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Modelling the Distributional Effects of the Cost-of-Living Crisis in Turkey and the South Caucasus: A Microsimulation Analysis

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Abstract This study analyzes the distributional effects of the cost-of-living crisis in Turkey and the South Caucasus by employing microsimulation techniques and household budget survey data. It investigates the changes in prices between December 2020 and 2022, highlighting the combined impact of the COVID-19 pandemic and the post-war price changes in Ukraine. By comparing welfare systems and price fluctuation patterns, the study sheds light on the differing impacts across neighbouring countries. The effects of inflation are closely related to specific price increases for various goods and the distribution of household budgets. In particular, lower-income countries and individuals allocate a higher share of their budgets to essential goods such as food, heating oil, and electricity. Notably, this is the first comparative analysis of its kind in the developing world, with previous studies limited to the European Union. We expanded the static incidence analysis across two dimensions. First, we looked at a way to measure welfare called comparative advantage. It shows how much money someone needs to keep their utility level the same when prices go up or down. It is worth noting that comparable levels of inflation regressivity are due to different interactions between the magnitude of price inflation and its disproportionate impact on the income distribution. We also applied the Atkinson social welfare function to analyse equally-distributed-equivalent income, decomposition changes in welfare into two components: the distributional effect and the size effect. Second, in all countries, the savings rate rises as income increases. Consequently, when prices increase faster than wage growth, lower-income groups cannot quickly absorb these rises. Therefore, they feel the impact of price increases more significantly.

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1. Introduction

The coronavirus pandemic and the war in Ukraine led to a sharp increase in prices throughout the world (***Lokshin et al., 2023***). Given the nature of the price increases has seen a concentration in price growth of necessities such as energy and food there are particular concerns about the distributional impact of these price changes (***Sologon et al., 2022***). This impact has been magnified in a country that has traditionally experience high prices such as Turkey. During the period, Turkey has experienced the largest increase in prices, Turkish inflation hit a peak of 85.5% in October 2022 (***Turkstat, 2022***). The crisis is a major concern for people; in surveys on the macroeconomic outlook, 93 percent of

respondents in the European Union and more than 80 percent of people in various countries in Central Asia cited the cost-of-living as a major concern (***World Bank, 2023***). In this paper, we undertake an analysis of the distributional impact of price changes in the cost-of-living crisis in Turkey, via a comparative analysis with neighbouring countries in the South Caucasus

Official measures of the cost-of-living have evolved since the early 20th century (***Konus, 1939***; ***Arrow, 1958***; ***Prais, 1959***; ***Pollak, 1980***; ***Deaton, 2003***), while the use of the consumer price index to measure the cost-of-living has been criticised for its inability to account for the heterogeneous needs of economic agents (***Allen, 1958***; ***Boskin and Hurd, 1986***; ***Amble and Stewart, 1994***; ***Crawford and Smith, 2002***; ***Hobijn and Lagakos, 2005***). Studies focusing on group-specific price indexes have analysed the unequal effects of inflation along the distribution of household incomes (***Brittain, 1960***; ***Tipping, 1970***; ***Fry and Pashardes, 1985***; ***Crawford and Smith, 2002***; ***Doorley et al., 2022***). However, this approach has been criticised for failing to account for substitution behaviour (***Aizorbe and Jackman, 1993***; ***Murphy and Garvey, 2004***; ***Loughrey and O'Donoghue, 2012***).

Comparative research can help us to understand in greater detail a situation such as the Cost of Living Crisis by comparing one country with another. There have been a number of comparative studies which allow us to understand the complex and differentiated impact in different settings of distributional impact of high consumer inflation for European households (***Amores et al., 2023***; ***Basso et al., 2023***; ***Chafwehé et al., 2024***). ***Sologon et al. (2022)*** evaluated the distributional and welfare impact of the current cost-of-living across European countries and incorporated consumption behavioural responses to price changes. The behavioural responses were relatively minor, underscoring that households have limited flexibility in adjusting their consumption, particularly when the most significant price changes affect essential goods (***Curci et al., 2022***; ***Albacete et al., 2022***; ***O'Donoghue et al., 2023***; ***Basso et al., 2023***). This literature has being extended to consider the impact support measures aiming to mitigate the impact of inflation and on the interaction with policy systems with price inflation via fiscal drag (***Shahir and Figari, 2021***).

Studies on the impact of the cost-of-living crisis have focused on OECD countries while there is relatively little literature for developing countries.[1] For Brazil, ***Timmins (2006)*** estimated spatial differences in the cost-of-living conditions and household location. This approach provides a nuanced understanding of the economic landscape in Brazil, highlighting the importance of considering regional variations in the formulation of economic policies. ***Bittencourt (2007)*** also found a negative effect of inflation on income distribution. ***Zhang (2011)*** analysed the distributional impact of energy price reform in Turkey and the reform leads to an increase in energy prices, which disproportionately affects lower-income households since energy expenditures constitute a larger share of their total consumption. ***Ivanic et al. (2012)*** estimated the first-order effects of the 2006-2008 food price crisis for a large number of developing countries using microsimulation techniques. The findings underscore the need for targeted social protection measures to mitigate the adverse impacts of food price volatility on the poor. ***Rodriguez and Atamanov (2021)*** explored the first-order impact of the cost-of-living changes due to the COVID-19 epidemic on household wealth and poverty in the Islamic Republic of Iran. Both inflation and the COVID-19 pandemic have led to a decline in household welfare, with significant adverse impacts on poverty and inequality and inflation has eroded the purchasing power of households, while the pandemic has resulted in job losses and reduced income for many families. (***Rodriguez and Atamanov, 2021***). ***Canavire Bacarreza et al. (2023)*** assessed the distributional effects of fuel price increases on poverty and income inequality in Paraguay. The results indicate that increases in fuel prices disproportionately affect lower-income households, as fuel expenditures constitute a larger share of their total income and the surge in fuel prices leads to higher transportation and food costs, further straining the budgets of poor households (***Canavire Bacarreza et al., 2023***).

