Box 1. The inflationary impact of labour shortage

The skill mismatch and the continued downtrend in the working-age population in Romania's economy, influenced *inter alia* by a high emigration rate, affect the equilibrium in the labour market, the local companies facing significant challenges when rebuilding or expanding employment. Wages are typically the first to be adjusted in order to close the gap between labour demand and supply, an evolution which is then passed through via marginal costs into price developments. This analysis relies on firm-level survey data and seeks first to quantify the effects of labour shortage on real wage dynamics by economic activity. Subsequently, they are included in a multisectoral general equilibrium model having specific mechanisms to connect labour market developments with consumer price movements.

Labour shortage is the gap between the need for adequately skilled staff and the available candidates at a given real market wage. It is only partially captured using specific macroeconomic indicators (job vacancy rate, labour market tightness indicator), while firms resort to other strategies as well (training, capital investment, streamlining of processes) in order to cover that need, when the marginal cost of increasing the number of employees outweighs the related marginal benefit. In this context, firm-level data can provide a picture closer to employers' real perception of the constraints on the availability of qualified staff. Papers using exclusively survey data show that firms with more acute skilled labour shortages offer more substantial wages, as compared to the other entities in the economy (see, for instance, Frohm, 2021 and Kölling, 2022). Moreover, companies' perception of labour shortages changes slowly over time, the trajectory being ascribed to a significant extent to structural factors, such as the participation rate, educational attainment level, regional labour supply (Healy *et al.*, 2015, Groiss and Sondermann, 2023), as well as to technological changes, which increase the skill mismatch, particularly in high skill occupations (Acemoglu and Autor, 2011). Cyclical developments can be relevant as well, with companies adjusting upwards their search effort, wage policy, or downwards their skill requirements when they need to expand employment in order to cover the mounting demand for their products (Carrillo-Tudela *et al.*, 2023), all this resulting in higher wage costs. However, survey data also show that a firm may inaccurately assess that it faces a labour shortage, while in reality it cannot provide sufficiently high wages and/or appropriate working conditions to attract adequately skilled workforce (Brunello and Wruuck, 2021).

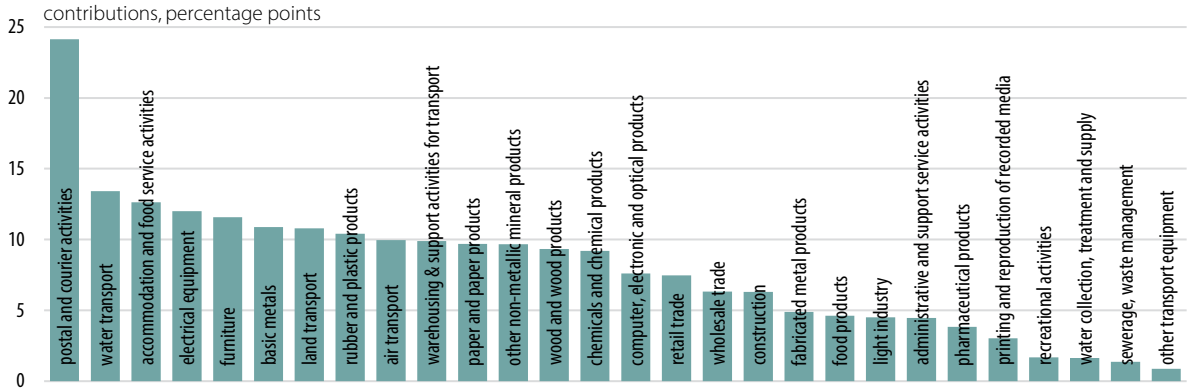
The data used to assess labour shortage effects on wage dynamics across the national economic sectors were extracted from the *Survey on the access to finance of non-financial corporations in Romania*, conducted by the NBR twice a year. The *Survey* covers data from 2017 to 2024 H1, except for 2022, when the question about the availability of skilled staff was not included. The survey observations were corroborated with the balance sheet data of firms, provided by the Ministry of Finance (available only until 2023). The database thus established also comprises, in addition to the annual growth of average wage paid by a certain firm, other indicators representing control variables in the regression model. In this vein, this Box continues the NBR's analysis made in 2024[1], where wage cost dynamics

[1] "Box. The effect of labour shortages on wage growth and number of employees", published in the NBR's August 2024 *Inflation Report*.

per employee were estimated to stand about 7 percentage points higher, on average, in the period from 2017 to 2021, for the firms facing shortage of labour, especially skilled staff.

