

Energy Price Shocks, Inflation, and Distribution in Italy: A Simulation Model and Policy Analysis

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Rising energy prices following the Russo-Ukrainian war generated the greatest inflation rise of the last decades in advanced economies. This paper uses the EUROGREEN data-driven macro-simulation model for the Italian economy (D'Alessandro et al., 2020; Distefano and D'Alessandro, 2023) to analyze the macroeconomic and distributional effects of energy price and mark-up shocks. The EUROGREEN dynamic framework follows a stock-flow consistent approach in line with Post-Keynesian Economics, also building on an input-output structure for the Italian economy. The interrelation between economic activity, employment, wages, and prices is formalized in a way compatible with the conflict inflation perspective (Rowthorn, 1977; Lavoie, 2022; Morlin, 2023). The simulations show how price shocks, mark-up shocks, and wage indexation affect inflation, GDP, employment, the labour share of income, and consumption levels of different income groups. We find that increases in energy prices and profit margins hit the income and real consumption of the most vulnerable social groups (low-skilled workers and people out of the labour force) the hardest. Wage indexation protects workers' incomes from price increases without leading to any accelerationist trends in inflation dynamics, albeit making inflation persistent over a longer time horizon. However, wage indexation has ambiguous effects on income distribution within the working class, increasing the distance between workers at the top and the bottom of the income distribution. We conclude that additional policies, such as targeted subsidies and a minimum wage policy, could further protect the income of low-skilled workers and reduce wage inequality.

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Introduction

The recent return of inflation in advanced economies, after the long period of stability named “Great Moderation”, has brought the issue of structural supply shocks as the cause of the generalised rise in prices back to the centre of economic debate. Underlying the current inflationary surge is the rise in oil, gas and commodity prices. The increase in energy prices, accelerated by Russia’s invasion of Ukraine in February 2022 and the subsequent escalation of international tensions, has built on a framework of pre-existing tensions on consumer price dynamics, already visible in the pandemic period.

Rising energy prices have an impact on all production processes, as energy goods enter - directly and indirectly - into the production of all goods and services. An increase in prices and profits in the upstream sectors of the production processes has an impact on the prices charged by companies operating in the downstream sectors, which are induced to protect their profit margins by passing on the increase in production costs to prices, creating a domino effect all along the supply chain up to the final consumer. Recent empirical research has shown how firms operating in downstream sectors have managed not only to defend, but even to expand their profit margins by exploiting expectations of rising prices of intermediate inputs (see, for example, ECB, 2023 and Weber and Wasner, 2023). The current price growth thus seems to be attributable to a profit inflation dynamic (Storm, 2022). If the main causes of the current inflationary phenomenon are microeconomic in nature - scarcity and price growth of intermediate inputs, sectoral imbalances, increasing profit margins of firms with market power, the presence of bottlenecks in supply chains - the adoption of restrictive monetary policies, aimed at squeezing aggregate demand, appears unsuitable to slow down the rise of price level (Stiglitz and Regmi, 2023).

There is a close relationship between inflation and income distribution. On the one hand, the growth of the price level can be seen as the result of a conflict between capital and labour over the distribution of the social product - a thesis supported by heterodox economic schools (Rowthorn, 1977; Ciccarone and Gnesutta, 1993; Graziani, 1998, 2003; Lavoie, 2022). Interestingly, even some mainstream analyses now recognise the relevance of this perspective (Lorenzoni and Werning, 2023).¹ On the other hand, inflation caused by foreign price increases has a direct impact on the distribution of the social product, leading - in the absence of price-adjustment mechanisms for wages - to a worsening in the distribution to the detriment of labour income (Morlin, 2023). Fears of a price-wage spiral seem unfounded in the current context, given the extremely weak bargaining position of the working class and the low responsiveness of monetary wages to price increases. The problem, rather, is that rising consumer prices and restrictive monetary policies have significant effects on employment and workers’ real incomes. The risk is that the economic and social costs of inflation and of the policies implemented to cope with it fall entirely on the working class, already hit by years of stagnation or decline in real wages (Cirillo *et al.*, 2023)

