price elasticity concerning increases in the minimum wage in Bulgaria. According to these calculations, a 1% increase in the minimum wage corresponds to a 0.05% rise in the HICP. The 19.6% increase in the minimum wage in 2024 is associated with a rise of around 1% in consumer prices, according to the applied methodology.

[35] For more details about the input-output analysis please refer to "Appendix 2 Wage shocks and their impact on prices according to input-output tables".

[36] It is worth noting that rises in public wages can also drive prices upwards through the demand-pull channel. Additionally, if higher wages are funded by a larger budget deficit, it could alter agents' perceptions of fiscal sustainability, thereby influencing their inflation expectations. Consequently, shifts in inflation perceptions are likely to prompt increased consumption by households and reduced saving, especially in a high inflation environment.

5. The elasticity of prices to wages through the lens of a Phillips curve model

Considering the significant acceleration of inflation during 2021–2022, questions have arisen about the role of labour costs in driving price increases. Understanding this role requires analyzing both the size of the labour cost pass-through and how it evolves over time. To address these questions, this section investigates potential changes in the relationship between ULC and inflation at the macroeconomic level. The analysis utilizes the estimation of a reduced-form Phillips curve model for Bulgaria, defined as the relationship between inflation (and its lag) and unit labour costs.

The approach in this section for analyzing labour cost pass-through differs from the statistical method outlined in Section 4 in three key ways. First, the Phillips curve model specification incorporates time-varying coefficients and error variance, allowing the pass-through to fluctuate over time in response to changing economic conditions. This flexibility enables the model to capture the evolving relationship between labour costs and inflation. Second, the model uses macroeconomic data spanning a longer period, from the third quarter of 2001 to the second quarter of 2023. Third, the econometric technique employed accounts for the simultaneous impact of both wage-related and non-wage related shocks on prices (such as those arising from commodity prices, demand, inflation expectations and labour supply).

While model results indicate that the estimated labour cost pass-through is, on average, similar to that obtained from firm-level data and input-output analysis, there is evidence that the wage-price link is state- and possibly shock-dependent. Specifically, the results indicate some flattening of the Phillips curve relationship from the period following the Global financial crisis until mid-2013. Since then, the Phillips curve has steepened, with this trend becoming more pronounced after the COVID-19 pandemic.

5.1. Theory of the New Keynesian Phillips Curve

In the neoclassical production theory, the pass-through of production costs depends on the cost structure of firms only. This is consistent with the cost-push view of inflation whereby wage increases put immediate upward pressure on prices, irrespective of the type of shocks that are hitting the economy (demand, technology or monetary policy shocks) and the presence of adjustment costs. Micro-founded New Keynesian models account for the presence of various shocks in the economy and this is why they have become the workhorse for the analysis of monetary policy, business cycle and price fluctuations in recent years (Gali and Gertler, 1999; Gali, Gertler and Lopez-Salido, 2001; Gali, 2015).

According to the New Keynesian framework, there is monopolistic competition in the goods market and thus each firm produces a differentiated good for which it sets the price (instead of taking the price as exogenous), given a demand constraint[37]. Moreover, these models often incorporate a form of price stickiness, meaning that only a fraction of firms can adjust their prices in any given period. Consequently, when setting prices, firms consider not only current marginal costs but also expected marginal costs, leading to a gradual adjustment of the aggregate price level toward equilibrium. Regarding the labour market, the New Keynesian literature frequently departs from the assumption of perfect competition and incorporates the notion that households provide distinct labour inputs, granting them some influence in determining their own wages[38]. Furthermore, in New Keynesian models, workers are often modelled to face constraints on the frequency with which they can adjust nominal wages.

In the case of a small and open economy, consumer prices in period t can be expressed as a weighted average of prices of domestically produced goods and foreign (imported) goods ($P_{\mathrm{F,t}}$)[39]

$$P_{\mathrm{t}} = (P_{\mathrm{H,t}})^{1-\vartheta} (P_{\mathrm{F,t}})^{\vartheta}$$

where ϑ denotes the share of foreign goods in the consumer basket.

It can be shown that consumer inflation, defined as the rate of change in the consumer price index, that is, $\pi_{\mathrm{t}} = P_{\mathrm{t}} - P_{\mathrm{t-1}}$, is linked to the inflation of domestic and foreign goods according to the relation:

$$\pi_{\mathrm{t}} = \pi_{\mathrm{H,t}} + \vartheta \Delta s_t$$

where Δs_t is the percentage change in the terms of trade[40] adjusted for the openness index ϑ. A key equation in New Keynesian models is the price Phillips curve for domestic inflation, which has the following general form:

$$\pi_{\mathrm{H,t}} = \beta \mathrm{E}_t\{\pi_{H,t+1}\} - \lambda\widehat{\mu_t}$$

where $\lambda\widehat{\mu_t}$ is the markup gap. Next, Gali (2015) derives a relationship between the average price markup for the economy and domestic output, which takes the following form:

[37] Please refer to chapter 3 and chapter 6 in Gali (2015).

[38] In particular, workers are assumed to have some monopoly power, which allows them to set the wage for the differentiated labour services they supply.

[39] Please refer to chapter 8 in Gali (2015).

[40] Formally, $s_t = p_{\mathrm{F,t}} - p_{\mathrm{H,t}}$ and lower case letters denote logarithms, that is $p_{\mathrm{F,t}} = \log(P_{\mathrm{F,t}})$ and $p_{\mathrm{H,t}} = \log(P_{\mathrm{H,t}})$.

$$\mu_t = -\left(\sigma + \frac{\varphi + \alpha}{1 - \alpha}\right) y_t + \vartheta(\omega - 1) s_t + \left(1 + \frac{\varphi + \alpha}{1 - \alpha}\right) a_t - \vartheta z_t$$

where $\sigma, \varphi, \alpha, \vartheta, \omega$ are the so-called deep parameters that describe structural features of the economy and the behaviour of households and firms. According to the equation for μ_t the average markup is a function of domestic output (y_t), technology (a_t), the terms of trade (s_t) and a preference shifter z_t. The inclusion of technology and terms of trade in the equation arises from the impact of both variables on the real wage, which occurs through an income effect on labour supply. It can also be shown that mathematically the deviation of the average markup from the steady state, $\widehat{\mu_t}$, is proportional to the output gap, and the Phillips curve for domestically produced goods can be written in the following form:

$$\pi_{\mathrm{H,t}} = \beta \mathrm{E}_t\left\{\pi_{H,t+1}\right\} + k_v \widehat{y_t}$$

where $\widehat{y_t}$ represents the output gap, and k_v is the slope of the Phillips curve, which depends on the degree of openness, ϑ.

If in the New Keynesian model both wage decisions and price decisions are staggered "á la Calvo", Blanchard and Gali (2007) show that the relation between price inflation and the output gap is modified as follows:

$$\pi_{\mathrm{t}} = \beta \mathrm{E}_t\{\pi_{t+1}\} + \gamma_1 \widehat{y_t} + \gamma_2 \widehat{\omega_t}$$

In that case, inflation depends on the output gap ($\widehat{y_t}$) and the distance of the real wage from its natural level (real wage gap, $\widehat{\omega_t}$). In this setup the parameter γ_2 measures the pass-through of real wages to inflation conditional on the economic situation.

In empirical research, economists often use a hybrid Phillips curve model, which extends the Calvo framework by incorporating two types of firms. A fraction, $1 - \rho$, of firms are considered "forward-looking" and behave similarly to the firms in Calvo's model. These firms set prices optimally, considering the timing constraints of adjustments and using all available information to forecast future marginal costs. The remaining firms, of measure ρ, are termed "backward-looking" and follow a simple rule of thumb based on the recent history of aggregate price behaviour. This distinction explains the inclusion of past inflation in the Phillips curve equation (Gali and Gertler, 1999).

Given the relationship between the business cycle and the unemployment rate, empirical research often expresses the reduced-form Phillips curve model in terms of the unemployment rate gap instead of the output gap (see also Blanchard and Galí (2007) for some theoretical derivations). Additionally, the unobservable real wage gap can be proxied by real unit labour costs, an approach adopted by Bjørnstad and Nymoen (2008) when testing the Phillips curve model using panel data for OECD countries. In this paper, the nominal ULC measure is used, with the rationale for this choice discussed in the model specification section.

5.2. Model Specification and Data

The benchmark reduced-form model that is employed in this paper is as follows:

$$\pi_t = \gamma_t + \rho_t \pi_{t-1} + \theta_t \pi_t^e + \beta_{1t} \Delta ulc_t + \beta_{2t} \pi_t^{imp} + \beta_{3t} x_t + e^{\frac{h_t}{2}} \varepsilon_t$$

$$\begin{aligned}
\gamma_t &= \gamma_{t-1} + \sigma_\gamma \nu_t^\gamma \\
\rho_t &= \rho_{t-1} + \sigma_\rho \nu_t^\rho \\
\theta_t &= \theta_{t-1} + \sigma_\theta \nu_t^\theta \\
\beta_{it} &= \beta_{it-1} + \sigma_{\beta_i} \nu_t^{\beta_i} \text{ (for i=1, 2, 3)} \\
h_t &= h_{t-1} + \sigma_h \eta_t
\end{aligned}$$

where π_t represents inflation (quarterly percent change in consumer prices) at time t, γ_t is a time-varying intercept parameter, π_t^e denotes expected inflation at time t, Δulc_t is the quarterly change in nominal unit labour costs at time t, π_t^{imp} is import price inflation, x_t is a measure of slack and ε_t is a shock term with a time-varying volatility function $e^{\frac{h_t}{2}}$.

To estimate the model, macroeconomic data from the third quarter of 2001 to the second quarter of 2023 is used. Specifically, consumer prices are measured by the HICP, while inflation expectations are based on data from business surveys[41]. Unit labour costs are calculated as the ratio of compensation per employee to productivity, with data sourced from national accounts statistics. Import prices are measured by the import deflator of goods from national

[41] Data is from the Business survey published by the National Statistical Institute and pertains to firms' selling price expectations over the next three months.

accounts. In the benchmark specification for x_t, the unemployment rate[42] from the Labour force survey of the NSI is chosen, although the results remain robust to other traditional measures of slack, such as the output gap, unemployment rate gap, GDP growth, and private consumption. The model is estimated using seasonally adjusted series, with the unemployment rate expressed in levels and inflation expectations in first differences. The quarterly growth rates of the remaining series are calculated using log differences.

The model captures demand conditions by the unemployment rate and supply shocks by changes in unit labour costs and import prices. The specification that is employed stands out with respect to standard single-equation Phillips curve models in two directions. First, it allows the coefficients on explanatory variables to be time-dependent, which implies that the structural relationships between inflation and its drivers might change over time. Second, the variance of the unobserved shocks is also allowed to change over time[43]. The main reason for that is to avoid any possible change in this variance to be absorbed by the process for the time varying coefficients, thus overestimating the variation in the slope of the Phillips curve (β_{1t}) or the autoregressive coefficient (ρ_t).

The model parameters are allowed to vary over time for several reasons. An alteration in inflation expectations or a change in wage and price mark-ups could shift the Phillips curve up or down in the inflation/ULC space, affecting the intercept in the curve. Descriptive evidence suggests that inflation expectations react relatively strongly to news about future changes of regulated prices of energy products or in case of significant commodity price changes. In addition to that, WDN survey data[44] reveals that the price- and cost-setting behaviour of firms depends on the type, duration and magnitude of shocks faced by firms. This implies that the estimated pass-through of wages to prices is closely related to the prevailing economic conditions in the country and to the dynamics of international commodity prices. Institutional factors, such as changes in the minimum wage and social security thresholds, are also important as they influence the degree to which firms change wages and other cost components in response to changes in the macroeconomic environment. The macroeconomic responsiveness of HICP inflation to labour costs (β_{1t}) also

[42] The unemployment rate for people aged 15 and over is used. The unemployment rate is preferred because in the post-Global financial crisis period Bulgaria experienced the so-called 'jobless' growth. Although GDP posted growth rates from 2010 to 2012, employment tended to decrease which was associated with increased uncertainty and subdued private consumption.