There are systematic differences between in the results of developing countries compared to the distributional impact of inflation in OECD countries. In developing countries, there is a larger share of household income is spent on necessities such as food, fuel, and basic utilities. As a result, increases in the cost of living disproportionately affect poorer households, who may already be spending most of their income on these essentials. Poorer households have limited savings and fewer resources to

1. The categorization of countries is based on the World Bank's classification by per capita income. Hereinafter, the countries with high income are referred as developed countries, while the countries with upper- and lower-middle income are referred as developing countries.

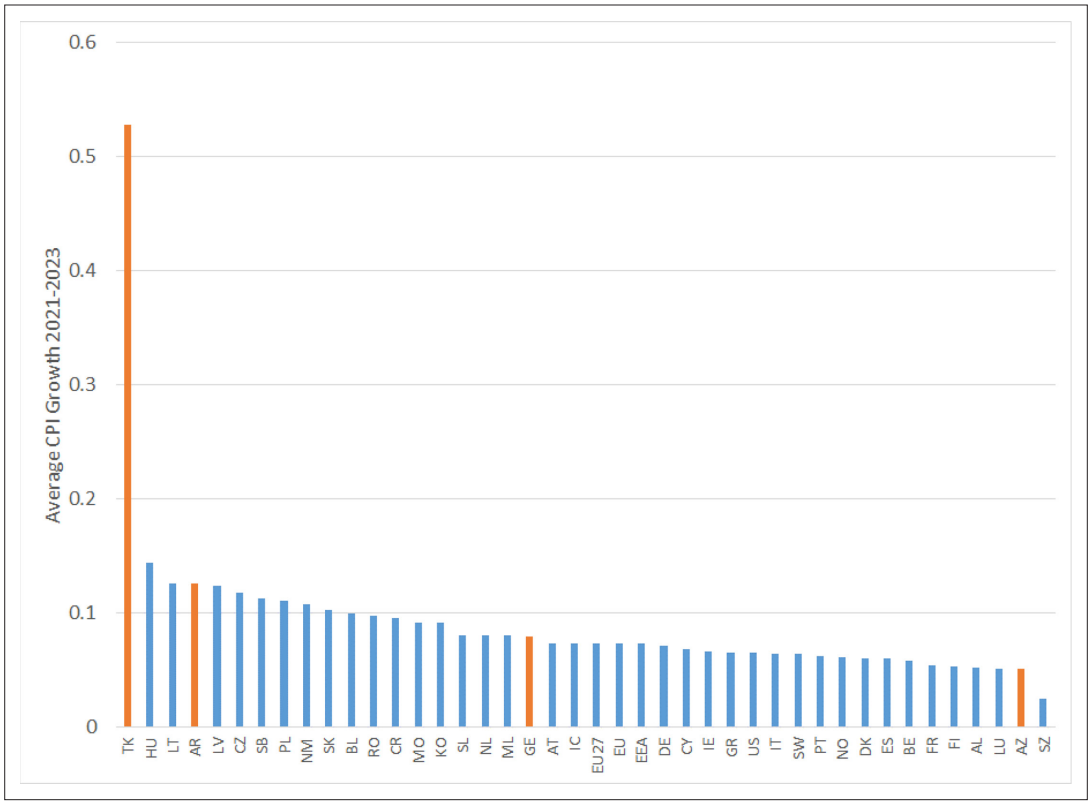

Figure 1 Annualised price inflation in Turkey, the South Caucasus and European Union neighbours.

Source: Eurostat, Armenia, Azerbaijan and Georgia Statistical Offices

cope with rising costs and higher vulnerability to inflation and currency fluctuations can exacerbate the cost-of-living crisis eroding purchasing power.

In this study we extend the literature by considering the impact of the costs of living crisis in a number of neighbouring middle income countries Armenia, Georgia and Turkey in order to explain systematic differences. The average annual inflation rate in 2022 in Turkey was over 50%. This is in contrast to the European Union's average of 7.3%. Neighbouring countries Armenia, Georgia, and Azerbaijan have experienced average annual inflation rates of 13.2%, 7.9%, and 5%, respectively, as illustrated in ***Figure 1***. Turkey has repeatedly faced high inflation rates in the past. In light of Turkey's exceptional price growth, this paper aims to examine the distributional consequences of inflation within the country, comparing it with countries within its immediate geography in the South Caucuses.

Table 1. Average annualised consumer prices index (1996-2023)

	1996-1999	2000-2004	2005-2009	2010-2014	2015-2020	2021-2023
Turkey	0.737	0.308	0.083	0.073	0.124	0.528
Armenia	0.056	0.031	0.039	0.038	0.007	0.056
Azerbaijan			0.118	0.037	0.062	0.058
Georgia			0.017	0.018	0.015	0.053
EU	0.016	0.021	0.023	0.019	0.013	0.073
Turkey Rank	1	1	2	1	1	1

Source: Eurostat, IMF.