In this contribution we use the EUROGREEN dynamic macro-simulation model (D'Alessandro *et al.*, 2020; Distefano and D'Alessandro, 2023) to analyse the transmission of energy price and profit margin shocks, as well as the macroeconomic and distributional impact of the introduction of a wage indexation policy. In the first part, through several simulation exercises corresponding to different real wage and profit margin (mark-up) response scenarios, we discuss how price shocks affect

¹ In a tweet on 30 December 2002, Olivier Blanchard wrote that: “Inflation is fundamentally the outcome of the distributional conflict, between firms, workers, and taxpayers. It stops only when the various players are forced to accept the outcome”.

inflation dynamics, GDP and employment developments and the evolution of income distribution between capital and labour. Contrary to mainstream economic theory, the introduction of a policy of wage indexation would protect workers' incomes from increasing prices without causing any explosive trend in inflation dynamics. In the second part, we examine the effects of inflationary shocks and wage indexation policy on income distribution within the working class. The simulation exercise confirms that increases in energy prices and profit margins hit wages and real consumption of the most vulnerable social groups (low-skilled workers and people outside the labour force) the hardest. The pegging of monetary wages to the growth of the price level would allow the fall in purchasing power of lower incomes to be stemmed, while having ambiguous effects on the distribution of income within the working class.

Methodology

The EUROGREEN model is a dynamic macro-simulation model calibrated to data on the Italian economy in 2010 and includes several macroeconomic and environmental variables, a segmented labour market (with low, medium and high-skilled labour supply and demand), several indicators of income and wealth distribution and a dynamics of process innovations determined by production cost trends (Cieplinski et al., 2021). By adopting a systems dynamics perspective, the EUROGREEN model makes it possible to analyse the multiple interconnections and main feedback mechanisms between socioeconomic and environmental components.

The causal relationships between the economic variables included in the model are formulated on the basis of post-Keynesian economic theory (Lavoie, 2022). In the model, therefore, we assume that the economy is driven by effective demand, both in the short and long run, and has no spontaneous tendency towards full employment of factors of production. Investment is primarily determined by the degree of capacity utilisation, subject to a ceiling determined by the ability to finance out of their current profits. Enterprises determine prices by setting a profit margin (mark-up) on average production costs, which depend on the unit cost of intermediate goods, the depreciation of capital stock and the unit cost of labour. The profit margins in each production sector are calibrated to the actual data in the initial period and are determined by the trend in demand in each sector. The unit labour cost dynamic is determined by the trend of the average nominal wage, employment, and labour productivity.

The relationship between employment, income distribution and price growth reflects the theories of conflicting claims inflation (Rowthorn, 1977; Lavoie, 2022): in expansionary phases, employment growth leads to an increase in nominal wages; firms attempt to protect their profit margins by transferring - in part - the increase in production costs to prices; in contrast to the neoclassical theory, the distributional outcome is not determined a priori on the basis of a “natural” income distribution but depends on the concrete evolution of the power relations between capital and labour, which is significantly influenced by labour market institutions and economic policy orientations.

The model is also based on an environmentally extended social accounting matrix and a system of input-output relations for the analysis of sectoral interdependencies consistent with official national accounts. The input-output structure underlying the EUROGREEN model allows a more rigorous analysis of the transmission channels of energy price increases to the other production sectors. Using a bridging matrix (Cazcarro, et al. 2022), it is also possible to analyse how increases in prices in each

production sector are transmitted to household consumption goods.¹ Since each income group has a specific consumption basket, shocks to energy prices and profit margins affect households asymmetrically according to their income level.