[43] The set-up of the time variation feature of the model is relatively standard. In this framework the coefficients and the log-volatility are assumed to follow a unit root process that captures structural breaks in the model, given by the unobserved shocks: ν_t^{γ}, ν_t^{ρ}, ν_t^{θ}, $\nu_t^{\beta_i}$ and η_t.

[44] Please refer to Section 2.

depends on the composition of ULC growth. As explained in Section 3, higher wages in the public or construction sectors could lead to an acceleration of the ULC growth rate, but without this resulting in stronger pressures on consumer prices, at least not directly. As a result of that, the estimated slope of the Phillips curve (β_{1t}) may vary over time.

Before proceeding with the estimation of the reduced-form Phillips curve, some clarification of the relationship between inflation and production costs is needed. There has been an extensive discussion in the literature about the proper proxy for (real) marginal costs[45]. While neoclassical production theory suggests a relationship between prices and nominal ULC, the New Keynesian literature proposes that real ULC[46] is the correct driver of inflation; it also emphasises that inflation is forward-looking, with lagged inflation playing a secondary role[47]. Studies that use reduced-form equations often find, however, a statistically insignificant relationship between inflation and real marginal costs[48]. The experience with data for Bulgaria also points to an unstable relationship, favouring the use of nominal ULC in the Phillips curve. It should be stressed that, in addition to being widely used in applied work (see Eickmeier and Moll (2009)), there are theoretical models that define a role for nominal ULC. The imperfect competition model, for example, assumes that the price of domestically produced costs is set as a mark-up over nominal ULC and the mark-up depends on the relative price of domestic goods in terms of foreign goods (see Bjørnstad and Nymoen (2008) and Lagoa, S (2017)).

5.3. Model Estimation and Main Results

Bayesian methods are employed for estimating the model. The Gibbs sampler procedure is employed in the spirit of Primiceri (2005). Within this framework, prior distributions are set for the (constant) parameters of the model, which include the variances of the transition equations (σ_γ, σ_ρ, σ_θ, σ_{β_i} and σ_h). Inverse-

[45] See for example Gali and Gertler (1999), and Gali, Gertler, and Lopez-Salido (2001).

[46] The indicator for real unit labour costs, defined as $\frac{W_t N_t}{P_t Y_t}$, is equivalent to the labour income share.

[47] Eexpected inflation affect current inflation because economic agents are forward-looking while prices are rigid in the short-term, which causes agents to take into account expected future prices in current pricing decisions. Given that a proportion of agents have backward-looking expectations, in empirical works lagged inflation is often included as an explanatory variable in the Phillips curve.

[48] See for example Bjørnstad and Nymoen (2008) (the authors test the New Keynesian Phillips Curve on a panel of OECD countries and find that real ULC has a negative sign and is not statistically significant) and Bårdsen, Jansen and Nymoen (2004) (the authors find that the significance of real ULC in Galí, Gertler and López-Salido (2001) for the euro area is not robust to small changes in the estimation methodology).

Gamma prior distributions are used for these parameters with the following parameterisation,

$$\sigma_\gamma^2, \sigma_\rho^2, \sigma_\theta^2, \sigma_{\beta_i}^2 \sim IG(6, 0.0005)$$

$$\sigma_h^2 \sim IG(6, 1.5)$$

Relatively conservative priors are chosen, which means that a priori the coefficients are assumed to barely move over time, while the log-volatility process is expected to capture most of the variation. In other words, time variation in the structural coefficients will be observed only if the data contains strong evidence for such a pattern. Additionally, data from the firm-level analysis, especially the estimated volatility of the labour-cost pass-through, was considered when determining the prior parameters. For the initial conditions of the transition equations, $\gamma_0, \rho_0, \theta_0, \beta_{i0}$ and h_0, the ordinary least square estimates are used. These parameters are needed to initialize the smoothing algorithm that is used to extract the latent states of the model.[49] Based on the experience with the model, the choice of starting values has little impact on the final results if the number of Gibbs iterations is large enough. In this study 100 000 Gibbs iterations are used[50].

Figure 16 depicts the estimates of the slope coefficient on the economy-wide ULC over the period from the first quarter of 2002 to the second quarter 2023. Shaded areas mark the 68% and 40% credibility intervals and the central estimate is the median. The estimates clearly indicate a gradual decrease of the slope coefficient since the beginning of 2008, pointing to a flattening of the relationship between inflation and ULC growth rate. In the subperiod from 2002 to 2008, a 1% increase in ULC resulted in an approximate 0.11% rise in consumer prices in the same quarter (0.12% in the end of 2007). In the aftermath of the Global financial crisis (covering the period from 2009 to mid-2013), the short-term (contemporaneous) impact on HICP was estimated to be around 0.09%-0.10%. After mid-2013, there is a discernible trend indicating a gradual strengthening of the link between unit labour costs and prices. This trend intensified notably after 2020. These results suggest that in an environment marked by significant negative supply shocks, heightened uncertainty and elevated inflation expectations, price adjustments have become more simultaneous and frequent as the cost of keeping prices constant increased. According to the empirical estimates for Bulgaria, from 2022 onwards a one-off 1% rise in ULC in a

[49] See Carter and Kohn (1994) "On Gibbs Sampling for State Space Models", Biometrika, 81.

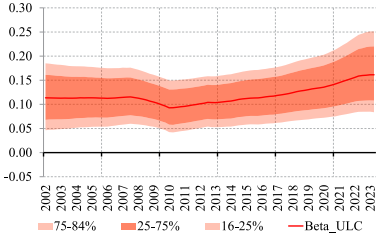
[50] All estimations were performed using Matlab 2018b.

particular quarter corresponded to a 0.16% increase in consumer prices during the same quarter (in contrast to the 0.13% estimated for 2019 and 0.11% for 2014). The reinforcement of the relationship between labour costs and HICP is evident not only in the preferred (benchmark) Phillips curve model but across all alternative specifications that have been employed (see Figure 18).

The rise in the slope of the Phillips curve in recent years has also been accompanied by an increase in the persistence of inflation, as indicated by the coefficient ρ_t in the Phillips curve model (see Figure 17). While higher inflation persistence during periods of elevated inflation is well documented in the economic literature (see Borio et. al. (2023)), a recent IMF study highlights a higher persistence in Bulgaria compared to other EU countries, suggesting the presence of country-specific factors (see Nguyen et. al. (2023)). Several elements may contribute to this trend. First, greater energy intensity of the Bulgarian economy and higher weight of energy and food products in Bulgaria's HICP set the stage for more pronounced and enduring second-round effects stemming from the surge in international commodity prices during the second half of 2021 and throughout 2022. Second, evidence suggests that inflation expectations in Bulgaria have become more backward-looking in a high-inflation environment, accompanied by a rise in the prevalence of inflation indexation practices[51]. Third, in a tight labour market with backward-looking wage setting, wage dynamics has become more sensitive to inflation, amplifying the feedback loop between the two. Fourth, amid strong household spending, firms appear more inclined to pass on rising input costs to consumer prices than to absorb them through profit reductions, as indicated by the decomposition of the final demand deflator presented in Section 3. Furthermore, Bulgaria's macroeconomic policy mix has likely amplified the impact of the above factors on inflation persistence recently. Despite the currency board regime, ECB's monetary tightening that started in the second half of 2022 proved insufficient in reining in credit growth in Bulgaria due to the weak transmission of ECB's policy rates to domestic monetary conditions, stemming from ample liquidity and strong competition in the banking sector. Simultaneously, fiscal policy has stayed relatively loose in the post-pandemic period, supporting the income of low-income households with high propensity to consume, resulting in resilient private consumption growth.

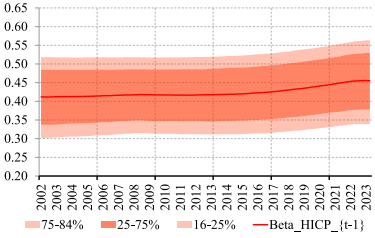
[51] For instance, during the period 2022–2023, the three major telecommunication companies in Bulgaria unilaterally introduced inflation indexation clauses to their general contracts. These clauses permit the annual adjustment of telecommunication service prices at the start of each year based on the inflation rate from the previous year, with adjustments being possible only in an upward direction.

Figure 16: **Estimates of the Phillips curve coefficient on ULC, β_1 (benchmark specification)**



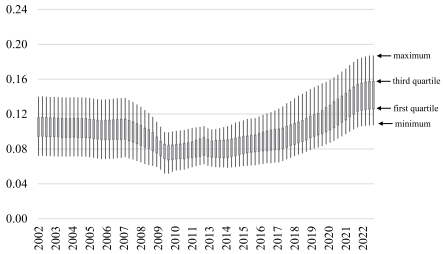
Note: Shaded areas mark the 68% and 40% credibility intervals.
Source: NSI, Eurostat, own calculations

Figure 17: **Estimates of the Phillips curve coefficient on lagged inflation, ρ_t (benchmark specification)**



Note: Shaded areas mark the 68% and 40% credibility intervals.
Source: NSI, Eurostat, own calculations

Figure 18: **Estimates of the Phillips curve coefficient on ULC, β_1 (all specifications)**



Note: The box and whisker chart depicts the estimated Phillips curve coefficient on ULC (β_1) across 20 specifications. These specifications vary based on the slack measure used (such as the unemployment rate, unemployment gap, output gap, real GDP growth rate, or private consumption growth rate), the indicators for price expectations (including those of firms or consumers), and the indicators for external prices (such as the import price deflator or energy prices). The series for energy prices is constructed by the BNB, taking into account data for crude oil, domestic natural gas and electricity prices, with each component weighted by its respective share in Bulgaria's energy consumption mix.
Source: NSI, Eurostat, own calculations.

Regarding the benchmark Phillips curve model, the long-run (cumulative) impact of labour costs on prices depends on both the slope of the Phillips curve (β_{1t}) and inflation persistence (ρ_t). Mathematically, the cumulative increase

in consumer prices after n periods following a 1% increase in ULC can be estimated as $\beta_{1t} * (1 + \rho_t + \rho_t{}^2 + \cdots + \rho_t{}^{n-1})$. This is depicted on Figure 19. Based on the results, the majority of price adjustments following an increase in labour costs occur within 1 year, with the magnitude of the pass-through showing variation over the historical period. In the 2001-2006 period a 1% rise in ULC resulted in 0.19% cumulative increase in HICP after 12 quarters, with the pass-through increasing to 0.20% in 2007. After the Global financial crisis, amid high unemployment rate, subdued demand and falling commodity prices, firms showed a limited response in changing consumer prices when faced with increases in ULC. The lowest cumulative impact was observed in 2010, and amounted to 0.16%. Starting in 2011, the cumulative labour cost pass-through exhibited an upward trajectory, eventually reaching the levels observed in 2007 by 2016. From 2017 through the first half of 2023, the estimated pass-through increased significantly, with the short-run impact multiplier reaching 0.16 and the long-term pass-through (after 12 quarters) rising to 0.30.

The results from the Phillips curve model can be used to assess the price pressures, arising from the increase of the minimum wage in 2024. Assuming that the rise in the minimum wage will not be matched by an increase in productivity, which is a fair assumption for low-skilled labour, then an increase in the minimum wage by 19.6% will result in an increase in the economy-wide unit labour costs (ULC) by approximately 4.0%. According to the Phillips curve, such an increase would translate into a pick-up of consumer prices by 1.2%.