Table 1 reports inflation rates for Turkey, Armenian, Azerbaijan, Georgia and the EU respectively. Turkey has consistently recorded the highest annualized inflation rate among EU countries and neighbouring countries in each five-year period, with the exception of Iceland, which marginally surpassed Turkey during the 2005-2009 financial crisis. While Turkey experienced relatively moderate price growth, averaging around 10% between 2005 and 2020, the late 1990s saw even higher inflation rates than those currently observed. The early 2000s witnessed an annualized rate exceeding 30%. Turkey's inflation has remained elevated since the oil crisis of the 1970s, consistently outpacing the average rates. In a literature review, Kibritçioğlu (2002) attributed much of this persistent inflation to factors such as public sector deficits, fuelled by infrastructure and military spending, which crowd out domestic capital. Additional drivers include political instability and ingrained expectations of high inflation within the economy. Contrastingly, the countries of the South Caucasus - namely Armenia, Georgia, and Azerbaijan[2] - have demonstrated more effective control over inflation since gaining independence from the Soviet Union, as noted by Aliyev and Gasimov (2014).

Muellbauer (1974) evaluated the distributional consequences of inflation, taking into account substitution behaviour, by estimating a linear expenditure system of demand equations and the implicit indices of the true cost of living for different levels of expenditure in Britain. Following this line of research, ***Creedy and Van De Ven (1997)***, ***Loughrey and O'Donoghue (2012)*** and ***Sologon et al. (2022)*** have assessed the distributional effects of inflation in Australia and a selection of EU countries. We draw upon this approach to assess the impact of price changes on household income distribution, utilising a variety of welfare measures.

Our contribution lies in expanding the literature concerning the cost-of-living crisis (COLC), as our study represents the first comparative analysis of its kind within the developing world. Previous studies have predominantly concentrated on the European Union, thereby limiting the scope of comparative studies to this region (***Sologon et al., 2022***).

Understanding price changes in Turkey is crucial for policymakers, given the economy's complexities and assess broader impacts on regional and global economic stability as disruptions in managing Turkey's COLC can impact international markets and trade flows and may influence regional security. As of October 2022, Turkey experienced an annual inflation rate of 85.51%, marking the highest level in a quarter-century. This inflationary trajectory in Turkey is an inverted U-shape, influenced by a strong base effect as well as global fluctuations in food and energy prices. In contrast, by the end of 2022, Armenia recorded an inflation rate of 8.64%, Azerbaijan had 13.85%, and Georgia had 11.90%. This research enriches existing literature by examining the distributional consequences of rising living costs due to inflation across countries with varying consumption habits and welfare systems.

The paper has the following outline. Section 2 describes the methodology and addresses the data used on price changes for various consumption patterns. Section 3 assesses the distributional and welfare consequences of inflation, followed by concluding remarks in Section 4.

2. Methodology and data

The purpose of this paper is to model the impact of price inflation and to simulate the impact on the distribution of households in Turkey and the South Caucasus and to explore behaviour-adjusted inequality measures.

In developing this analysis, we use the distributional-microsimulation framework developed by ***Sologon et al. (2022)*** to evaluate the distributional and welfare impact of inflation and extended in the PRICES framework (Prices, Revenue recycling, Indirect tax, Carbon, Expenditure microsimulation model) to incorporate environmental taxes (***O'Donoghue et al., 2023***). This modelling framework simulates price and consumption-based policies including indirect taxes, price inflation (consumer price and producer price) and environmental taxation. In this paper, we utilise a subset of the analytical capacity looking at consumer price inflation.

The approach involves the application of good-specific CPI changes from p_{0i} to p_{1i} between December 2020 and December 2022 to each disaggregated expenditure variable x_i in the Household Budget Survey:

2. Using tabular data, we reference the situation in Azerbaijan, but focus our micro analysis on the other three for which micro data is available.

$$x_i^* = x_i . \left(\frac{p_{1i}}{p_{0i}}\right) \quad (1)$$

Our interest is in how inflation affects different households in different ways and therefore instead of solely considering the change in the standard of living for the average person, we also factor in the welfare losses or gains related to prices across all household income levels. When prices change, households will either change their savings s (the difference between income y and expenditure x) or change the consumption of individual goods x_i. However, the former requires an inter-temporal model, which is beyond the scope of this paper and the data we use.

For the purposes of this analysis therefore we utilise a welfare metric that accounts for behavioural elasticities. A money metric of the change in welfare, as a function of price change and behavioural drivers, is based on the concept of *compensating variation* (CV), which is the monetary compensation that households should receive after price increases given the initial total expenditure in order to maintain their utility (to be equally well off) as before the price change.

Derived in ***Sologon et al. (2022)***, the welfare loss ΔW_{CV}^H can be expressed as follows[3]:

$$\Delta W_{CV}^H = \left[\sum_i p_{1i}\gamma_i^h + \Pi_i \left(\frac{p_{1i}}{p_{0i}}\right)^{\phi_i^{pg}} \left(y_0^h - \sum_i p_{0i}\gamma_i^h\right)\right] - y_0^h \quad (2)$$

where y_0^h is the total initial expenditure, γ_i^h is the subsistence consumption and ϕ_i^{pg} represent the marginal budget shares (derived from the Linear Expenditure System described below).

The parameters required in calculating the Compensating Variation require us to take into account the elasticity of demand for various product groups and their substitution with each other. This method enables the assessment of the effect of price alterations on the distribution of household income, while taking into account households' ability to offset some of their welfare losses through substitution behaviour. The difference between the two represents the adjustment made by households to account for their consumption behaviour to maintain their utility under price increases.