The direction of process innovations is determined endogenously by the trend of unit labour costs and the unit cost of intermediate goods. More specifically, process innovations can lead firms to save labour and/or intermediate inputs. The probability that new technologies that save labour or intermediate inputs will be discovered and implemented depends on the ratio of unit labour cost to intermediate input cost. An increase in the unit cost of labour relative to the unit cost of intermediate goods in a given production sector, for example, increases the probability that firms in that sector will discover and adopt labour-saving innovations. The dynamics of innovations thus follow a stochastic (non-deterministic) process, determined by a random component related to the probability of a new technology being discovered and introduced into production processes. Since this random component varies in each simulation, we have reported the results of 200 simulations for each scenario. The scenarios are compared by comparing the median value of the simulations.

In this chapter, we estimated the impact of an increase in energy prices and profit margins, as well as the introduction of a wage indexation policy, on the inflation rate and real consumption of workers according to their income group. The four income groups examined are identified on the basis of the skill level or employment status of the workers: 1) low-skilled individuals outside the labour force (the most vulnerable social group); 2) low-skilled employed; 3) medium-skilled employed; 4) high-skilled employed. To simplify the analysis, the simulations are carried out on the variables related to male workers.² The results are presented by comparing the trend of the variables of interest in the scenario under consideration with their trend in the counterfactual scenario - the “baseline trajectory” - which describes how the Italian economy would have fared without the inflationary shock of 2022. In all scenarios the variables follow the trend of the baseline trajectory until 2022 - the year in which we introduce price increases and, possibly, increases in profits and wages into the model.

Scenarios

We present the results of three simulation scenarios.

- **Baseline trajectory.** The baseline trajectory illustrates the development of the economy in the absence of price, profit and wage increases. This scenario provides the comparative benchmark for evaluating the other scenarios.
- **ΔP scenario.** In this scenario, we introduce the energy price shock that occurred in 2022, with the assumption that it will gradually taper off until it is fully absorbed in 2025. The increase in energy prices leads to both an increase in prices paid by the final consumer and an increase in firms’

¹ Data come from the Household Budget Survey, which collects information on household expenditure. See Distefano et al. (2020) and Distefano and D'Alessandro (2023) for a discussion of the methodology, in particular the relationship between the classification of sectors in the input-output structure and the classification of household consumption goods.

² In the EUROGREEN model, workers are classified according to gender (male or female), skill level (low, medium, high), employment status (employed, unemployed, out of the labour force, retired) and the production sector to which they belong (19 sectors, identified according to the NACE Rev. 2 classification). For reasons of space, it was decided to limit the analysis to male workers only, considering the average income received by each of the four categories in the 19 production sectors. Of course, the model is well-suited to deal with other dimensions of income distribution, including gender inequalities.

production costs. The increase in production costs propagates across all production sectors through the input-output structure.

- $\Delta(P + M)$ scenario. In this scenario we assume - along with an energy price shock - a generalised increase in the profit margin (mark-up) set by firms on production costs. The mark-up gradually decreases over a time horizon of five years. After this period, the mark-up goes back to the “pre-shock” path.
- $\Delta(P + M + W)$ scenario. In this scenario we introduce a full wage indexation rule. To the wage equation of the basic trajectory - wages are a decreasing function of the unemployment rate and an increasing function of labour productivity - we add a component of consumer price growth. Monetary wages, therefore, in addition to partially responding to changes in the unemployment rate and labour productivity - as in the basic trajectory - grow proportionally to the increase in the general price level. Full indexation therefore provides full protection of the purchasing power of wages from inflation. i.e.

The results of the simulation exercise are illustrated graphically. Each figure shows the median and the confidence interval of the results of 200 simulations for each scenario. Each simulation modifies the random component related to the generation and diffusion of technological innovations. The median results allow for a comparison between alternative scenarios.

Results

We first analyze the effects of the shocks on inflation, output, the employment rate and the labour share of income. We then consider how the shocks affect income and consumption of workers in different income groups.