Figure 19: **Cumulative impact of a 1% increase in ULC on consumer prices over 12 quarters (benchmark Phillips curve model)**

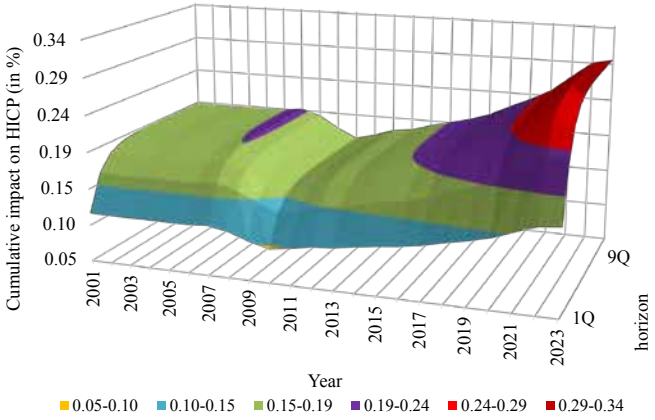
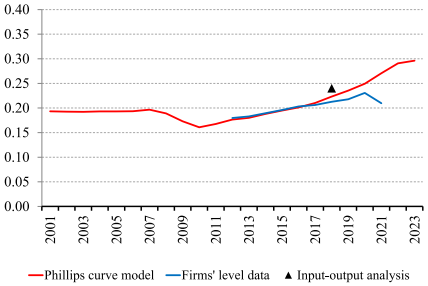


Figure 20 serves as a robustness check, comparing labour cost pass-through estimates from the benchmark Phillips curve model with those derived from firm-level data and input-output analysis. Despite differences in data sources and methodologies, all three approaches yield similar findings regarding the wage-price relationship during 2011–2019, when estimates are available for each method. The results indicate a long-term trend of increasing labour cost pass-through, driven by the rising share of firms' labour costs in total costs. At the same time, estimates based on the Phillips curve model clearly highlight the state-dependent nature of the wage-price link. During economic downturns, firms are more likely to absorb part of labour cost increases through profit reductions or cuts in non-wage costs, a pattern also observed in other studies on Bulgaria. Conversely, during periods of economic expansion – characterized by strong private consumption and rising commodity prices – firms are more likely to fully pass on labour cost increases to consumer prices, reinforcing the wage-price link. Additionally, Phillips curve estimates suggest that following a wage shock, most of the inflationary effects materialize within the first four quarters.

Figure 20: **Labour cost pass-through based on the Phillips curve model (cumulative impact after 12 quarters) and firms' level data**



Note: The (benchmark) Phillips curve model depicts the long-term (after 12 quarters) cumulative impact of a 1% increase in ULC on HICP. The approaches based on firms' level data and input-output analysis do not precisely determine the time required for the wage shock to be passed on to consumer prices.
Source: Own calculations

6. Conclusion

This paper explores the relationship between wages and prices in Bulgaria and is motivated by the strong increase in compensation per employee during the period 2017–2022 (averaging 10.0% per year). This rise resulted in an increase in unit labour costs and sparked discussions about the size of the pass-through from labour costs to prices. The analysis addresses two key questions: (1) the size of this pass-through and (2) how the sensitivity of prices to labour cost changes has evolved over time. The findings confirm the hypothesis that the wage-price relationship has strengthened since 2021.

To estimate the elasticity of prices to labour costs, the paper employs three distinct approaches.

The first approach draws its theoretical underpinnings from the neoclassical production theory, according to which the pass-through of labour costs reflects the cost structure of firms that are engaged in the production and trade of consumer goods and services. By employing firm-level data from the ORBIS database the analysis finds that, as of 2021, the cost of labour comprises 16.2% of the expenses incurred by firms that produce consumer goods and services included in the HICP. Adjusting for labour costs embedded in intermediate inputs and upstream supply chain activities (such as trade), the total direct and indirect labour cost share of domestically produced goods and services is estimated at 25.7%. After accounting for the share of imported consumer goods, the estimated elasticity of HICP to labour cost changes is 0.21, with core HICP components exhibiting a higher pass-through due to their greater labour intensity.

The second approach to explore the wage-price nexus is based on data from input-output tables. The main advantages of input-output tables are that they inherently account for international trade, sectoral interlinkages and the structure of consumption expenditures. Their main disadvantages are related to the publishing lag of information and to data aggregation, which could lead to a bias in the calculation of the wage pass-through. Calculations based on input-output tables for Bulgaria (with a breakdown of 45 sectors) reveal that the elasticity of prices to wages was 0.24 as of 2019. This implies that a 1% increase in wages in all economic sectors could end up in 0.24% higher consumer prices.

Although the micro-data study and input-output analysis provide valuable insights into the average price change following a wage increase, they do not account for the time it takes for the shock to transmit through the economy. Additionally, they do not capture potential variations in the pass-through over time, which may depend on factors such as the phase of the business cycle, the

magnitude of economic shocks–both wage and non-wage related–or shifts in firms' pricing strategies.

To address these limitations, the third approach for analyzing labour cost pass-through is based on a reduced-form Phillips curve model. It differs from the other methodologies by utilizing aggregated macroeconomic data on a quarterly basis, spanning from the third quarter of 2001 to the second quarter of 2023. This econometric approach accounts for the simultaneous impact of both wage and non-wage-related shocks on prices–such as changes in commodity prices, demand fluctuations, and labour supply shocks. Additionally, it allows for time variation in the labour cost pass-through. Another advantage of the Phillips curve model is that it provides insights into the time it takes for prices to adjust after a labour cost shock. The model reveals that a 1% increase in unit labour costs (ULC) resulted in a cumulative price impact ranging from 0.21% to 0.23% over the period from 2017 to 2019, with most of this adjustment occurring within the first four quarters. These findings align with the results obtained through the other approaches. Additionally, the Phillips curve model indicates a strengthening of the pass-through effect after 2019, reaching 0.30 in the first half of 2023.

The findings underscore the importance of aligning wage growth with productivity gains to maintain price stability. Fiscal policy should be well-targeted in periods of strong pro-inflationary shocks–whether domestic or external–and should avoid fueling excessive consumption growth, as firms' price-setting behavior appears to be state-dependent. Failure to consider these interdependencies could contribute to a sustained wage-price spiral, resulting in persistently higher inflation in Bulgaria relative to other EU countries, particularly in periods of heightened commodity price volatility.

Appendices

Appendix 1 The wage-price link in national accounts

1. Decomposing the growth rate of the final demand deflator

This appendix describes how national accounts data can be used to gauge price pressures in Bulgaria. The decomposition of the annual rate of change of the final demand deflator into the deflators of GDP and imports is presented below.[52]. The starting point for this procedure is the nominal value of final demand, which is, by definition, the sum of GDP and imports:

$$FD_t^n = GDP_t^n + M_t^n \text{ [eq. 1]}$$

where FD_t^n is the market value of final demand for Bulgaria at time t, while GDP_t^n and M_t^n denote gross domestic product and imports at current prices, respectively. The final demand deflator is obtained by dividing the current price value of final demand by its real counterpart:

$$FD_t^p = \frac{FD_t^n}{FD_t^r} = \frac{GDP_t^n + M_t^n}{FD_t^r} = GDP_t^p \frac{GDP_t^r}{FD_t^r} + M_t^p \frac{M_t^r}{FD_t^r} \text{ [eq. 2]}$$

where FD_t^p, GDP_t^p and M_t^p denote the deflators of final demand, GDP and imports, respectively. FD_t^r, GDP_t^r and M_t^r stand for real final demand, GDP and imports (all measured at constant prices of 2015). Equation [2] corresponds to the level of the final demand deflator at time t, and to express it in growth rates, the following transformations are required:

$$\frac{FD_t^p}{FD_{t-1}^p} FD_{t-1}^p = \left(\frac{GDP_t^p}{GDP_{t-1}^p} GDP_{t-1}^p \right) \frac{GDP_t^r}{FD_t^r} + \left(\frac{M_t^p}{M_{t-1}^p} M_{t-1}^p \right) \frac{M_t^r}{FD_t^r} \text{ [eq. 3]}$$

$$\frac{FD_t^p}{FD_{t-1}^p} \frac{FD_{t-1}^n}{FD_{t-1}^r} = \left(\frac{GDP_t^p}{GDP_{t-1}^p} \frac{GDP_{t-1}^n}{GDP_{t-1}^r} \right) \frac{GDP_t^r}{FD_t^r} + \left(\frac{M_t^p}{M_{t-1}^p} \frac{M_{t-1}^n}{M_{t-1}^r} \right) \frac{M_t^r}{FD_t^r} \text{ [eq. 4]}$$

[52] In order to keep derivations simple in this appendix, it is assumed that data is at yearly frequency. Using quarterly data would require some additional transformations.

As a next step, both sides of equation (4) are multiplied by $\frac{FD_t^r}{FD_{t-1}^n}$ to obtain:

$$\frac{FD_t^p}{FD_{t-1}^p}\frac{FD_t^r}{FD_{t-1}^r} = \frac{GDP_t^p}{GDP_{t-1}^p}\frac{GDP_t^r}{GDP_{t-1}^r}\underbrace{\frac{GDP_{t-1}^n}{FD_{t-1}^n}}_{w_{t-1}^{GDP}} + \frac{M_t^p}{M_{t-1}^p}\frac{M_t^r}{M_{t-1}^r}\underbrace{\frac{M_{t-1}^n}{FD_{t-1}^n}}_{w_{t-1}^{M}} \text{ [eq. 5]}$$

Equation [5] can now be expressed in growth rates as follows:

$$(1+\pi_t^{FD})(1+g_t^{FD}) = (1+\pi_t^{GDP})(1+g_t^{GDP})w_{t-1}^{GDP} + (1+\pi_t^{M})(1+g_t^{M})w_{t-1}^{M} \text{ [eq. 6]}$$

where π_t^{FD}, π_t^{GDP} and π_t^{M} denote the growth rate of the deflators for final demand, GDP and imports, while g_t^{FD}, g_t^{GDP}, and g_t^{M} denote the real growth rates of the respective components. According to equation (6) the increase of nominal final demand is a weighted average of the increase of nominal GDP and nominal imports. Given that $g_t^{FD} = g_t^{GDP}w_{t-1}^{GDP} + g_t^{M}w_{t-1}^{M}$ it follows that:

$$\pi_t^{FD}(1+g_t^{FD}) = \pi_t^{GDP}(1+g_t^{GDP})w_{t-1}^{GDP} + \pi_t^{M}(1+g_t^{M})w_{t-1}^{M} \text{ [eq. 7]}$$

$$=> \pi_t^{FD} = \pi_t^{GDP}\frac{(1+g_t^{GDP})w_{t-1}^{GDP}}{(1+g_t^{FD})} + \pi_t^{M}\frac{(1+g_t^{M})w_{t-1}^{M}}{(1+g_t^{FD})} \text{ [eq. 8]}$$

According to equation (8), the percent change of the final demand deflator is a weighted average of the GDP and import deflators.

2. Decomposing the growth rate of the GDP and GVA deflators

As explained in Section 3, in applied research economists often use either the GDP deflator or the GVA deflator as a proxy for domestic price pressures. In order to better identify the sources of domestic price pressures, GDP needs to be further decomposed into the various components of income. GDP is, by definition, the sum of gross value added (GVA) and taxes less subsidies on products. GVA, in turn, is the sum of compensation of employees (COE), gross operating surplus/mixed income (GOS/MI) and other taxes less subsidies on production (T).

$$GDP = \underbrace{COE + GOS/MI + \overbrace{\underbrace{other\ taxes\ less\ subsidies\ on\ production\ (T)}_{Gross\ value\ added\ (GVA)} + taxes\ less\ subsidies\ on\ products}^{Taxes\ on\ production\ and\ imports\ less\ subsidies\ (TXS)}}$$ [eq. 9]

Below is presented a decomposition of the growth rate of the GVA deflator (π_t^{GVA}) into contributions from labour costs, profits and taxes. The same accounting framework can be used to calculate the contributions of various income components to the growth rate of the GDP deflator (π_t^{GDP}) or the final demand deflator (π_t^{FD}). The starting point for the decomposition is the definition of the GVA deflator, i.e. the division of nominal GVA by its real counterpart:

$$GVA_t^p = \frac{GVA_t^n}{GVA_t^r}$$

$$= \frac{COE_t + GOS/MI_t + T_t}{GVA_t^r}$$

$$= \frac{COE_t + (EMP_t - EES_t)\frac{COE_t}{EES_t}}{GVA_t^r} + \frac{GOS/MI_t - (EMP_t - EES_t)\frac{COE_t}{EES_t}}{GVA_t^r} + \frac{T_t}{GVA_t^r}$$

$$= \frac{\frac{COE_t}{EES_t}EMP_t}{GVA_t^r} + \frac{GOS/MI_t - (EMP_t - EES_t)\frac{COE_t}{EES_t}}{GVA_t^r} + \frac{T_t}{GVA_t^r}$$

$$= ULC_t + profit\ per\ unit\ of\ output_{\ t} + taxes\ per\ unit\ of\ output_{\ t}$$ [eq. 10]

where COE_t, EMP_t and EES_t denote nominal compensation of employees, number of employed persons and number of employees. On the second line up from the bottom in the above derivation, the economy-wide level of profits is

calculated as the differences between gross operating surplus/mixed income and the compensation of self-employed workers[53].