Another way to account for the welfare impact of prices changes is to use the measure, equivalent income, which is defined as the value of income, y_e, which at some reference prices, p_r, gives the same utility as the actual income level:

$$V\left(p_r, y_e^h\right) = V\left(p, y^h\right) \quad (3)$$

Derived in ***Sologon et al. (2022)***, the change in welfare using Equivalent Income can be defined as:

$$\Delta W_{y_e}^H = y_{e1}^h - y_{e0=}^h \left[\sum_i p_{0i}\gamma_i^h + \Pi_i \left(\frac{p_{0i}}{p_{1i}}\right)^{\phi_i^{pg}} \left(y_1^h - \sum_i p_{1i}\gamma_i^h\right)\right] - y_0^h \quad (4)$$

The compensating variation and equivalent income allow us to produce money metrics that compensate for changes in prices in order to maintain the utility of households.

While incomes may also have changed for individual households, we have limited our analysis to the price impact due to the infrequency of income growth data and the absence of price variability data. This choice is made to avoid inaccuracies in showing the distributional impact. It is better to report price changes alone than try to model income changes before the data on these changes has been produced. Rather, we will compare our price changes to average changes in income, which were available for this study in official statistics.

2.1. Welfare effects

In order to derive the behaviour adjusted money metrics for welfare changes due to price change, we utilise a Linear Expenditure System (LES) demand system building upon the methodology described in ***Creedy (2000)*** to model the behavioural responses to price changes and to provide

3. Please refer to Sologon et al. (2022) for the mathematical derivation of CV.

behaviour-adjusted distributional measures. This has relatively limited data requirements necessary to produce price elasticities.

The expenditure function, $E\left(p,\ U\right)$ specifies the minimum expenditure required to achieve a given utility level, U, in the context of a given price vector, represented as $p = (p_1, \ldots, p_n)$. The linear expenditure system (LES) is characterized by additive utility functions:

$$U = \sum_{i=1}^{n} \left(x_i - \gamma_i\right)^{\Phi_i} \tag{5}$$

where x_i denotes the consumption of each good, γ_i represents the subsistence or committed consumption level for each good, and represents the marginal budget shares. We begin the process of utility maximization under the budget constraint $y = \sum p_i x_i$. This optimization leads to the linear expenditure functions for each good (or group of goods) i:

$$p_i x_i = p_i \gamma_i + \Phi_i \left(y_h - \sum_j p_j \gamma_j \right) \tag{6}$$

From this we derive budget elasticities, e_i which provide us with , an essential component of the utility function:

$$e_i = \frac{\Phi_i y}{p_i x_i} => \Phi_i = e_i\, w_i \tag{7}$$

where w_i stands for the budget share of commodity group i, $0 \leq {}_i < 1, \sum_i \phi_i = 1$.

Differentiating and adjusting we produce own-price elasticities, e_{ii} , which provide us with the required values for γ_i, another core element of the utility function:

$$e_{ii} = \frac{\gamma_i\left(1-\Phi_i\right)}{x_i} - 1 => \gamma_i = \frac{\left(e_{ii}+1\right)x_i}{\left(1-\Phi_i\right)} \tag{8}$$

To determine the values of and γ_i, we first need to estimate the budget elasticities, e_i, and the own-price elasticities, e_{ii}, which we will discuss in more detail in the following sections.

In the first stage, we calculate budget elasticities, e_i, which provide information on how the distribution of budget shares across expenditure groups, w_i, varies with income. These budget elasticities are estimated based on the methodology described in ***Creedy (1998)***. We estimate the parameters of the linear expenditure system (LES) for each commodity group i using Engel functions:

$$w_i^h = \alpha_i + \beta_i ln y^h + \varphi_i \left(ln y^h\right)^2 + \delta_i \mathrm{X^h} \tag{9}$$

where w_i^h represents the budget share allocated to commodity group i within household h, relative to the total consumption of household y^h. The variable X includes a set of individual and household characteristics of household h. In our analysis, we consider a total of 19 different commodity groups i, ranging from $i = 1, \ldots, 19$. To estimate the parameters of the Engel functions shown in Equation 9, we use a pooled ordinary least squares approach at the household level.

Using the parameters, we estimated for each commodity group (where i ranges from 1 to 19) in Equation 9 the budget elasticities e_i. The formula for deriving these budget elasticities is as follows:

$$e_i = 1 + \frac{dw_i}{dy}\frac{lny}{w_i} = 1 + \frac{\beta_i + 2\varphi_i lny}{w_i} \qquad \mathrm{if} \varphi_\mathrm{i} \neq 0 \tag{10}$$

We evaluate the budget elasticities, e_i, at population sub-group average incomes $\overline{lny}^{pg}$ and budget shares $\overline{w_i}^{pg}$:

$$e_i^{pg} = 1 + \frac{\beta_i + 2\varphi_i \overline{\mathrm{lny}}^{pg}}{\overline{w_i}^{pg}} \qquad \mathrm{if} \varphi_\mathrm{i} \neq 0 \tag{11}$$

$$e_i^{pg} = 1 + \frac{\beta_i}{\overline{w_i}^{pg}} \qquad \mathrm{if} \varphi_\mathrm{i} = 0 \tag{12}$$