Figure 1 shows the effects of the shocks on inflation. In the ΔP scenario, the effect of higher energy prices brings total inflation to 7% in 2022, with the trajectory gradually decreasing to below 2% in 2026. The $\Delta(P + M)$ scenario, which also includes an increase in firms’ profit margins in all production sectors, leads to an inflation rate of 9% in 2022, more in line with what actually occurred in that year, confirming that rising profits fuelled Italian inflation.

In the $\Delta(P + M + W)$ scenario, inflation is prolonged due to wage indexation, with price level growing around 8% in 2024, gradually decreasing to 2% in 2030, four years later than in the other scenarios.

(Figure 1 about here)

Figure 2 shows the dynamics of real GDP (at 2010 prices). In all three scenarios, output falls below the baseline trajectory. In both the ΔP and the $\Delta(P + M)$ scenario, the negative effect of inflation on real GDP is persistent, even after inflation returns to low values. The introduction of wage indexation ($\Delta(P + M + W)$ scenario) allows for a partial recovery of production levels in 2024, as higher real wages sustain aggregate demand. However, the dynamics of real GDP would continue to lag behind the baseline trajectory similar to the other scenarios.

(Figure 2 about here)

The employment rate also decreases in all three scenarios under consideration (Figure 3). In 2030, the employment rate would be about two percentage points lower in the ΔP scenario and about four percentage points lower in the $\Delta(P + M)$ scenario, due to the fall in output. In the $\Delta(P + M + W)$ scenario, employment would fall even further because the increase in real wages push companies to introduce more labour-saving innovations.

(Figure 3 about here)

Figure 4 shows the effects of the shocks on the labour share of national income. The immediate impact of an increase in the inflation rate is an erosion of the labour income share, which accounted for about 50% of GDP in 2021. In the ΔP scenario, the wage share in GDP drops to 45% in 2030 due to the fall in real wages. In the $\Delta(P + M)$ scenario, the generalised increase in firms' profit margins brings the wage share even lower (43%). The fall in wages continues even after 2025. Rising prices and profits thus have permanent effects on functional income distribution. The introduction of a wage indexation policy, on the contrary, leads to an increase of the wage share by two to three percentage points as compared to the baseline trajectory. Therefore, the introduction of an institutional mechanism for adjusting wages to price growth would change the power relations between capital and labour, allowing workers to get a larger share of national income.

(Figure 4 about here)

However, inflation has asymmetric effects on different income groups, even within the working class, as each income category has a specific basket of consumer goods. In the EUROGREEN model, workers are classified according to skill level and employment status, and it is therefore possible to estimate how inflation affects each of these groups.

Figure 5 shows the inflation rate for four income groups, identified on the basis of employment status and skill level, in the $\Delta(P + M)$ scenario. For people out of the labour force, inflation in 2023 is close to 10% due to the high weight of energy and food goods in their consumption basket. Conversely, for high-skilled workers, inflation in 2023 is estimated at around 5.5%. For the other categories, it lies in between 6% and 7%. The difference between the inflation rate of the highest and lowest income quintile that we find is close to the values found by some empirical studies at the European level (ECB, 2022) and ISTAT estimates for Italy (Cirillo *et al.*, 2023).

(Figure 5 about here)

The asymmetric impact of inflation on the real incomes of different social groups translates into an asymmetric effect on consumption. Figure 6 shows the percentage change in real consumption by income group relative to the baseline trajectory in 2025. In all three scenarios, it is only high-skilled workers who manage to achieve real increases in their consumption levels; for the medium-skilled category, the losses are small, while lower income groups are the most affected. For people out of the labour force, the drop in consumption is particularly heavy, between 20% and 25%. Since they are not employed and do not receive labour incomes, wage indexation does not prevent them from facing a significant decline in their consumption levels.