Equation [10] is in levels and in order to express it into growth rates the following transformation is performed (in what follows profit and taxes per unit of output are abbreviated as PPU and TPU, respectively):

$$GVA_t^p = ULC_t + PPU_t + TPU_t$$

$$\frac{GVA_t^p}{GVA_{t-1}^p} GVA_{t-1}^p = ULC_t \frac{ULC_{t-1}}{ULC_{t-1}} + PPU_t \frac{PPU_{t-1}}{PPU_{t-1}} + TPU_t \frac{TPU_{t-1}}{TPU_{t-1}} \text{ [eq. 11]}$$

As a next step both sides of equation [11] are multiplied by $\frac{1}{GVA_{t-1}^p} = \frac{GVA_{t-1}^r}{GVA_{t-1}^n}$ to get:

$$\frac{GVA_t^p}{GVA_{t-1}^p} = \frac{ULC_t}{ULC_{t-1}} \left(ULC_{t-1} \frac{GVA_{t-1}^r}{GVA_{t-1}^n} \right) + \frac{PPU_t}{PPU_{t-1}} \left(PPU_{t-1} \frac{GVA_{t-1}^r}{GVA_{t-1}^n} \right) + \frac{TPU_t}{TPU_{t-1}} \left(TPU_{t-1} \frac{GVA_{t-1}^r}{GVA_{t-1}^n} \right)$$

$$= \frac{ULC_t}{ULC_{t-1}} \left(\frac{COE_{t-1} \frac{EMP_{t-1}}{EES_{t-1}}}{GVA_{t-1}^n} \right) + \frac{PPU_t}{PPU_{t-1}} \left(\frac{GOS/MI_{t-1} - (EMP_{t-1} - EES_{t-1}) \frac{COE_{t-1}}{EES_{t-1}}}{GVA_{t-1}^n} \right)$$

$$+ \frac{TPU_t}{TPU_{t-1}} \left(\frac{T_{t-1}}{GVA_{t-1}^n} \right) \text{ [eq. 12]}$$

Therefore:

$$(1 + \pi_t^{GVA}) = (1 + \%\Delta ULC_t) \left(\frac{COE_{t-1} \frac{EMP_{t-1}}{EES_{t-1}}}{GVA_{t-1}^n} \right)$$

$$+ (1 + \%\Delta PPU_t) \left(\frac{GOS/MI_{t-1} - (EMP_{t-1} - EES_{t-1}) \frac{COE_{t-1}}{EES_{t-1}}}{GVA_{t-1}^n} \right)$$

$$+ (1 + \%\Delta TPU_t) \frac{T_{t-1}}{GVA_{t-1}^n} \text{ [eq. 13]}$$

[53] In national accounts the term 'gross mixed income' refers to the income of unincorporated enterprises (e.g. small family businesses like farms and retail shops or self-employed taxi drivers, lawyers and health professionals). Since in most such cases it is difficult to distinguish between income from labour and income from capital, the balancing item in the generation of income account is 'mixed' by including both. In the derivation of Equation 10 and the subsequent analysis, it is assumed that labour income per person is uniform across the economy. Therefore, the total labour income of unincorporated enterprises is calculated as the product of the number of self-employed workers and the average compensation per employee.

Equation [13] can be further simplified to obtain the final expression:

$$\pi_t^{GVA} = \%\Delta ULC_t \left(\frac{COE_{t-1}}{GVA_{t-1}^n} \frac{EMP_{t-1}}{EES_{t-1}} \right) + \%\Delta PPU_t \left(\frac{GOS_{t-1} - (EMP_{t-1} - EES_{t-1}) \frac{COE_{t-1}}{EES_{t-1}}}{GVA_{t-1}^n} \right) + \%\Delta TPU_t \frac{T_{t-1}}{GVA_{t-1}^n} \quad [\text{eq. } 14]$$

where %Δ denotes the growth rate of the respective variable. According to equation [14] the growth rate of the GVA deflator is a weighted average of the growth rate of unit labour costs, unit profit and unit taxes.

Appendix 2 Wage shocks and their impact on prices according to input-output tables

Input-Output analysis (IO) was founded by Wassily Leontief (Leontief, 1966) in the 30s of the 20th century. He created a new field for empirical research at the border between microeconomics and macroeconomics. The IO analysis is based on the interdependencies between different economic sectors or industries. The main aim of the IO analysis is to assess the impacts of positive or negative economic shocks and analyse the ripple effects throughout the economy.

A central part of input-output analysis is the input-output table, which maps the flow of goods and services between all sectors of an economy over a given period (typically one year). These tables provide insights into the economy's production structure and the inputs used in production, including intermediates, labour, capital, and land. Each sector's production activity is characterized by structural (technical) coefficients that quantify the relationships between the inputs absorbed and the output generated. The interdependencies among sectors can be captured through a system of linear equations that express the balance between the total input and output of each good and service produced.

A concise version of the input-output table[54] for Bulgaria is presented in Table 5. The data is from OECD and it is compiled in millions of USD.

[54] The extended input-output table includes 45 branches according to the Classification of Products by Activity (CPA). For the sake of brevity data presented in Table 5 is aggregated to 6 branches: "Agriculture"; "Industry"; "Construction"; "Trade, hotel, transport"; "Business services"; and "Other services" (where the largest subsector is "Public administration, education and health, social and personal services").

Table 5: **Input-output table for Bulgaria, 2021 edition (millions of USD)**

		INPUT OF PRODUCTION ACTIVITIES						FINAL USES							Output
		Agri-culture	Industry	Construc-tion	Trade, hotel, transport	Business services	Other services	Private consump-tion (resident households)	Govern-ment consump-tion	Invest-ment	Changes in inven-tories	Direct purchases by non-residents (exports)	Exports (cross border)	Direct purchases abroad by residents (imports)	
		1	2	3	4	5	6	7	8	9	10	12	13	14	**15**
Agriculture	1	587	647	15	80	24	11	985	21	61	20	60	2 940	0	**5 450**
Industry	2	294	8 824	1 631	2 501	887	697	7 027	171	901	1 009	640	21 106	0	**45 688**
Construction	3	67	646	1 186	548	863	362	309	43	5 475	4	68	243	0	**9 814**
Trade,hotel,transport	4	585	5 101	953	3 140	864	445	6 326	371	871	- 107	2 447	7 603	0	**28 600**
Business services	5	427	1 700	1 275	3 524	5 727	1 272	9 085	598	857	115	645	2 843	0	**28 065**
Other services	6	20	149	74	537	394	1 687	2 780	8 672	59	5	447	396	0	**15 219**
Domestic products	**7**	**1 978**	**17 067**	**5 135**	**10 329**	**8 759**	**4 474**	**26 512**	**9 876**	**8 225**	**1 045**	**4 306**	**35 131**	**0**	**132 836**
Imported products	**8**	**1 043**	**15 169**	**2 068**	**3 925**	**1 684**	**908**	**9 091**	**548**	**3 611**	**267**	**0**	**0**	**1 319**	**39 633**
Taxes less subsidies on products	9	235	1 259	254	1 285	407	425	3 809	325	492	0	1 513	0	49	**10 051**
Intermediate consumption/ Fina	**10**	**3 256**	**33 495**	**7 457**	**15 539**	**10 850**	**5 806**	**39 412**	**10 749**	**12 328**	**1 312**	**5 819**	**35 131**	**1 368**	**182 520**
Compensation of employees	11	753	6 375	1 223	6 472	6 229	7 105								
Other taxes less subsidies on production	12	1 441	5 819	1 135	6 589	10 986	2 307								
Gross operating surplus and mixed income	13														
Value added at basic prices	**14**	**2 194**	**12 194**	**2 358**	**13 061**	**17 215**	**9 413**								
Output at basic prices	**15**	**5 450**	**45 688**	**9 814**	**28 600**	**28 065**	**15 219**								

Note: Data refers to 2018.
Source: OECD

The columns of Table 5 provide information about the economic activities in Bulgaria: production sectors (agriculture, industry, construction and services-related sectors) in columns 1–6 and categories of final demand (consumption, investment and exports) in columns 7–14. The corresponding inputs of these activities are reported in the rows of the matrix: domestic products (from agriculture, industry, construction and services-related sectors) in rows 1–6, imported products in row 8, net taxes on products (row 9) and primary inputs (compensation of employees, operating surplus, net taxes on production) in rows 11–13.

The first six columns of the input-output table provide information on the cost structure of the main economic sectors and their underlying production functions. They include all inputs in production: the uses of domestic and foreign intermediates and of labour[55]. These relations can be expressed by the following production function.

$$x_j = f(x_{ij}, L_j)$$

where:

x_j = output of commodity j

x_{ij} = intermediate input of commodity i in sector j

L_j = labour in sector j

f = technology function that transforms inputs into output in sector j

[55] More detailed versions of the input-output tables should contain information about other factors of production, such as land and capital. The available data for Bulgaria does not provide such information.

1. Price model of input-output analysis

In input-output analysis prices are determined by a set of linear equations. These equations state that the price which each sector of the economy receives per unit of output must equal the total outlays incurred in the course of its production. The outlays comprise not only payments for inputs purchased from the same and from other industries (either domestic of foreign) but also the value added, which essentially represents payments made to the exogenous factors of production, i.e. capital and labour.

Input-output tables can be presented as a matrix. The costs of production are reported for each sector in the corresponding column of the matrix. The transposed columns are reported in the following system:

$$x_{11}p_1 + x_{21}p_2 + \cdots + x_{n1}p_n + m_1p^M + z_1^L w + z_1^K q = x_1p_1 \quad [\text{eq. } 1]$$
$$x_{12}p_1 + x_{22}p_2 + \cdots + x_{n2}p_n + m_2p^M + z_2^L w + z_2^K q = x_2p_2 \quad [\text{eq. } 2]$$
$$\cdots$$
$$x_{1n}p_1 + x_{2n}p_2 + \cdots + x_{nn}p_n + m_np^M + z_n^L w + z_n^K q = x_np_n \quad [\text{eq. } 3]$$

where:

x_{ij} = domestic intermediate input of commodity i in sector j (quantity)
x_j = output of sector j (quantity)
p_i = price of commodity (product) i
m_j = imported intermediate inputs in sector j (quantity)
p^m = price of imported intermediate input
z_j^L = labour input to sector j (quantity)
q = factor price for primary input labour (wage rate)
z_j^K = capital input to sector j (quantity)
q = factor price for primary input capital

It is assumed that all n sectors of the economy are producing with Leontief production functions. The model implicitly assumes that there are conditions for perfect competition (many suppliers, many purchasers, free access to markets, full information). Another key assumption behind the IO analysis is that in the production process all inputs (intermediates, labour, and capital) are used in fixed proportions in relation to output. This is often represented by the so called "technical" coefficients. It is assumed that a substitution of inputs is impossible. Therefore, changes of factor prices have no impact on the technical input coefficients.

Input coefficients identify stable cost components and technical input relations. They are calculated by dividing each entry of the input-output table by the corresponding column total. The input coefficients can be interpreted as the corresponding shares of costs for goods, services and primary inputs in total output. As the input coefficients cover all inputs, including taxes, they add up to unity[56]. For the purposes of the price model, the following input coefficients are defined:

$a_{ij} = x_{ij}/x_j$ - Input coefficients for *domestic intermediates*
$b_j = m_j/x_j$ - Input coefficients for *imported intermediates*
$v_j^L = z_j^L/x_j$ - Input coefficients for *labour*
$v_j^K = z_j^K/x_j$ - Input coefficients for *capital*

If the assumption is made that sectors produce with fixed (i.e., stable over time) technical input coefficients, the equation system [1]-[3] can be rewritten by replacing x_{ij} with $a_{ij}\ x_j$. These equations serve to make explicit the dependence of interindustry flows on the total output of each sector.