Table 2. Budget and price elasticities

Expenditure Category	AR		GE		TR	
	Budget	Price	Budget	Price	Budget	Price
Food and Non-alcoholic beverages	0.699	-0.799	0.941	-0.671	0.626	-0.455
Alcoholic Beverages	0.848	-0.873	1.798	-1.007	0.517	-0.309
Tobacco	0.451	-0.468	0.372	-0.263	0.098	-0.060
Clothing and Footwear	0.954	-0.983	0.365	-0.213	0.876	-0.530
Home fuels	1.573	-1.569	0.699	-0.398	1.521	-0.912
Electricity	1.008	-1.037	0.677	-0.346	0.880	-0.531
Rents	0.274	-0.289	1.154	-0.652	0.250	-0.162
Household services	1.580	-1.585	0.983	-0.558	1.611	-0.963
Health	1.182	-1.212	0.983	-0.592	1.015	-0.616
Private transport	1.514	-1.522	1.800	-1.009	1.367	-0.828
Public Transport	0.913	-0.942	0.941	-0.671	0.748	-0.455
Information & Communication	0.969	-0.998	1.798	-1.007	0.881	-0.535
Recreation and culture	1.369	-1.350	0.372	-0.263	1.270	-0.790
Education	1.126	-1.156	0.365	-0.213	0.962	-0.585
Restaurants and hotels	0.873	-0.903	0.699	-0.398	0.776	-0.484
Other goods and services	1.159	-1.167	0.590	-0.346	1.055	-0.677
Childcare costs	.	.	1.154	-0.652	.	.
Motor fuels	1.008	-1.037	0.983	-0.558	0.599	-0.363
Durables	0.858	-0.886	0.983	-0.592	1.208	-0.763

Once we have calculated the budget elasticities, e_i, we can proceed to calculate according to Equation 7, using the population group-specific $\bar{w}_i$. This calculation yields a matrix of estimates for a set of 10x19 values:

$$\Phi_i^{pg} = e_i^{pg} * \overline{w}_i^{pg} \tag{13}$$

To calculate γ_i according to Equation 8, we need not only but also the own-price elasticities of demand, e_{ii}. To estimate these price elasticities, we use an approximation method described in ***Creedy (2001)***. These price elasticities can be derived using a method based on

Frisch (1959) for direct additive utility functions. This method requires the use of the elasticity of marginal utility of spending with respect to total spending, often referred to as the Frisch parameter, ξ. Both own-price and cross-price elasticities are expressed as follows:

$$e_{ij} = -e_i w_j \left(1 + \frac{e_i}{\xi}\right) + \frac{e_i \delta_{ij}}{\xi} \tag{14}$$

where $\delta_{ij} = 1$ if $i = j$, and 0 otherwise. Own-price elasticities are expected to have negative values, since price increases usually lead to a decrease in demand for the good in question. The closer e_{ij} is to -1, the more pronounced is the elasticity of demand in response to price increases. To derive estimates for the Frisch parameter, ξ, we use the method described in ***Creedy and Dixon (1998)*** and ***Lluch et al. (1977)***.

Table 2 presents the estimated data on budget shares and price elasticities of demand.[4] Income elasticity of demand is an economic measure of how responsive the quantity demanded for a good or service is to a change in income. Price elasticity of demand is the ratio of the percentage change in quantity demanded of a product to the percentage change in price. As expected, price elasticities of demand generally exhibit negative values, indicating an inverse relationship between price and quantity demanded. This observation virtually rules out the possibility of Giffen behaviour as suggested by ***Jensen and Miller (2008)***.

In each country, the elasticity of the budget elasticity for food and non-alcoholic beverages is less than one, suggesting that the budget share for food decreases as total spending changes. Similar patterns emerge for other major item such as home fuels in Armenia and Turkey, where the elasticities of the budget shares exceed one. For home fuels, Armenia and Turkey have similar budget share elasticities, while the value in Georgia falls well below one.

In contrast, the budget share elasticity exceeds one for certain commodity groups, including recreation and culture except in Georgia. The results for the alcohol category suggest an inelastic price elasticity of demand for Armenia and Turkey, which is consistent with ***Fogarty (2006)***

It is worth noting that a low budget share elasticity does not necessarily mean that the commodity group is a necessity for most of the population, a consideration that is relevant to our results regarding spending on alcohol and tobacco. The budget share elasticities for clothing and footwear are either close to one except in the case of Georgia. When the budget share elasticity is close to 1, it suggests that the expenditure on clothing and footwear changes proportionately with changes in total income. When the elasticity is between 0.3 and 1, it suggests that the expenditure on clothing and footwear increases with income, but at a less than proportional rate.

2.2. Welfare decomposition

To assess the overall impact of price changes on the welfare of the entire population, we use the social welfare function associated with the Atkinson index, which is based on the equally distributed equivalent income (Y_{ede}) before (0) and after price adjustments (1).

$$W(e) = y_{ede}(e) = \bar{y_e} * (1 - A(e)) \tag{15}$$

This is used to evaluate the change in welfare due to the increase in prices, relative to the initial situation pre-price changes.

$$\Delta W = \left(y_{ede_1} - y_{ede0}\right) / y_{ede0} \tag{16}$$

Following ***Sologon et al. (2022)***, the welfare change can be decomposed into the contribution of the efficiency and equity components of welfare and their interactions by expanding and manipulating the difference in Equation 16[5]:

$$\begin{aligned}
&\Delta W = \left[\bar{y_{e1}}\left(1 - A_1(e)\right) - \bar{y_{e0}}\left(1 - A_0(e)\right)\right] / \bar{y_{e0}}\left(1 - A_0(e)\right) \\
&\Delta W = \left(\bar{y_{e1}} - \bar{y_{e0}}\right) / \bar{y_{e0}} + \left(A_1(e) - A_0(e)\right) / A_0(e) \\
&+ \left(\bar{y_{e1}} - \bar{y_{e0}}\right) / \bar{y_{e0}}\left(A_1(e) - A_0(e)\right) / A_0(e) \\
&\Delta\%W = \Delta\%\bar{y_e} + \Delta\%A(e) + \left(\Delta\%\bar{y_e} * \Delta\%A(e)\right)
\end{aligned} \tag{17}$$