The $\Delta(P + M)$ scenario is the one that hits consumption of middle- and low-skilled workers the most. The introduction of a wage indexation policy ($\Delta(P + M + W)$ scenario) mitigates the fall in real consumption for the middle-skilled workers. At the same time, people with higher incomes would obtain the greatest benefits due to their lower exposure to price increases in their consumption basket, their more favourable employment status and the presence of a higher share of income from financial wealth.

(Figure 6 about here)

Conclusions

The simulations presented here, based on the EUROGREEN model, make it possible to analyse the transmission of inflation throughout the economy and to consider the effects of mark-up shocks and wage indexation. The results confirm that inflation has significant distributive effects, which mainly affect wage and lower income earners.

We have shown that energy price shocks alone are not sufficient to explain the observed inflation in 2022. A key role in the price dynamics was played by the growth of profit margins, which raised inflation and reduced the wage share of income. In the first scenario, we introduced into the model an energy price shock of a similar magnitude to that observed in Italy over the last year; in the second, we added an increase in profit margins in all production sectors. In both cases, the increase in price levels leads to a fall in production and employment and to a redistribution of income from wages to profits – a redistribution that is found to persist even after the initial shock has been absorbed. Since energy and food goods have a greater weight in the basket of low-income individuals, the rise in consumer prices particularly penalises the purchasing power and real consumption of people out of the labour force and who have low skills and low wages.

The introduction of a wage indexation policy would extend the duration of inflation - which would fall to 5% in 2025 - but would not lead to a wage-price spiral. In our simulation, wage indexation would stem the fall in aggregate demand, protect the purchasing power of wages and - by intervening in the govern of distributional conflict - allow employees raise their share of output. The impact of wage indexation on income distribution within the working class is more ambiguous. Since indexation policies peg nominal wages to an average consumer price index, the social groups most exposed to inflationary dynamics - low-skilled workers and individuals outside the labour force - would continue to suffer a real loss, albeit to a lesser extent, while workers with higher incomes - for whom price growth is lower than the average inflation rate - would see their real incomes rise further. In order to combine the goal of protecting the purchasing power of wages with that of reducing labour

income inequality, wage indexation policies should be accompanied by other social and redistributive interventions to protect the most vulnerable segments of the population, such as the introduction of a minimum wage and income support for those out of the labour force.

Our model simulations highlight the main mechanisms of inflation transmission in the economy and their distributive effects. It is the task of economic policies - monetary, fiscal, income, redistributive - to ensure that inflation does not become a further mechanism for impoverishing labour and increasing inequality in Italy.

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Fig. 1. Inflation (%)