The new system of equations is therefore:

$$a_{11}x_1p_1 + a_{21}x_1p_2 + \cdots + a_{n1}x_1p_n + b_1x_1p^m + v_1^Lx_1w + v_1^Kx_1q = x_1p_1 \quad [\text{eq. } 4]$$
$$a_{12}x_2p_1 + a_{22}x_2p_2 + \cdots + a_{n2}x_2p_n + b_2x_2p^m + v_2^Lx_2w + v_2^Kx_2q = x_2p_2 \quad [\text{eq. } 5]$$
$$\cdots$$
$$a_{1n}x_np_1 + a_{2n}x_np_2 + \cdots + a_{nn}x_np_n + b_nx_np^m + v_n^Lx_nw + v_n^Kx_nq = x_np_n \quad [\text{eq. } 6]$$

After dividing each row of the equation system by the output levels x_j, the following expression is obtained:

$$a_{11}p_1 + a_{21}p_2 + \cdots + a_{n1}p_n + b_1p^m + v_1^Lw + v_1^Kq = p_1 \quad [\text{eq. } 7]$$
$$a_{12}p_1 + a_{22}p_2 + \cdots + a_{n2}p_n + b_2p^m + v_2^Lw + v_2^Kq = p_2 \quad [\text{eq. } 8]$$
$$\cdots$$
$$a_{1n}p_1 + a_{2n}p_2 + \cdots + a_{nn}p_n + b_np^m + v_n^Lw + v_n^Kq = p_n \quad [\text{eq. } 9]$$

[56] Net taxes on products and production to the capital input are added in order to keep notation simple in the calculations that follow. This does not influence the results about the impact of wages on prices.

The system described by equations [7]–[9] can easily be represented by matrices, which facilitates its solution. In matrix notation the price model is defined as:

$$A^{'}p + Mb + Wv^{L} + Qv^{K} = p \text{ [eq. 10]}$$

Transforming equation [10] results in equation [11]:

$$p - A^{'}p = Mb + Wv^{L} + Qv^{K} \text{ [eq. 12]}$$

By applying an additional transformation to equation [11], equation [12] derived: $(I - A^{'})p = Mb + Wv^{L} + Qv^{K}$ [eq. 13]

The solution of the linear equation system is therefore:

$$p = (I - A^{'})^{-1}(Mb + Wv^{L} + Qv^{K}) \text{ [eq. 14]}$$

where:

$A^{'}$ = transposed matrix of input coefficients for domestic intermediates (technology matrix)
I = identity matrix
$(I - A^{'})$ = transposed Leontief matrix
$(I - A^{'})^{-1}$ = transposed Leontief inverse
b = column vector of input coefficients for imported intermediates
M = diagonal matrix with prices for imported intermediates
v^{L} = column vector of input coefficients for labour input
W = diagonal matrix with unit factor price for capital input
v^{K} = column vector of input coefficients for labour input
Q = diagonal matrix with unit factor price for capital input
p = vector of prices (price indices) for commodities/products

The objective of the price model is to calculate the unknown product prices (price indices) based on exogenously given input coefficients for imported intermediates and primary factors (labour and capital), which are weighted by their respective factor prices.

It should be noted that the input-output table for Bulgaria does not provide separately information on quantities and prices. Therefore, the input coefficients for primary input have to be weighted with a unit price index. In the literature (Eurostat, 2008) the price model has often been used to study the impact of changes in primary inputs (factor prices) on product prices. When the price model is applied, it is assumed that all conditions of perfect competition are fulfilled. Higher factor prices for primary inputs will cause higher product prices in competitive markets. The approach is able to simulate the effects of a cost-push shock on inflation.

2. Input content in input-output analysis

The price model that is discussed above results from the structure of the economy presented with the input-output table for Bulgaria. The impact of changes in prices of imported intermediates and/or primary inputs (such as compensation of employees and gross operating surplus) on product prices is closely linked to the input content of final demand components. In simpler terms, the prices of products from a specific sector reflect both the direct and indirect requirements of intermediates and primary factors utilized in the production process of those products. Likewise, the prices of final demand components (such as private consumption, government consumption, investment in fixed assets, and exports) are influenced by the expenditure patterns of economic agents and the composition of inputs associated with those expenditures.

Appropriate extensions of the input-output system enable the evaluation of both direct and indirect requirements necessary for the production of products within a specific sector. In this study, a specific extension of the input-output equation system known as the central model of input-output analysis is utilized (see Miller and Blair (2012) and Eurostat (2008)):

$$Z = B(I - A)^{-1}Y$$

B = matrix of input coefficients for a specific variable of interest in economic analysis (imported intermediates, labour, etc.)

A = matrix of input coefficients for domestic intermediates (technology matrix)

I = identity matrix

$(I - A)$ = Leontief matrix

Y = diagonal matrix for final demand by product

Z = matrix with results for direct and indirect requirements (intermediates, labour, etc.)

Matrix B contains the input coefficients corresponding to the variable being studied, such as intermediates, labour, gross operating surplus, and more. The diagonal matrix Y represents exogenous final demand for goods and services categorized by product, such as agricultural products, manufactured products, and services. Matrix Z combines the outcomes of the direct and indirect requirements for intermediates, labour, capital, and energy in the production of goods and services. This approach enables a comprehensive evaluation of the total requirements, both direct and indirect, involved in the production of a product at all stages of the production process.

3. Estimates of the input content of domestically produced products

The aim of the current section is to estimate the input content of domestically produced products. The 2021 edition of input-output tables compiled by the OECD, based on economic data from 2018, is utilized. According to the data presented in Table 6 and Table 7, the aggregate output of Bulgarian firms in 2018 reached 132,836 million USD at current prices. The domestic inputs utilized in the production process amounted to 47,741 million USD, representing approximately 35.9% of total costs. On the other hand, imported intermediates (raw materials) amounted to 24,798 million USD, accounting for approximately 18.7% of total costs. In 2018, net taxes on intermediate and final products amounted to 3,863 million USD, which constituted 2.9 % of total costs. The value added, which is used for remuneration of the primary production factors, reached 56,434 million USD, accounting for 42.5% of total costs. Around half of the value added was allocated for the remuneration of workers in exchange for their labour services. It should be noted that Table 6 and Table 7 provide information solely about the direct imports of intermediates by firms in the respective economic sectors. These imported intermediates are further processed and sold to final consumers within the country or abroad. In addition to these intermediates, there are also final goods that are directly imported and purchased by households, the government, or firms for consumption or investment purposes. In 2018, the total value of these final goods amounted to 14,835 million USD (see Table 5), which accounted for 37.4% of all imports in the country. These final goods represented 29.7% of the final expenditures of domestic residents and the direct purchases made by non-residents in Bulgaria.

Table 6: **Production costs (direct requirements) based on input-output table, 2021 edition (millions of USD)**

Production costs (in million USD)			Domestic inputs	Imported inputs				Taxes	Value added		Output = Total costs
Sector	Code	№	Total	Total	Energy	Food	Other	Net taxes on intermediate and final products	Wages	Other	
Agriculture, hunting, forestry	CPA_A1-2	1	1 955	1 019	186	217	617	233	750	1 429	**5 386**
Fishing and aquaculture	CPA_A3	2	23	24	1	1	22	2	4	11	**64**
Mining and quarrying, energy producing products	CPA_B5-6	3	118	52	35	0	17	9	180	128	**486**
Mining and quarrying, non-energy producing products	CPA_B7-8	4	514	151	29	1	122	51	229	508	**1 453**
Mining support service activities	CPA_B9	5	23	12	2	0	10	1	4	4	**45**
Food products, beverages and tobacco	CPA_C10-12	6	3 187	1 613	287	530	796	299	843	593	**6 534**
Textiles, wearing apparel, leather and related products	CPA_C13-15	7	609	847	24	4	819	90	630	209	**2 385**
Wood and of products of wood and cork (except furniture)	CPA_C16	8	320	121	7	2	112	35	92	60	**628**
Paper products and printing	CPA_C17-18	9	520	305	44	1	259	37	183	180	**1 226**
Coke and refined petroleum products	CPA_C19	10	755	2 821	1 947	9	865	37	36	90	**3 740**
Chemical and chemical products	CPA_C20	11	515	713	231	14	468	40	175	280	**1 723**
Pharmaceuticals, medicinal chemical products	CPA_C21	12	268	170	51	1	118	18	132	143	**730**
Rubber and plastics products	CPA_C22	13	823	672	51	3	618	57	251	226	**2 029**
Other non-metallic mineral products	CPA_C23	14	504	621	402	1	217	34	202	306	**1 667**
Manufacture of basic metals	CPA_C24	15	3 178	2 241	635	3	1 603	107	198	304	**6 028**
Fabricated metal products, except machinery and equipment	CPA_C25	16	1 067	544	8	1	535	42	580	383	**2 616**
Computer, electronic and optical products	CPA_C26	17	273	225	1	1	224	28	126	123	**776**
Electrical equipment	CPA_C27	18	877	681	20	1	660	80	304	197	**2 139**
Machinery and equipment n.e.c.	CPA_C28	19	907	531	28	1	502	33	382	298	**2 150**
Motor vehicles, trailers and semi-trailers	CPA_C29	20	510	397	6	1	390	93	202	80	**1 283**
Other transport equipment	CPA_C30	21	226	165	2	0	162	10	74	37	**512**
Other manufacturing; repair and installation of machinery and equipment	CPA_C31-33	22	692	483	41	2	440	95	470	377	**2 117**
Electricity, gas, steam and air conditioning supply	CPA_D	23	794	1 705	1 289	6	411	30	785	1 027	**4 342**
Water supply; sewerage, waste management and remediation activities	CPA_E	24	387	102	27	0	75	35	295	262	**1 081**
Construction	CPA_F	25	5 135	2 068	458	17	1 594	254	1 223	1 135	**9 814**
Wholesale and retail trade; repair of motor vehicles	CPA_G45-47	26	4 627	1 782	359	21	1 403	342	3 681	4 774	**15 206**
Land transport and transport via pipelines	CPA_H49	27	2 479	1 225	553	5	668	716	948	903	**6 271**
Water transport	CPA_H50	28	61	32	5	0	27	10	36	12	**151**
Air transport	CPA_H51	29	368	211	55	1	156	82	73	25	**758**
Warehousing and support activities for transportation	CPA_H52	30	1 509	308	28	2	278	47	507	395	**2 766**
Postal and courier activities	CPA_H53	31	248	55	12	0	43	21	156	38	**518**
Accomodation and food services	CPA_I	32	1 038	312	75	73	164	68	1 070	443	**2 931**
Publishing, audiovisual and broadcasting activities	CPA_J58-60	33	250	77	4	0	72	18	298	240	**883**
Telecommunications	CPA_J61	34	704	130	4	0	125	52	462	604	**1 952**
IT and other information services	CPA_J62_63	35	1 223	312	10	1	301	66	1 626	601	**3 829**
Financial and insurance activities	CPA_K	36	1 656	171	5	0	166	62	1 256	2 501	**5 647**
Real estate activities	CPA_L	37	1 836	265	21	2	243	68	357	5 611	**8 138**
Professional, scientific and technical activities	CPA_M	38	1 807	430	24	2	403	75	1 269	916	**4 497**
Administrative and support services	CPA_N	39	1 282	300	54	3	243	65	959	513	**3 119**
Public administration and defence; compulsory social security	CPA_O	40	1 021	268	2	2	263	57	2 940	734	**5 020**
Education	CPA_P	41	430	54	2	1	51	22	1 763	474	**2 743**
Human health and social work	CPA_Q	42	1 067	281	46	4	232	62	1 712	518	**3 640**
Arts, entertainment and recreation	CPA_R	43	1 395	173	22	2	149	247	300	349	**2 462**
Other service activities	CPA_S	44	561	132	24	2	107	38	314	234	**1 279**
Private households with employed persons	CPA_T	45	0	0	0	0	0	0	77	0	**77**
TOTAL			**47 741**	**24 798**	**7 115**	**936**	**16 747**	**3 863**	**28 157**	**28 277**	**132 836**

Note: (1) Data refers to 2018.