2.3. Distributional metrics

We assess the variations in household consumption baskets across the different countries, focusing on the budget allocations for key commodity items. This enables us to determine the individual commodities that are most influential in driving inflation in each country. To understand the distributional consequences of inflation, we examine both the structure of household spending and the inflationary trends across income levels within each nation. This allows us to evaluate whether the impact of

4. We derived specific budget elasticities for ten different population subgroups categorized by household type, as described in the Data section. Although not reported here, this results in a matrix of 10x19 budget elasticities.
5. For a review of the literature investigating the decomposition of distributional outcomes using microsimulation techniques, please refer to Sologon et al. (2023).

inflation is progressive or regressive and to pinpoint the specific commodities that contribute to these distributional effects.

In order to quantify the progressive/regressive effects we follow ***Sologon et al. (2022)***, who adapted the measures typically used in the taxation literature to an inflationary context. The distributive effect of inflation can be calculated using the Reynolds-Smolensky index (***Lambert, 2001***):

$$RS = CI_{X+C} - CI_X \tag{18}$$

where CI_X is the concentration index for pre-price change total expenditure (X) (households ranked by disposable income) and CI_{X+C} is the concentration index for post-price change total expenditure (X+C). Following ***Sologon et al. (2022)***, ***Pfähler (1990)*** and ***Decoster et al. (2002)***, RS can be decomposed into an inflation rate and a disproportionality component:

$$RS = \frac{r}{1+r} * K \tag{19}$$

where r is the average inflation rate and K is the Kakwani index developed by ***Kakwani (1977)***. K reflects the disproportionality between the structure of initial expenditure and the increase in expenditure due to inflation:

$$K = CI_C - CI_X \tag{20}$$

CI_C captures the income-related inequality in the changes in total expenditure (C) due to price changes and CI_X measures the income-related inequality in total initial expenditure. A negative RS indicate a regressive impact of inflation (affecting more the bottom).

K or the progression of inflation along the income distribution can be further decomposed into the contribution of each commodity group:

$$K = \frac{r_1}{r} * K_{C_1} + \frac{r_2}{r} * K_2 + \ldots + \frac{r_i}{r} * K_{C_i} \tag{21}$$

where r_i refers to the average inflation rate and K_{C_i} is calculated as:

$$K_{Ci} = CI_{C_i} - CI_X \tag{22}$$

where CI_{C_i} captures the income-related inequality in the changes in expenditure of commodity item i (C_i) due to price changes in item i.

2.4. Data

Our analysis is based on the most recent and reliable data from each country's household budget survey. Specifically, we use data from the 2022 Household Budget Survey (AR-HBS) for Armenia, the 2022 Household Budget Survey (GE-HBS) for Georgia, and the 2019 Household Budget Survey (TR-HBS) for Turkey. Microdata for Azerbaijan is not available for research purposes.[6, 7] However, there is detailed distributional data available for budget shares, but detailed by decile of consumption rather than decile of income that we use in this paper. For comparative purposes we include a number of tables in the Appendix for the four countries.

These surveys have a similar structure and provide comprehensive insights into various aspects of household finances, including a detailed breakdown of expenditures, household composition, demographic and socio-economic characteristics of household members, and disposable income. Based on the detailed information on household expenditures provided by these surveys, we calculate changes in the cost of living for individual households by accounting for price variation across expenditure categories. We then adjust the composition of households' baskets to account for recent price changes. It is important to note that our unit of analysis in these datasets is the household. We do not examine income within the household, and acknowledge that income distribution within households can vary substantially.

The sample size varies across countries, with Georgia having the largest dataset with 13,621 households, followed by Turkey with 11,521 households and Armenia with 5,184 households. It should be

6. It should be noted that the data used are from before the Nagorno-Karabakh conflict between Armenia and Azerbaijan and the migration of people from Nagorno-Karabakh.
7. We compared the data for Armenia and Georgia for respectively 2020 and 2021 and found the results to be robust to the COVID effect during these years, due to the high share of necessities in these countries.

Table 3. Price changes from December 2020 to December 2022 (in %) (COICOP)

COICOP Heading	Expenditure item	HCPI Price change (in %)		
		AR	GE	TR
	All-items HICP	16.94	23.1	123.5
CP01	Food and non-alcoholic beverages	24.17	32.6	155.7
CP02	Alcoholic beverages and tobacco	18.88	15.1	98.2
CP03	Clothing and footwear	20.42	2.0	51.2
CP04	Housing, water, electricity, gas and other fuels	10.21	60.3	131.3
CP05	Furnishings, household equipment and routine maintenance of the house	21.25	23.2	143.9
CP06	Health	6.15	2.4	100.8
CP07	Transport	12.06	19.6	137.3
CP08	Communication	1.51	-1.0	44.2
CP09	Recreation and culture	22.78	7.9	88.1
CP10	Education	6.17	11.8	61.0
CP11	Restaurants and hotels	14.72	28.5	137.3
CP12	Miscellaneous goods and services	16.78	17.6	107.9

noted that the level of disaggregation available in the Turkish data is much greater than that available in either of the publicly available Armenian and Georgian datasets. This limits comparative analysis at a deeper level than the adjusted COICOP classification we use.