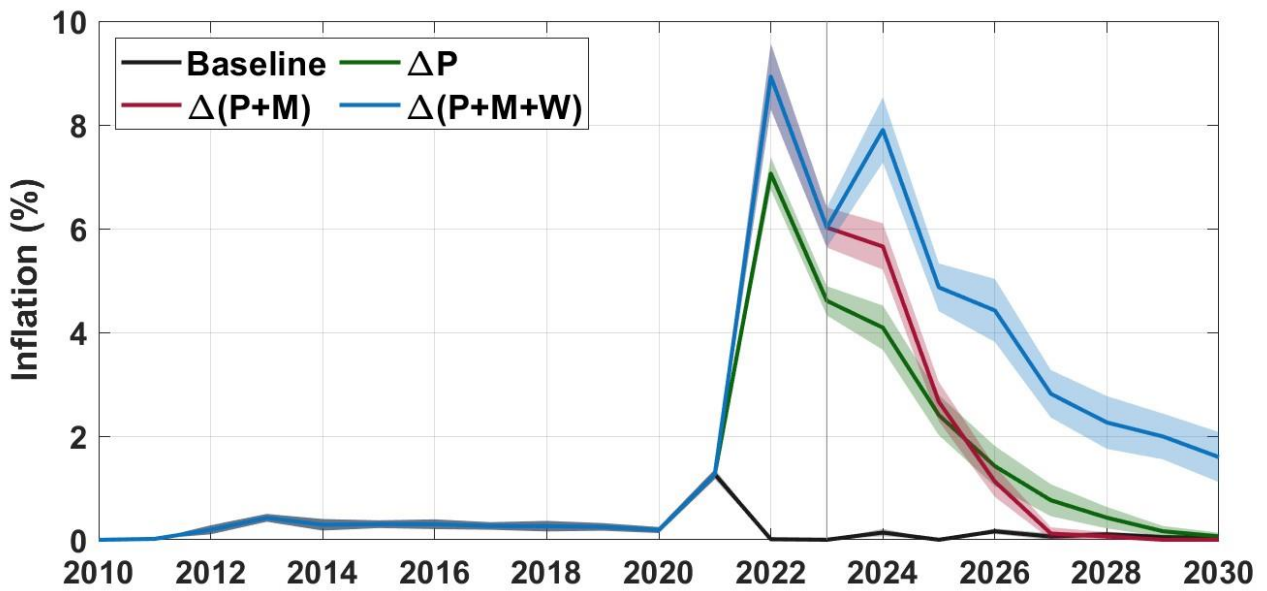


Fig. 2. Real GDP

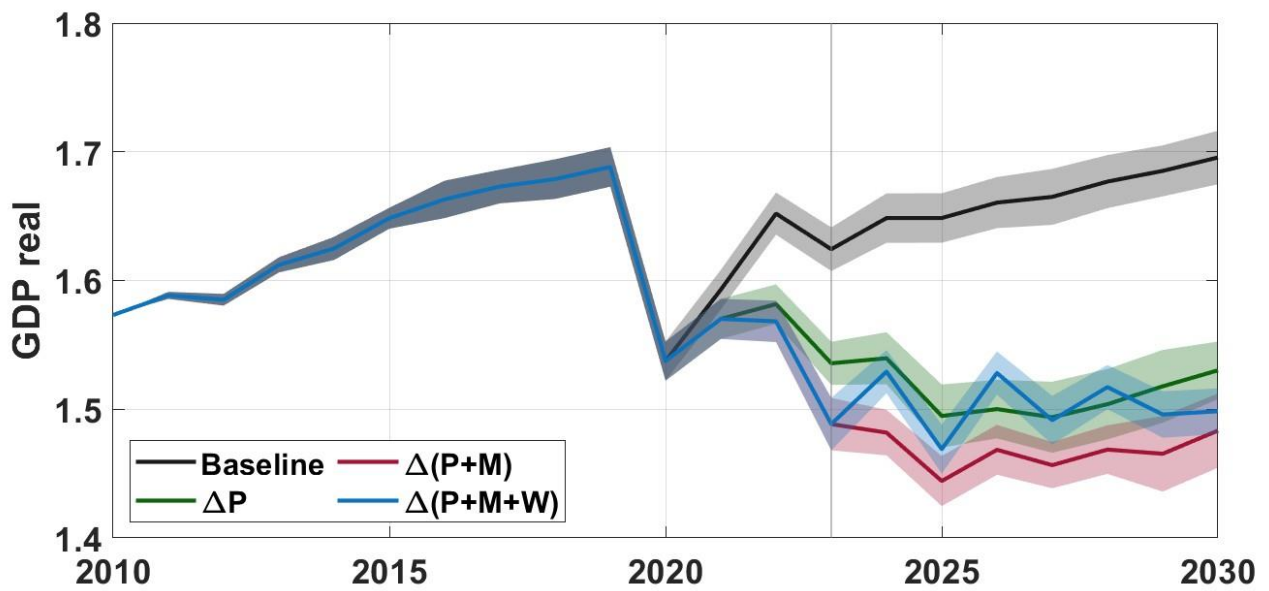


Fig. 3. Employment rate (%)