(2) The category “Imported energy products” corresponds to products that are imported into Bulgaria from the foreign sectors “B5-6 Mining and quarrying, energy producing products” and “C19 Coke and refined petroleum products”.

(2) The category “Imported food products” corresponds to products that are imported into Bulgaria from the foreign sectors “A1-3 Agriculture, hunting, forestry; fishing” and “C10-12 Food products, beverages and tobacco”.

Source: OECD

Table 7: **Production costs (direct requirements) based on input-output table, 2021 edition (% of total costs)**

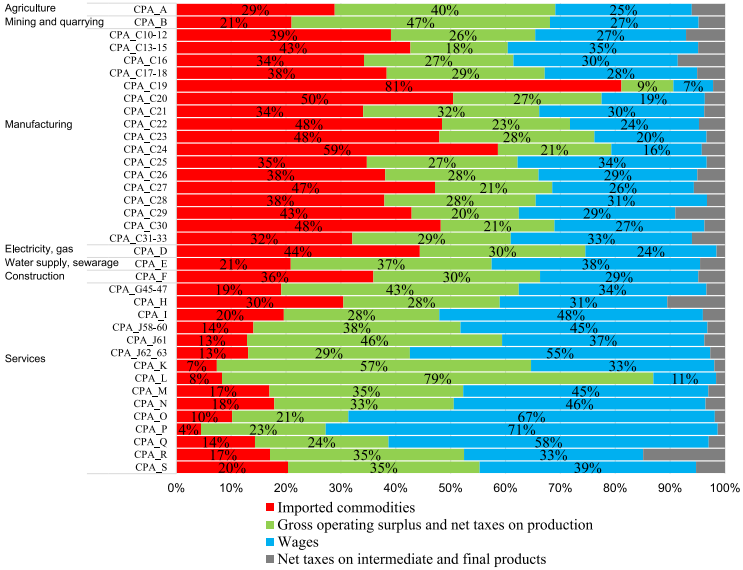
Production costs (% of total costs)			Domestic inputs	Imported inputs				Taxes	Value added		TOTAL COSTS
Sector	Code	№	Total	Total	Energy	Food	Other	Net taxes on intermediate and final products	Wages	Other	
Agriculture, hunting, forestry	CPA_A1-2	1	36.3%	18.9%	3.4%	4.0%	11.4%	4.3%	13.9%	26.5%	**100%**
Fishing and aquaculture	CPA_A3	2	36.2%	37.1%	1.1%	1.1%	34.9%	2.8%	6.2%	17.7%	**100%**
Mining and quarrying, energy producing products	CPA_B5-6	3	24.3%	10.6%	7.2%	0.0%	3.4%	1.8%	37.0%	26.4%	**100%**
Mining and quarrying, non-energy producing products	CPA_B7-8	4	35.4%	10.4%	2.0%	0.0%	8.4%	3.5%	15.8%	35.0%	**100%**
Mining support service activities	CPA_B9	5	52.1%	26.5%	4.7%	0.0%	21.8%	3.1%	9.6%	8.7%	**100%**
Food products, beverages and tobacco	CPA_C10-12	6	48.8%	24.7%	4.4%	8.1%	12.2%	4.6%	12.9%	9.1%	**100%**
Textiles, wearing apparel, leather and related products	CPA_C13-15	7	25.5%	35.5%	1.0%	0.2%	34.3%	3.8%	26.4%	8.8%	**100%**
Wood and of products of wood and cork (except furniture)	CPA_C16	8	51.0%	19.2%	1.2%	0.2%	17.8%	5.6%	14.6%	9.6%	**100%**
Paper products and printing	CPA_C17-18	9	42.4%	24.8%	3.6%	0.1%	21.1%	3.1%	15.0%	14.7%	**100%**
Coke and refined petroleum products	CPA_C19	10	20.2%	75.4%	52.1%	0.2%	23.1%	1.0%	1.0%	2.4%	**100%**
Chemical and chemical products	CPA_C20	11	29.9%	41.4%	13.4%	0.8%	27.2%	2.3%	10.2%	16.2%	**100%**
Pharmaceuticals, medicinal chemical products	CPA_C21	12	36.6%	23.3%	7.0%	0.1%	16.1%	2.5%	18.1%	19.6%	**100%**
Rubber and plastics products	CPA_C22	13	40.6%	33.1%	2.5%	0.1%	30.4%	2.8%	12.4%	11.2%	**100%**
Other non-metallic mineral products	CPA_C23	14	30.2%	37.2%	24.1%	0.1%	13.0%	2.1%	12.1%	18.4%	**100%**
Manufacture of basic metals	CPA_C24	15	52.7%	37.2%	10.5%	0.1%	26.6%	1.8%	3.3%	5.0%	**100%**
Fabricated metal products, except machinery and equipment	CPA_C25	16	40.8%	20.8%	0.3%	0.0%	20.4%	1.6%	22.2%	14.6%	**100%**
Computer, electronic and optical products	CPA_C26	17	35.1%	29.1%	0.1%	0.1%	28.9%	3.6%	16.3%	15.9%	**100%**
Electrical equipment	CPA_C27	18	41.0%	31.8%	0.9%	0.1%	30.9%	3.7%	14.2%	9.2%	**100%**
Machinery and equipment n.e.c.	CPA_C28	19	42.2%	24.7%	1.3%	0.0%	23.3%	1.5%	17.8%	13.8%	**100%**
Motor vehicles, trailers and semi-trailers	CPA_C29	20	39.8%	30.9%	0.5%	0.1%	30.4%	7.2%	15.8%	6.3%	**100%**
Other transport equipment	CPA_C30	21	44.1%	32.3%	0.5%	0.0%	31.7%	1.9%	14.5%	7.2%	**100%**
Other manufacturing; repair and installation of machinery and equipment	CPA_C31-33	22	32.7%	22.8%	1.9%	0.1%	20.8%	4.5%	22.2%	17.8%	**100%**
Electricity, gas, steam and air conditioning supply	CPA_D	23	18.3%	39.3%	29.7%	0.1%	9.5%	0.7%	18.1%	23.7%	**100%**
Water supply; sewerage, waste management and remediation activities	CPA_E	24	35.8%	9.4%	2.5%	0.0%	6.9%	3.2%	27.3%	24.3%	**100%**
Construction	CPA_F	25	52.3%	21.1%	4.7%	0.2%	16.2%	2.6%	12.5%	11.6%	**100%**
Wholesale and retail trade; repair of motor vehicles	CPA_G45-47	26	30.4%	11.7%	2.4%	0.1%	9.2%	2.3%	24.2%	31.4%	**100%**
Land transport and transport via pipelines	CPA_H49	27	39.5%	19.5%	8.8%	0.1%	10.6%	11.4%	15.1%	14.4%	**100%**
Water transport	CPA_H50	28	40.3%	21.4%	3.4%	0.1%	17.9%	6.4%	24.1%	7.8%	**100%**
Air transport	CPA_H51	29	48.5%	27.9%	7.2%	0.2%	20.5%	10.8%	9.6%	3.3%	**100%**
Warehousing and support activities for transportation	CPA_H52	30	54.6%	11.1%	1.0%	0.1%	10.1%	1.7%	18.3%	14.3%	**100%**
Postal and courier activities	CPA_H53	31	47.8%	10.6%	2.4%	0.0%	8.2%	4.0%	30.2%	7.4%	**100%**
Accomodation and food services	CPA_I	32	35.4%	10.6%	2.6%	2.5%	5.6%	2.3%	36.5%	15.1%	**100%**
Publishing, audiovisual and broadcasting activities	CPA_J58-60	33	28.3%	8.7%	0.5%	0.0%	8.2%	2.0%	33.8%	27.2%	**100%**
Telecommunications	CPA_J61	34	36.1%	6.6%	0.2%	0.0%	6.4%	2.7%	23.7%	30.9%	**100%**
IT and other information services	CPA_J62_63	35	31.9%	8.1%	0.3%	0.0%	7.9%	1.7%	42.5%	15.7%	**100%**
Financial and insurance activities	CPA_K	36	29.3%	3.0%	0.1%	0.0%	2.9%	1.1%	22.2%	44.3%	**100%**
Real estate activities	CPA_L	37	22.6%	3.3%	0.3%	0.0%	3.0%	0.8%	4.4%	68.9%	**100%**
Professional, scientific and technical activities	CPA_M	38	40.2%	9.6%	0.5%	0.1%	9.0%	1.7%	28.2%	20.4%	**100%**
Administrative and support services	CPA_N	39	41.1%	9.6%	1.7%	0.1%	7.8%	2.1%	30.8%	16.4%	**100%**
Public administration and defence; compulsory social security	CPA_O	40	20.3%	5.3%	0.0%	0.0%	5.2%	1.1%	58.6%	14.6%	**100%**
Education	CPA_P	41	15.7%	2.0%	0.1%	0.0%	1.9%	0.8%	64.3%	17.3%	**100%**
Human health and social work	CPA_Q	42	29.3%	7.7%	1.3%	0.1%	6.4%	1.7%	47.0%	14.2%	**100%**
Arts, entertainment and recreation	CPA_R	43	56.7%	7.0%	0.9%	0.1%	6.0%	10.0%	12.2%	14.2%	**100%**
Other service activities	CPA_S	44	43.8%	10.3%	1.9%	0.1%	8.3%	3.0%	24.6%	18.3%	**100%**
Private households with employed persons	CPA_T	45	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	**100%**
TOTAL			**35.9%**	**18.7%**	**5.4%**	**0.7%**	**12.6%**	**2.9%**	**21.2%**	**21.3%**	**100%**

Note: (1) Data refers to 2018. Column "Code" shows the code of each sector according to the Nomenclature of Economic Activities (NACE) classification.
(2) The category "Imported energy products" corresponds to products that are imported into Bulgaria from the foreign sectors "B5-6 Mining and quarrying, energy producing products" and "C19 Coke and refined petroleum products".
(2) The category "Imported food products" corresponds to products that are imported into Bulgaria from the foreign sectors "A1-3 Agriculture, hunting, forestry; fishing" and "C10-12 Food products, beverages and tobacco".
Source: OECD, own calculations

A breakdown of the total input content (both direct and indirect requirements) of domestically produced goods and services is presented in Figure 21. On average for the economy, labour costs (measured by compensation of employees) account for 33.1% of the total costs of domestically produced products, with this share being the highest for services[57] (40.3%) and "water supply; sewerage, waste management and remediation activities" (38.0%). Within the services sector, the highest wage content is observed in "education" (71.4%), "public administration and defence; compulsory social security" (66.8%), and "human health and social work activities" (58.4%). In the sector of "wholesale and retail trade; repair of motor vehicles", which is the largest services subsector in terms of value added, wage costs represent 34.2% of total costs.

In addition to labour costs, imported materials also comprise a significant portion of firms' total costs. On average, imported raw materials account for 29.1% of the cost of domestically produced goods, with 8.4% attributed to imported energy materials and 1.1% attributed to imported agricultural raw materials and food products.

Figure 21: **Structure of productions costs (direct and indirect requirements) of final demand by product** (%)



Note: The category *'imported commodities'* comprises solely imported raw materials utilized by firms during their production process, and it does not encompass imported finished goods.
Source: OECD, own calculations

[57] Products of economic sectors from G45-47 to T based on the Nomenclature of Economic Activities (NACE) classification.

Figure 22 presents the cost structure of final demand products by category. The input-output analysis indicates that for most of the final demand components, except for 'final consumption expenditure of general government', labour costs constitute approximately one-third of total costs. Specifically, for products bought by resident households, labour costs represent 29.9% of their total cost, whereas for non-resident households (mostly foreign tourists in Bulgaria), this proportion rises to 37.4%.[58] The wage content of final consumption expenditures of the general governments amounted to 61.4% in 2018. In terms of import content and profits, Figure 22 highlights significant variation among different final demand categories. As an illustration, the percentage of imported raw materials embodied into final products varies widely, ranging from 11.7% for "final consumption expenditure of general government" to 22.6% for "household final consumption expenditure", 32.3% for "gross fixed capital formation", 38.4% for "exports", and 44.3% for "inventories".