The average wage increases in national economic sectors triggered by skilled labour shortage are shown in Chart A. The greatest impact is recorded in postal and courier activities, a sector which is labour intensive, on the one hand, and has seen sustained demand growth amid the expansion of online trade, on the other. Similar factors account for the rise in wages in the restaurants segment, to these also adding the reduction of productive capacities due to the pandemic. Rebuilding these capacities requires higher costs to attract the available labour from other economic sectors. For the other sectors, the common factor is, most likely, the lack of potential employees with specific technical or digital skills, a trend that is observed in most European economies (Cedefop, 2024).

Chart A. Labour shortage effect on sectoral wage dynamics



Note: The chart shows only the sectors where the labour shortage effect on wages is statistically significant. The impact represented graphically results from adjusting the estimated coefficient to companies' relevance for each business sector, depending on their number of employees. Based on a relatively small sample of firms, econometric assessments were made for every NACE section, except for industry, in which case the classification by main industrial grouping was used, and retail and wholesale trade, and restaurants, where the sector was defined on the basis of NACE divisions. The estimates were made using an instrumental variable econometric model, similar to that employed by Groiss and Sondermann, 2023. The control variables refer to the average wage and number of employees in the previous period, labour productivity growth, company age, annual trend and fixed sector effects defined for NACE divisions.

Source: Ministry of Finance, NBR, NBR calculations and estimates

The following stage of analysis implies a structural general equilibrium model that includes input-output linkages among national economic sectors, the theoretical framework being largely similar to that proposed by Smets *et al.* (2018). In this type of models, apparently benign developments in some economic sectors that are small, but at early stages of the production chain, can generate sizeable macroeconomic effects, the networks amplifying the supply-side shocks to producers (Carvalho and Tahbaz-Salehi, 2019). Moreover, the theoretical framework also incorporates open-economy mechanisms, each business sector having its own share in imports of intermediate goods. As regards the production process, the model simulates the linkages captured by symmetrical input-output tables of the Romanian economy, while also enabling the propagation of shocks both upstream and downstream along the production chains.

The labour market is segmented, in the sense that the available workforce in each economic sector is constant, with the relationship between the unemployed and employers governed by search-and-matching frictions, to which adds an endogenous separation mechanism allowing the firm to lay off a new employee if they have insufficiently high productivity. The model parameters are calibrated using an extensive data set referring to input-output tables, sectoral distribution of labour force, employment rates, level-firm balance sheet and price data, national accounts data, etc.[2]. As regards the sectoral size, the model simulates a 42-sector economy, defined at the level of NACE divisions and sections.

The literature provides strong indications for a significant opposite relationship between labour shortage and labour market efficiency (Carrillo-Tudela *et al.*, 2023; Groiss and Sondermann, 2023). This enables the use of micro estimates in the model, where the high wage dynamics generated by the change in labour market efficiency will be linked with the labour shortage[3]. Therefore, it is assumed that the hiring rate can be reduced independently from the number of job vacancies and the unemployed, given the presence of other factors that can make labour market matching more difficult (such as higher employment standards). A reduction in labour market efficiency leads to a lower probability of firms expanding their payrolls, as they first feel discouraged to post job vacancies[4]. The relatively low hiring rate of approximately 1.5 percent (according to the latest Eurostat data on the transition from unemployment to employment in the 2022-2023 period) also supports this development. Subsequently, once with the increase in employees' marginal value, firms start to post new job vacancies up to a level higher than the pool of unemployed persons, which results in labour market tightness. In this context, labour costs increase, also on account of the complementarity between labour and capital[5]. Further on, these developments reflect in marginal costs, which pass through relatively quickly to producer prices, given the high frequency of price changes. Then, changes in producer prices are further transmitted and amplified along the production chains, thus leading to the increase in inflation rate (based on firm-level data, an average period of three months between price changes is specified in the model, with services prices being considerably stickier than those in industry).