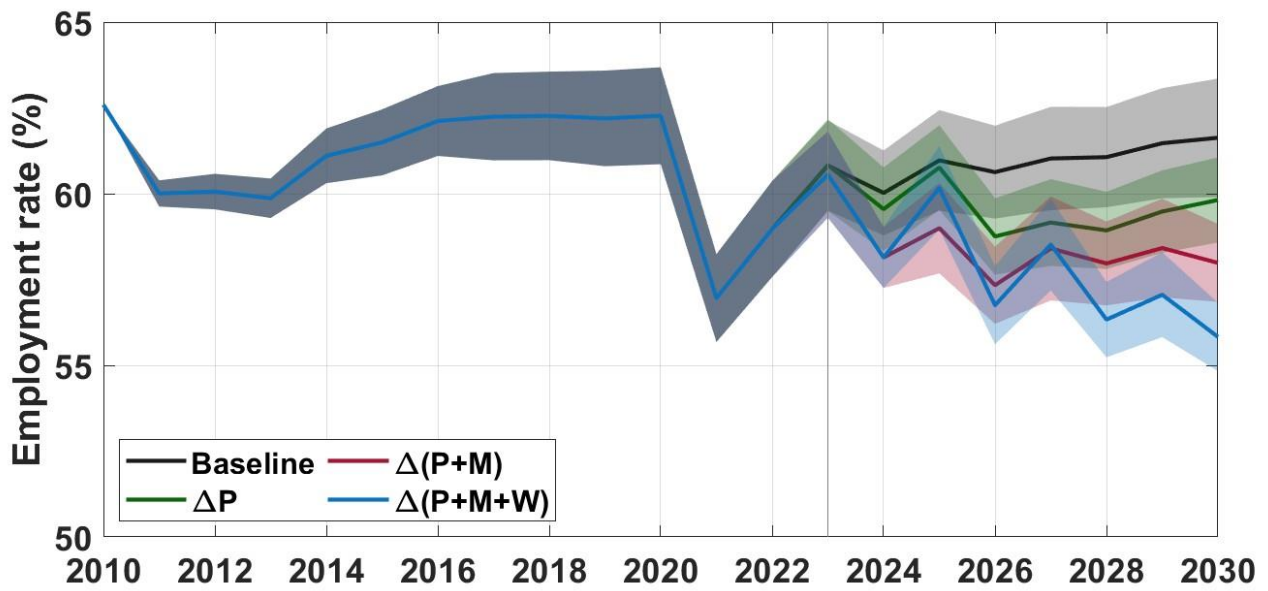


Fig. 4. Labour share of income

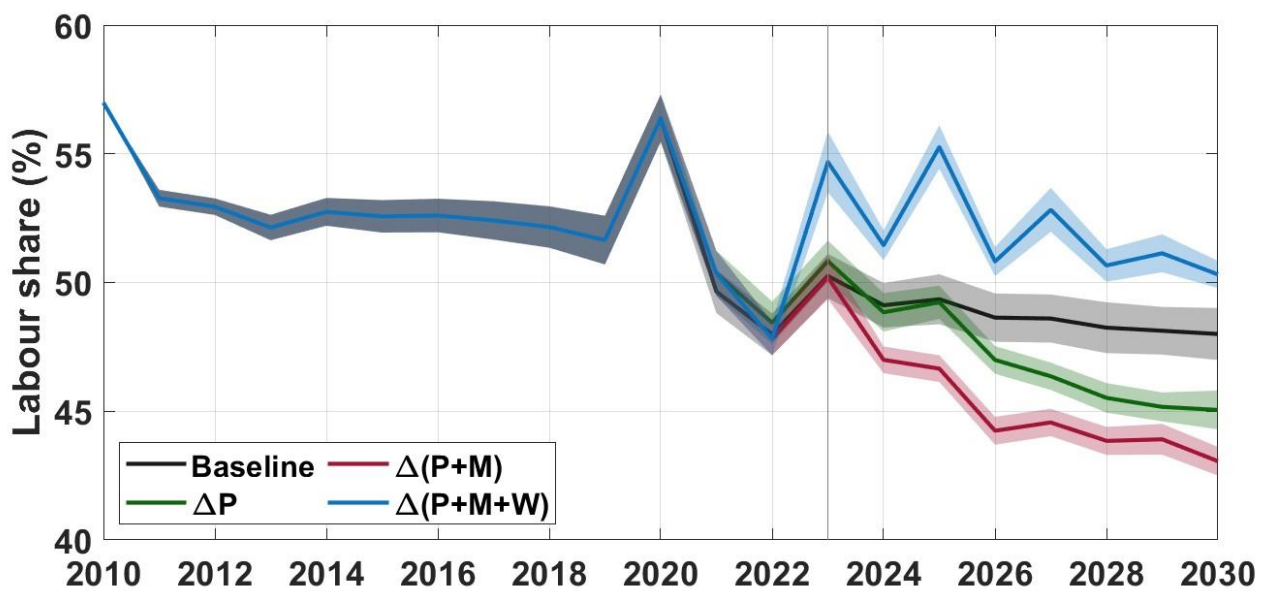