Figure 22: **Structure of productions costs (direct and indirect requirements) of final demand by category** (%)

Note: The category *'imported commodities'* comprises solely imported raw materials utilized by firms in further stages of the production process, and it does not encompass imported finished goods.
Source: OECD, own calculations

[58] On average, for all consumer products purchased directly by both resident and non-resident households, compensation of employees comprises 33.1% of total costs.

4. The impact of wages on prices in input-output analysis

Based on the input content of different economic sectors and the household consumption structure, input-output table data can be used to simulate the effects of wage increases on prices. In the following calculations it is assumed that the price of labour (i.e. compensation of employees) increases in all economic sectors by 10%. Since the price model of IO analysis relies on linear relationships (equations), the outcomes in this section vary proportionally to changes in the simulated wage shock. For instance, if wages rise by 20%, the impact on prices would be twice as high as that estimated for a 10% shock. The analysis is conducted in two steps. First, the impact of higher wages on product prices is estimated using the price model of input-output analysis. Second, the effect of higher product prices on the production cost of private consumption (and thus consumer prices) is assessed.

Table 8 and Table 9 present the effects of wage increases on products produced by the domestic economic sectors. It should be noted that the price model is based on the assumption that firms have the market power to fully pass on the rising costs of primary inputs to their product prices. If wages in all sectors increase by 10 percent, it is expected that, on average, the prices of agricultural products will rise by 2.5%; industrial goods by 2.7%; construction output by 2.9%; trade, hotel and transport services by 3.8%; business services by 2.2% and prices of other services by 5.1%.

After the wage increase and the corresponding price increases of domestically produced goods and services, the new set of price indices is used to inflate households' expenditures product by product. As the focus is on the dynamics of consumer prices and the HICP covers consumer expenditures of all households on the economic territory of the country in accordance with the domestic concept of consumption[59], household consumption is defined as the sum of the following categories of final demand: "Private consumption (resident households and NPISH[60])" and "Direct purchases by non-residents". In addition, following the induced price hikes, it is assumed that taxes (less subsidies) on products will remain proportional to the value of purchased goods and services before the price increase. The results are presented in Table 8 and Table 9. If labour costs in all sectors increase by 10 percent, the price of domestically produced products is expected to rise by 3.1%. After accounting for the fact that part of household expenditures is spent on foreign products, whose prices are unaffected by the domestic wage shock, consumer prices are expected to increase by 2.4%.

[59] For more information please refer to:
https://www.nsi.bg/sites/default/files/files/metadata/HICP_methodology_2021-ENG.pdf

[60] NPISH stands for non-profit institutions serving households.

Therefore, the calculated HICP elasticity to changes in wages is 0.24. This elasticity coefficient is derived on the basis of the cost-push view of inflation and embodies the assumptions that all firms along the supply chain fully pass higher wages to prices and that substitution of production factors is not possible. In reality, some firms may decide to absorb higher wages by reducing profits or they may replace the more expensive labour with capital, which would reduce the size of the wage pass-through.

It should be noted that the level of data aggregation is important for the calculated size of the wage pass-through. All results in this section were calculated based on an input-output table covering 45 economic sectors. To verify the stability of the results in terms of the format of the raw data, the following strategy was adopted: the input-output table was first aggregated to 6 large sectors, and then the price model was applied. This experiment revealed that less detailed data about the interlinkages between economic sectors resulted in a higher elasticity coefficient of around 0.26 (compared with 0.24 for the case of the detailed IO table).

In Section 1 of the paper it was commented that in 2017–2019 the government adopted a policy for increasing wages in the public sector by around 10% per year. Therefore, input-output tables can be used to estimate the impact of a 10% increase in wages in the public sector[61] on consumer prices, while keeping the wages in the other sectors fixed. Results suggest that this government policy would lead to an increase of consumer prices by 0.3% (see Table 10). The effect on prices would be greater if higher wages in the public sector induce increases of compensation per employee in the private sector.

Input-output analysis can also be used to simulate the impact of an increase in the minimum wage in Bulgaria. As of 2022, the share of minimum wage earners in total employees was 20.2%, up from 9.8% in 2008. Data on the share of people working at the minimum wage is available for 38 economic sectors. In order to conform to the 45-sector format of our input-output table, it is assumed that the share of wage earners is uniform across all subsectors and equivalent to that of the aggregated sector for which data is available. Results from the simulation are presented in Table 11. After a 10% increase in the minimum wage level, assuming all other wages in the economy remain constant, the prices of domestically produced goods can be expected to increase by 0.7%, with the impact on HICP amounting to 0.5%.

[61] These include "Public administration and defence; compulsory social security" (CPA_O), "Education" (CPA_P) and Human health and social work (CPA_Q).

Table 8: **The impact of a 10% wage increase in all sectors on the consumer price index (HICP)**

Sector	Code		Initial price index	New price index	Initial HFCE-domestic concept (mln USD)	New HFCE-domestic concept (mln USD)	Growth rate (in %)
Agriculture	CPA_A	1	1.0000	1.0247	1045	1071	2.5
Industry	CPA_B-E	2	1.0000	1.0269	7667	7874	2.7
Construction	CPA_F	3	1.0000	1.0288	377	388	2.9
Trade,hotel,transport	CPA_G-I	4	1.0000	1.0375	8773	9102	3.8
Business services	CPA_J-N	5	1.0000	1.0224	9730	9947	2.2
Other services	CPA_O-T	6	1.0000	1.0510	3227	3391	5.1
Domestic products		**7**			**30818**	**31773**	**3.1**
Imported final goods		**8**			**9091**	**9091**	
Taxes less subsidies on products		**9**			**5322**	**5449**	
Household final consumption expenditures - domestic concept (HFCE)		**10**			**45231**	**46313**	**2.4**

Note 1: Data refers to 2018.
Note 2: In the table, it is assumed that taxes less subsidies are proportional to the value of domestic and imported prices, which is why their value changes after the wage shock. Taxes on products are related to the value or the volume of products. They are levied on domestically produced or transacted products and on imported products. Taxes on products are classified into taxes on domestic products, taxes on imports and VAT. Subsidies on products are related to the value or the volume of products. They can be distinguished between subsidies on domestic products and subsidies on imports.
Note 3: HFCE stands for “Final consumption expenditure of households”.
Source: OECD

Table 9: **The impact of a 10% wage increase in all sectors on the consumer price index (HICP)**

Sector	Code		Initial price index	New price index	Initial HFCE-domestic concept (mln USD)	New HFCE-domestic concept (mln USD)	Growth rate (in %)
Agriculture, hunting, forestry	CPA_A1-2	1	1.000	1.025	1015	1040	2.5
Fishing and aquaculture	CPA_A3	2	1.000	1.017	30	31	1.7
Mining and quarrying, energy producing products	CPA_B5-6	3	1.000	1.043	49	51	4.3
Mining and quarrying, non-energy producing products	CPA_B7-8	4	1.000	1.026	19	20	2.6
Mining support service activities	CPA_B9	5	1.000	1.027	0	0	
Food products, beverages and tobacco	CPA_C10-12	6	1.000	1.027	2795	2872	2.7
Textiles, textile products, leather and footwear	CPA_C13-15	7	1.000	1.035	443	458	3.5
Wood and products of wood and cork	CPA_C16	8	1.000	1.030	111	114	3.0
Paper products and printing	CPA_C17-18	9	1.000	1.028	131	135	2.8
Coke and refined petroleum products	CPA_C19	10	1.000	1.007	451	455	0.7
Chemical and chemical products	CPA_C20	11	1.000	1.019	138	141	1.9
Pharmaceuticals, medicinal chemical and botanical products	CPA_C21	12	1.000	1.030	125	129	3.0
Rubber and plastics products	CPA_C22	13	1.000	1.024	193	198	2.4
Other non-metallic mineral products	CPA_C23	14	1.000	1.020	199	203	2.0
Basic metals	CPA_C24	15	1.000	1.016	57	58	1.6
Fabricated metal products	CPA_C25	16	1.000	1.034	206	213	3.4
Computer, electronic and optical equipment	CPA_C26	17	1.000	1.029	98	101	2.9
Electrical equipment	CPA_C27	18	1.000	1.026	196	201	2.6
Machinery and equipment, nec	CPA_C28	19	1.000	1.031	42	43	3.1
Motor vehicles, trailers and semi-trailers	CPA_C29	20	1.000	1.029	197	203	2.9
Other transport equipment	CPA_C30	21	1.000	1.027	55	57	2.7
Manufacturing nec; repair and installation of machinery and equipment	CPA_C31-33	22	1.000	1.033	415	429	3.3
Electricity, gas, steam and air conditioning supply	CPA_D	23	1.000	1.024	1267	1297	2.4
Water supply; sewerage, waste management and remediation activities	CPA_E	24	1.000	1.038	480	498	3.8
Construction	CPA_F	25	1.000	1.029	377	388	2.9
Wholesale and retail trade; repair of motor vehicles	CPA_G45-47	26	1.000	1.034	3947	4082	3.4
Land transport and transport via pipelines	CPA_H49	27	1.000	1.027	1422	1461	2.7
Water transport	CPA_H50	28	1.000	1.037	52	53	3.7
Air transport	CPA_H51	29	1.000	1.027	175	180	2.7
Warehousing and support activities for transportation	CPA_H52	30	1.000	1.038	407	422	3.8
Postal and courier activities	CPA_H53	31	1.000	1.050	210	220	5.0
Accommodation and food service activities	CPA_I	32	1.000	1.048	2561	2684	4.8
Publishing, audiovisual and broadcasting activities	CPA_J58-60	33	1.000	1.045	251	262	4.5
Telecommunications	CPA_J61	34	1.000	1.037	1134	1176	3.7
IT and other information services	CPA_J62_63	35	1.000	1.055	91	96	5.5
Financial and insurance activities	CPA_K	36	1.000	1.033	934	965	3.3
Real estate activities	CPA_L	37	1.000	1.011	6010	6078	1.1
Professional, scientific and technical activities	CPA_M	38	1.000	1.045	463	484	4.5
Administrative and support services	CPA_N	39	1.000	1.046	847	886	4.6
Public administration and defence; compulsory social security	CPA_O	40	1.000	1.067	248	265	6.7
Education	CPA_P	41	1.000	1.071	484	519	7.1
Human health and social work activities	CPA_Q	42	1.000	1.058	880	931	5.8
Arts, entertainment and recreation	CPA_R	43	1.000	1.033	932	963	3.3
Other service activities	CPA_S	44	1.000	1.039	604	628	3.9
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	CPA_T	45	1.000	1.100	77	85	10.0
Domestic products					**30818**	**31773**	**3.1**
Imported final goods					**9091**	**9091**	
Taxes less subsidies on products					**5322**	**5449**	
Household final consumption expenditures - domestic concept (HFCE)					**45231**	**46313**	**2.4**

Note 1: Data refers to 2018.
Note 2: In the table, it is assumed that taxes less subsidies are proportional to the value of domestic and imported prices, which is why their value changes after the wage shock. Taxes on products are related to the value or the volume of products. They are levied on domestically produced or transacted products and on imported products. Taxes on products are classified into taxes on domestic products, taxes on imports and VAT. Subsidies on products are related to the value or the volume of products. They can be distinguished between subsidies on domestic products and subsidies on imports.
Note 3: HFCE stands for "Final consumption expenditure of households".
Source: OECD

Table 10: **The impact of a 10% wage increase in the public sector (O-Q) on the consumer price index**

Sector	Code		Initial price index	New price index	Initial HFCE-domestic concept (mln USD)	New HFCE-domestic concept (mln USD)	Growth rate (in %)
Agriculture	CPA_A	1	1.0000	1.0004	1045	1045	0.0
Industry	CPA_B-E	2	1.0000	1.0003	7667	7670	0.0
Construction	CPA_F	3	1.0000	1.0007	377	377	0.1
Trade,hotel,transport	CPA_G-I	4	1.0000	1.0006	8773	8779	0.1
Business services	CPA_J-N	5	1.0000	1.0006	9730	9735	0.1
Other services	CPA_O-T	6	1.0000	1.0294	3227	3321	2.9
Domestic products		**7**			**30818**	**30927**	**0.4**
Imported final goods		**8**			**9091**	**9091**	
Taxes less subsidies on products		**9**			**5322**	**5337**	
Household final consumption expenditures - domestic concept (HFCE)		**10**			**45231**	**45354**	**0.3**