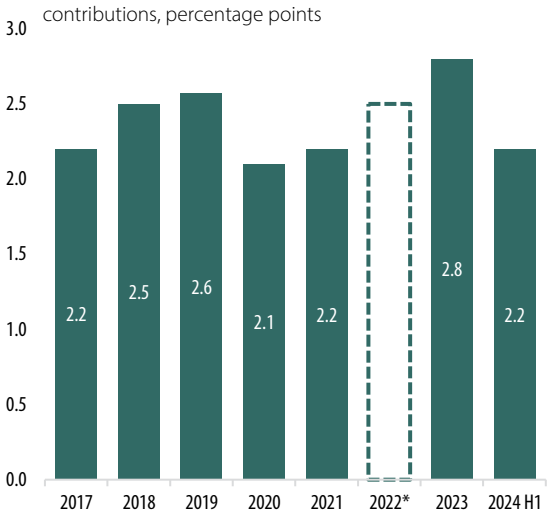
2 Certain parameters that could not be estimated or calibrated based on actual statistical data were taken over from Copaciu *et al*., 2016, who estimate for the domestic economy a model with mechanisms similar to that used in this analysis, but which assumes only two business sectors classified depending on the currency in which firms borrow.

3 The shock sequence associated with labour market efficiency was determined by fixing the sectoral wage cost dynamics to a one-year level and using the Kalman filter in a context in which the monetary policy rate remains unchanged. Subsequently, all shocks are simultaneously introduced and the model is simulated in perfect foresight in order to take account of non-linear effects, with network effects making a significant contribution. This approach also assumes that the economic agents know the entire shock structure, the assumption being feasible given the dominant structural component of this phenomenon.

4 An important contribution to this trajectory is made by the equilibrium period of over four months when a job stays vacant, a value in line with the calibrations in the literature (Ravenna and Walsh, 2008) and slightly below the anecdotal evidence collected by recruitment firms, suggesting a period of almost six months. A higher value determines the prevalence of firms becoming discouraged to post job vacancies.

5 The model uses a nested constant elasticity of substitution production function, which includes two substitution elasticities, one governing the capital-to-labour ratio and the other the relationship between capital-labour bundle and materials. The substitution elasticities were estimated using firm- and household-level data (NIS *Household Budget Surveys*).

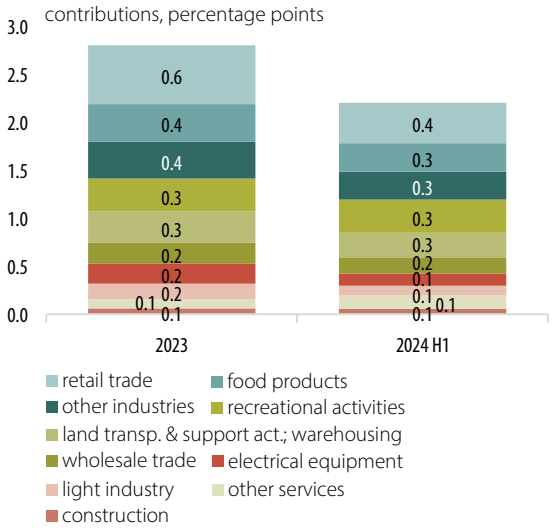
Chart B. Labour shortage effect on inflation rate



*) interpolated value due to unavailable data

Source: NBR estimates

Chart C. Contribution of sectoral labour shortage to the increase in inflation rate



Source: NBR calculations and estimates

The results show that the labour shortage in the Romanian economy pushed inflation up by approximately 2.8 percentage points[6] in 2023, when the highest contribution was recorded in the reviewed period (Chart B). The theoretical framework indicates a transmission coefficient of approximately 30 percent from real wage growth to the annual inflation rate. Subsequently, the impact on inflation rate fell to about 2.2 percentage points, due to more favourable expectations of labour availability in 2024 H1, attributed to a certain extent to the slowdown in economic activity. At the same time, noteworthy is the resilience of the labour shortage effect, which stays above the 2.0 percent threshold, suggesting the prevalence of structural factors on the labour market.

Although the labour shortage effect is manifest on most domestic economic sectors, only certain segments are clearly relevant to consumer prices (Chart C). Retail trade and recreational activities make significant contributions, i.e. approximately 1 percentage point in 2023 and 0.8 percentage points in 2024 H1. Strong influences also have food products, the light industry and electrical equipment, the last segment manufacturing several types of equipment used in consumer goods industries. The inflationary effects from land transport, warehousing and support activities for transport and wholesale trade propagate in a similar manner.

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