Fig. 5. Inflation (by income group) (%)

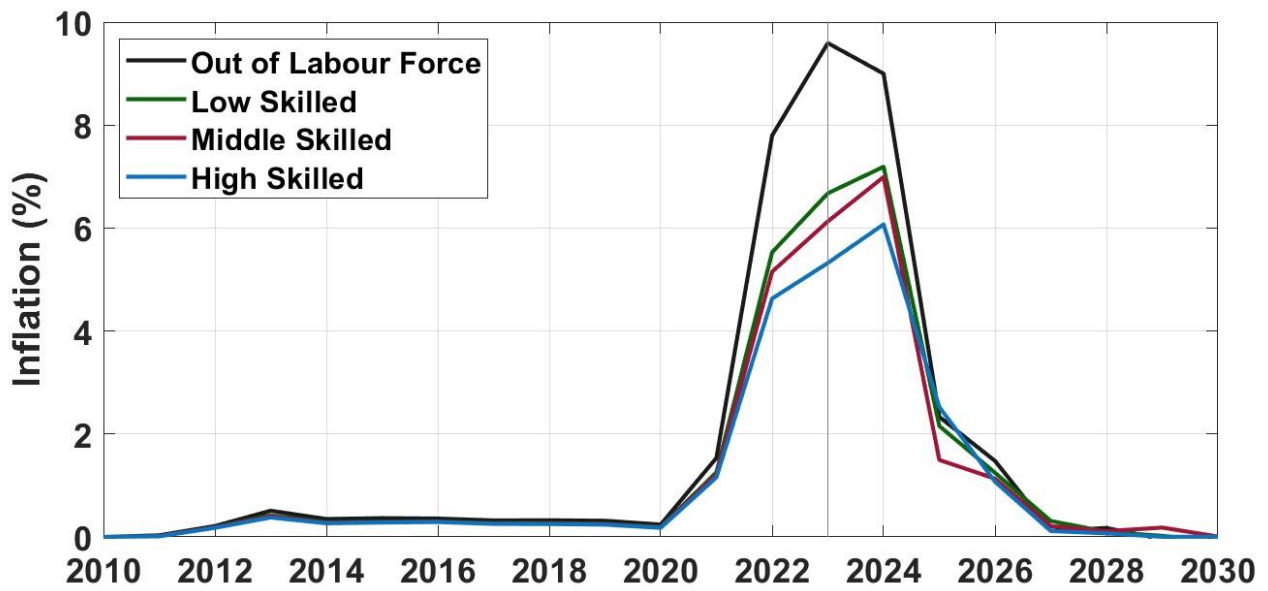


Fig. 6. Change in real consumption (by income group)