Note 1: Data refers to 2018.
Note 2: In the table, it is assumed that taxes less subsidies are proportional to the value of domestic and imported prices, which is why their value changes after the wage shock. Taxes on products are related to the value or the volume of products. They are levied on domestically produced or transacted products and on imported products. Taxes on products are classified into taxes on domestic products, taxes on imports and VAT. Subsidies on products are related to the value or the volume of products. They can be distinguished between subsidies on domestic products and subsidies on imports.
Note 3: HFCE stands for “Final consumption expenditure of households”.
Source: OECD

Table 11: **The impact of a 10% increase in the minimum wage on the consumer price index**

Sector	Code		Initial price index	New price index	Initial HFCE-domestic concept (mln USD)	New HFCE-domestic concept (mln USD)	Growth rate (in %)
Agriculture	CPA_A	1	1.0000	1.0058	1045	1051	0.6
Industry	CPA_B-E	2	1.0000	1.0062	7667	7715	0.6
Construction	CPA_F	3	1.0000	1.0077	377	380	0.8
Trade,hotel,transport	CPA_G-I	4	1.0000	1.0090	8773	8852	0.9
Business services	CPA_J-N	5	1.0000	1.0040	9730	9769	0.4
Other services	CPA_O-T	6	1.0000	1.0091	3227	3256	0.9
Domestic products		**7**			**30818**	**31022**	**0.7**
Imported final goods		**8**			**9091**	**9091**	
Taxes less subsidies on products		**9**			**5322**	**5349**	
Household final consumption expenditures - domestic concept (HFCE)		**10**			**45231**	**45463**	**0.5**

Note 1: Data refers to 2018.
Note 2: In the table, it is assumed that taxes less subsidies are proportional to the value of domestic and imported prices, which is why their value changes after the wage shock. Taxes on products are related to the value or the volume of products. They are levied on domestically produced or transacted products and on imported products. Taxes on products are classified into taxes on domestic products, taxes on imports and VAT. Subsidies on products are related to the value or the volume of products. They can be distinguished between subsidies on domestic products and subsidies on imports.
Note 3: HFCE stands for “Final consumption expenditure of households”.
Source: OECD

Bibliography

Babecký, J., Du Caju, P., Kosma, T., Lawless, M., Messina, J. & Room, T., 2012. Downward nominal and real wage rigidity: Survey evidence from European firms. The Scandinavian Journal of Economics, 114(4), pp. 884–910.

Banerji, A., 2005. The cyclical behavior of wages: Lagging at troughs and leading at peaks. Journal of Economic Dynamics and Control, 29(8), pp. 1525–1541.

Bjørnstad, R., Nymoen, R. (2008), "The New Keynesian Phillips Curve tested on OECD panel data", Economics E-Journal 2: 1–18.
Bårdsen, G., Jansen, E. & Nymoen, R., 2004. Econometric evaluation of the New Keynesian Phillips curve. Oxford Bulletin of Economics and Statistics, 66, pp. 671–686.

Bentolila, S. & Saint-Paul, G., 2003. Explaining movements in the labor share. Berkeley Electronic Journals in Macroeconomics: Contributions to Macroeconomics, 3(1), Article 9.

Bidder, R., 2015. Are wages useful in forecasting price inflation? FRBSF Economic Letter, No. 2015-33, November 2.

Bjørnstad, R. & Nymoen, R., 2008. The New Keynesian Phillips Curve tested on OECD panel data. Economics E-Journal, 2, pp. 1–18.

Blanchard, O. & Gali, J., 2007. Real wage rigidities and the New Keynesian model. Journal of Money, Credit and Banking, 39(S1), pp. 35–65.

Bobeica, E., Ciccarelli, M. & Vansteenkiste, I., 2019. The link between labor cost and price inflation in the euro area. European Central Bank Working Paper Series, No. 2235, February.

Bobeica, E., Ciccarelli, M. & Vansteenkiste, I., 2020. The link between labor cost inflation and price inflation in the Euro Area. In: G. Castex, J. Gali & D. Saravia, eds. Changing Inflation Dynamics, Evolving Monetary Policy. Vol. 27 of Central Banking, Analysis, and Economic Policies Book Series, Central Bank of Chile.

Bobeica, E., Ciccarelli, M. & Vansteenkiste, I., 2021a. The changing link between labor cost and price inflation in the United States. European Central Bank Working Paper Series, No. 2583.

Bobeica, E., Ciccarelli, M. & Vansteenkiste, I., 2021b. Why did the pass-through from labor cost to price inflation decline in the US? SUERF Policy Brief, No. 198, October.

Bobeica, E. & Jarocinski, M., 2019. Missing disinflation and missing inflation: A VAR perspective. International Journal of Central Banking, 15(1), pp. 1–46.

Bodnár, K., Fadejeva, F., Iordache, S., Malk, L., Paskaleva, D., Pesliakaitė, J., Jemec, N., Tóth, P., & Wyszyński, R., 2018. How do firms adjust to rises in the minimum wage? Survey evidence from Central and Eastern Europe. Bulgarian National Bank DP/111/2018.

Borio, C., Lombardi, M., Yetman, J., & Zakrajšek, E., 2023. The two-regime view of inflation. BIS Papers, No. 133.

Carlsson, M., & Nordström Skans, O., 2012. Evaluating microfoundations for aggregate price rigidities: Evidence from matched firm-level data. American Economic Review, 102(4), 1571–1595.

Carter, C., & Kohn, R., 1994. On Gibbs sampling for state space models. Biometrika, 81, 541–553.

Ciccarelli, M., & Osbat, C., 2017. Low inflation in the euro area: Causes and consequences. European Central Bank, Occasional Paper Series 181/2017.

Dees, S., & Guntner, J. H. F., 2014. An empirical analysis of euro area sovereign bond yield spreads: The role of financial market fragmentation. European Central Bank, Working Paper Series No. 1714.

Deutsche Bundesbank., 2019. The impact of wages on prices in Germany: Evidence from selected empirical analyses. Monthly Report, September.

Druant, M., Fabiani, S., Kezdi, G., Lamo, A., Martins, F., & Sabbatini, R., 2012. Firms' price and wage adjustment in Europe: Survey evidence on nominal stickiness. Labor Economics, 19(5), 772–782.

ECB., 2014. Monthly Bulletin July 2014. European Central Bank.

Emery, K. M., & Chang, C. P., 1996. Do wages help predict inflation? Federal Reserve Bank of Dallas Economic Review, First Quarter, 2–9.

Eickmeier, S., & Moll, K., 2009. The global dimension of inflation – Evidence from factor-augmented Phillips curves. European Central Bank, Working Paper Series No. 1011/2009.

European Commission., 2009. Five years of an enlarged EU: Economic achievements and challenges. European Economy – Report 1/2009.

Eurostat., 2008. Eurostat manual of supply, use and input-output tables. Eurostat Methodologies and Working Papers, 2008 Edition.

Gali, J., 2011. The Return of The Wage Phillips Curve, Journal of the European Economic Association, European Economic Association, vol. 9(3), pages 436-461, June.

Gali, J., 2015. Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications – Second Edition. Princeton University Press.

Gali, J., & Gertler, M., 1999. Inflation Dynamics: A Structural Econometric Analysis. Journal of Monetary Economics, 44(2), 195–222.

Gali, J., Gertler, M., & Lopez-Salido, J., 2001. European Inflation Dynamics. European Economic Review, 44(7), 1237–1270.

Gordon, R. J., 1988. The role of wages in the inflation process. American Economic Review, 78(2), 276–283.

Gumiel, J. E., & Hahn, E., 2018. The wage-price pass-through in the euro area. ECB Economic Bulletin, No. 8.

Hahn, E., 2019. The role of labor cost shocks in euro area inflation dynamics. ECB Working Paper Series No. 2317.

Hess, G. D., & Schweitzer, M. E., 2000. Does wage inflation cause price inflation? Federal Reserve Bank of Cleveland Economic Review, 36(1), 2–12.

Hu, L., & Toussaint-Comeau, M., 2010. Do labor market activities help predict inflation? Economic Perspectives, 34(2), 52–63.

Hviid, S., & Renkin, T., 2020. Labor cost pass-through to producer prices in Denmark. Denmarks Nationalbank, Working Paper No. 166.

Izquierdo, M., Messina, J., & Moral-Benito, E., 2017. The role of the institutional framework in shaping wage and price dynamics across Europe. ECB Working Paper Series No. 2068.

IMF., 2018. Labor costs and inflation in advanced economies. World Economic Outlook, April.

Ivanov, V., Paskaleva, D., & Vassilev, A., 2019. Labor market functioning and matching efficiency in Bulgaria over the period 2004–2017: Qualification and regional aspects. Bulgarian National Bank DP/114/2019.

Kasabov, D., Kotseva, P., Vassilev, A., & Yanchev, M., 2017. Relationship between inflation, potential output, and structural unemployment in Bulgaria. Bulgarian National Bank DP/104/2017.

Kasabov, D., & Paskaleva, P., 2018. Cost- and price-setting drivers in Bulgaria in the period 2009–2013: WDN survey evidence. Bulgarian National Bank DP/112/2018.

Knotek, E. S., & Zaman, S., 2014. On the relationships between wages, prices, and economic activity. Federal Reserve Bank of Cleveland Economic Commentary, No. 2014-14.

Kotseva, P., & Yanchev, M., 2017. Analysis of the Housing Market Developments and the Underlying Macroeconomic Fundamentals in Bulgaria. Bulgarian National Bank DP/103/2017.

Lagoa, S., 2017. Determinants of Inflation Differentials in the Euro Area: Is the New Keynesian Phillips Curve Enough? Journal of Applied Economics, Vol XX, No. 1 (May 2017), 75–103.

Leontief, W., 1966. Input-Output Economics. Oxford University Press.

Lozev, I., Vladova, Z., & Paskaleva, D., 2011. Wage-setting behaviour of Bulgarian

firms: Evidence from survey data. Bulgarian National Bank DP/87/2011.

Mehra, Y. P., 2000. Wage-price dynamics: Are they consistent with cost-push? Economic Inquiry, 38(2), 140–157.

Miller, R., & Blair, P., 2012. Input-Output Analysis: Foundations and Extensions (Second edition). Cambridge University Press.

Nekarda, C., & Ramey, V., 2013. The Cyclicality of the Price-Cost Markup. NBER Working Paper 19099.

Nguyen, A., Takizawa, H., & Vassileva, I., 2023. Inflation Dynamics in Bulgaria: The Role of Policies. IMF Working Paper WP/23/212.

Nickel, Ch., Bobeica, E., Koester, G., Lis, E., & Porqueddu, M., 2019. Understanding low wage growth in the euro area and European countries. European Central Bank, Occasional Paper No 232 / September.

Paskaleva, P., 2016. Labor cost and price adjustment practices of Bulgarian firms in the period 2009–2013, Wage Dynamics Network firm-level survey evidence. Bulgarian National Bank DP/101/2016.

Peneva, E. V., & Rudd, J. B., 2017. The passthrough of labor costs to price inflation. Journal of Money, Credit and Banking, 49(5), 1107–1132.

Primiceri, G., 2005. Time Varying Structural Vector Autoregressions and Monetary Policy. Review of Economic Studies, 72(3).

Rissman, E. R., 1995. Sectoral wage growth and inflation. Federal Reserve Bank of Chicago Economic Perspectives, 19(4), 16–25.

Sbordone, A. M., 2002. Prices and unit labor costs: A new test of price stickiness. Journal of Monetary Economics, 49(2), 265–292.

Stock, J. H., & Watson, M. W., 2008. Phillips curve inflation forecasts. NBER Working Paper Series No. 14322.

Zanetti, F., 2007. Labor market institutions and aggregate fluctuations in a search and matching model. European Economic Review, 51(8), 1913–1944.

ISBN 978-619-7409-32-1 (online)

The sculptural composition by Kiril Shivarov depicting Hermes and Demeter on the southern façade of the Bulgarian National Bank building is used in cover design