To update the cost of living for each household, we rely on Harmonized Consumer Price Index (HCPI) data obtained from ***Eurostat (2020)***; ***Eurostat (2022)*** for Turkey and from the national statistical offices for Armenia and Georgia. Eurostat provides monthly HCPI data for each EU member state plus some others including Turkey, carefully broken down to the 4-digit COICOP (Classification of Individual Consumption by Purpose) level. CPI information however is only available at an aggregated COICOP level for Armenia and Georgia from their national statistical offices.

Given this limitation, we take a practical approach by applying the 4-digit COICOP categories to items that exhibit the largest price fluctuations. Using HCPI data, we calculate price changes between December 2020 and December 2022 for each expenditure item in each country. The resulting consumer price index growth rates (CPI) for each item and country are documented in ***Table 1***. Ultimately, our adjusted COICOP analysis includes a total of 19 expenditure groups, but seven of them are the same as the original COICOP. The 19 expenditure groups are presented in detail in ***Table 3***.

To allow for heterogeneity in welfare effects, we construct 10 household types based on demographic characteristics and disposable income. We construct five household types based on demographic characteristics; 1) singles, 2) singles with children, 3) couples, 4) couples with children, 5) other households. Each household type is further split by disposable income levels: above and below the median equivalised household disposable income. Other households can include extended relatives living within the household.

2.5. Budget shares

The composition of goods and services within the typical consumption patterns of countries with different spending levels affects the variation in inflation rates over time. This is primarily due to the correlation between spending levels and the allocation of resources across categories. In particular, the study of the relationship between expenditure categories and essential goods, with special emphasis on goods such as food, electricity, lighting, and heating, is crucial. This phenomenon is described by Engle's law, which states that as a nation becomes wealthier, the share of total spending on essential

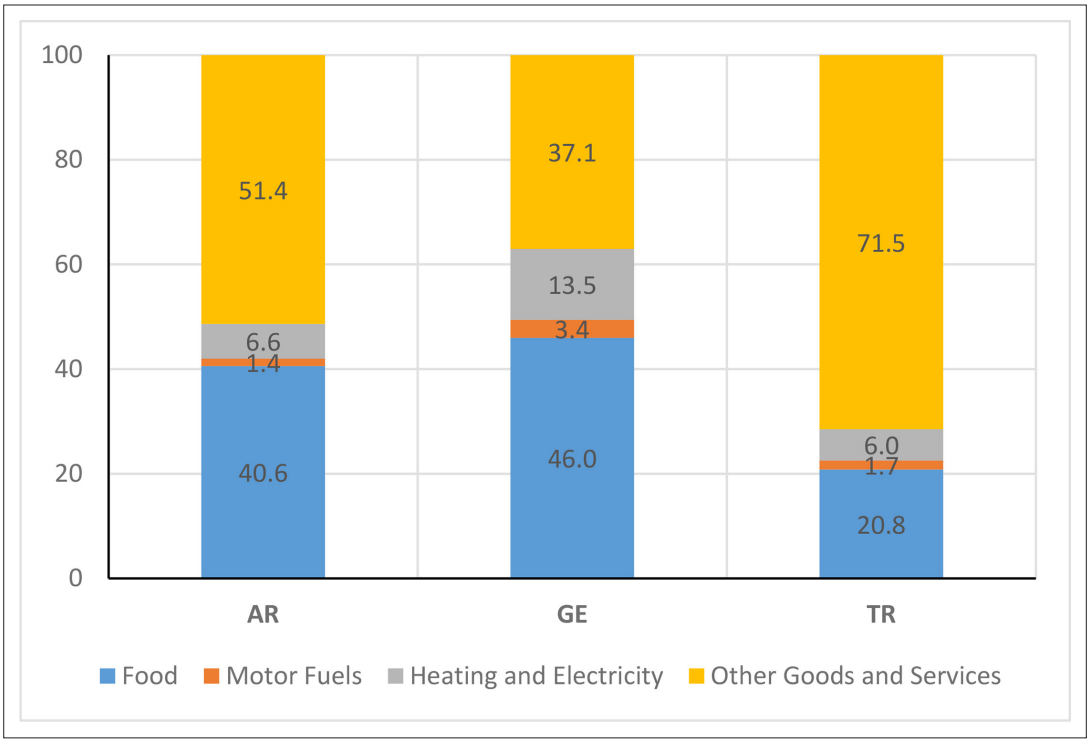

Figure 2 Aggregate budget shares

goods tends to decrease. This empirical regularity has been repeatedly observed in economic data, as shown by the seminal work of ***Houthakker (1957)***.

Figure 2 illustrates the distribution of budget allocations for diverse commodity sub-components within the typical households of both Turkey and the South Caucasus in the survey years. It is notable that the relative importance of items such as food, heating, electricity, and motor fuels in terms of the average budget shares varies significantly across these countries. Specifically, Armenia and Georgia exhibit lower budget allocations in comparison to Turkey. Notably, even in Turkey, an upper-middle-income country, there is a discernible trend towards lower budget allocations for essential necessities within the overall expenditure.

The distribution of average household shares for food shows a considerable range, from 20.8% in Turkey to 46% in Georgia with Armenia a slightly lower 40.6%, explained by the difference in income between these countries; Turkey has nearly twice the GDP per capita of Armenia and Georgia. Reflecting the necessity nature of food, poorer households and countries will have a higher food budget shares.

Motor fuel expenditures vary between countries. Georgia has a relatively high average share at 3.4%, while Armenia and Turkey have lower percentages at 1.4% and 1.7%, respectively. This is not surprising, because according to the official statistics of the countries, the number of motor vehicles per 1000 people in 2022 is 378 for Georgia, 254 for Turkey and 177 for Armenia. The average household share of expenditures on heating and electricity also shows interesting patterns, with Georgia recording the highest share at 13.5% and Turkey and Armenia significantly lower at respectively 6.0% and 6.6%. In summary, ***Figure 2*** indicates that middle-income households in Armenia and Georgia are more vulnerable to rising prices for essentials like food, heating, and electricity compared to those in Turkey. This higher vulnerability is because they spend a significant portion of their budgets on essentials like food, heating, and electricity. It highlights the connection between income, spending, and the cost of living.

Figure 3 describes the spending patterns in the quintiles of the income distribution in each country. These compositions show notable differences, particularly among low-income households, which spend a larger share of their budgets on essential categories such as food and energy. As income

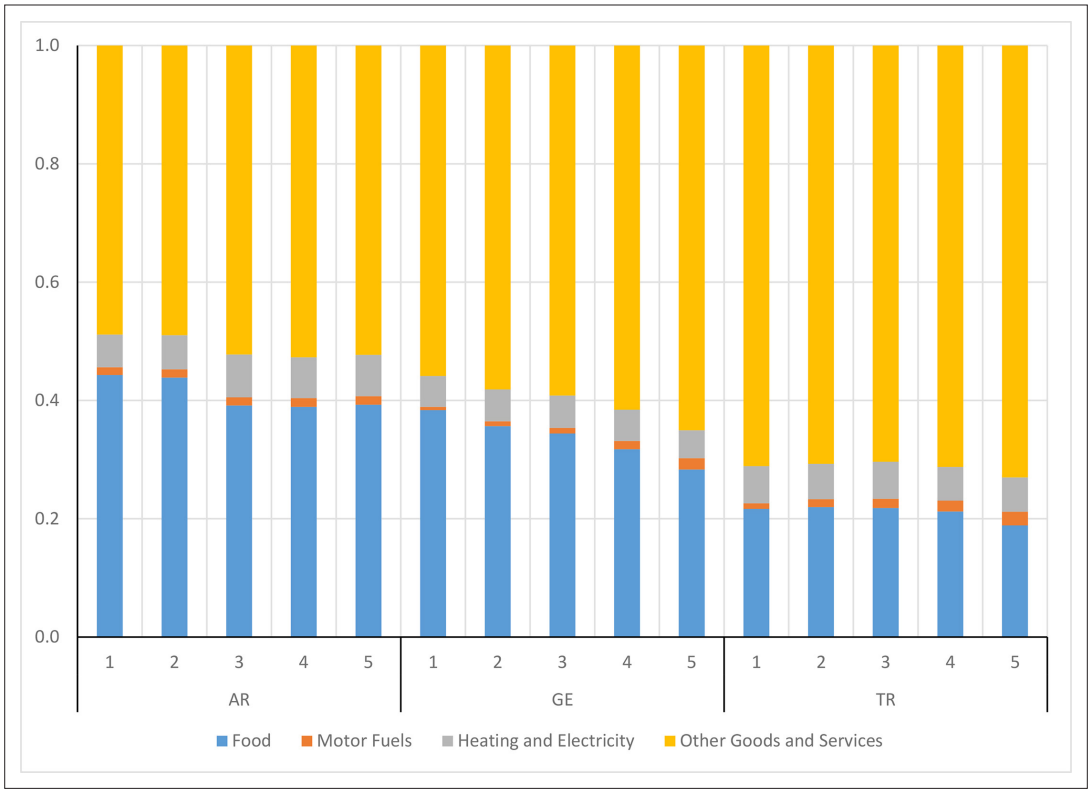

Figure 3 Budget shares of expenditure components across equivalised disposable income quintiles

rises, these budget shares gradually decline. Consequently, price fluctuations in these essentials have a greater impact on low-income households than on higher-income households.

The analyses reveal significant distinctions, especially within low-income households, where a substantial portion of their budgets is allocated to crucial categories like food and energy. As income increases, these budget allocations gradually decrease. As a result, fluctuations in the prices of these essentials exert a more pronounced effect on low-income households compared to their higher-income counterparts.

Figure 3 primarily examines the dynamics of allocations to specific commodity groups within each country. Notably, significant variations exist in these budget shares among countries. Concerning food, the budget share is lower for the top quintile than for the bottom quintiles within each country, indicating a budget elasticity of less than one. In Armenia, the bottom two quintiles have a considerably higher budget share than the bottom three deciles, while in Turkey, the bottom four quintiles share a similar, higher budget allocation for food compared to the top quintile. Georgia, in contrast, exhibits a gradual decline in budget share over the distribution, with the steepest decline. When comparing the countries, there's a consistent decrease in the food budget share, aligning with Engle's law and reflecting differences in GDP per capita.

It is worth noting that motor fuel allocations tend to increase with rising income, a trend that is particularly pronounced in Georgia and Turkey. This means that rising fuel prices have a greater impact on higher-income households, highlighting the complexity of the dynamics of income distribution in these countries.

For household heating and electricity costs, the share is higher for poor households in Turkey and Georgia, but in Armenia the opposite holds, albeit with the third quintile having the highest budget share. The bottom two quintiles in Armenia prioritise food relative to other commodity groups. As a result, heat and electricity does not feature like a necessity in wealthier countries. However, for quintiles three to five, the pattern of a declining budget share with income applies. It is noteworthy that motor fuel allocations generally increase with higher income, especially in Georgia and Turkey. This implies that the impact of rising fuel prices is more significant for wealthier households, adding complexity to income distribution dynamics in these countries.

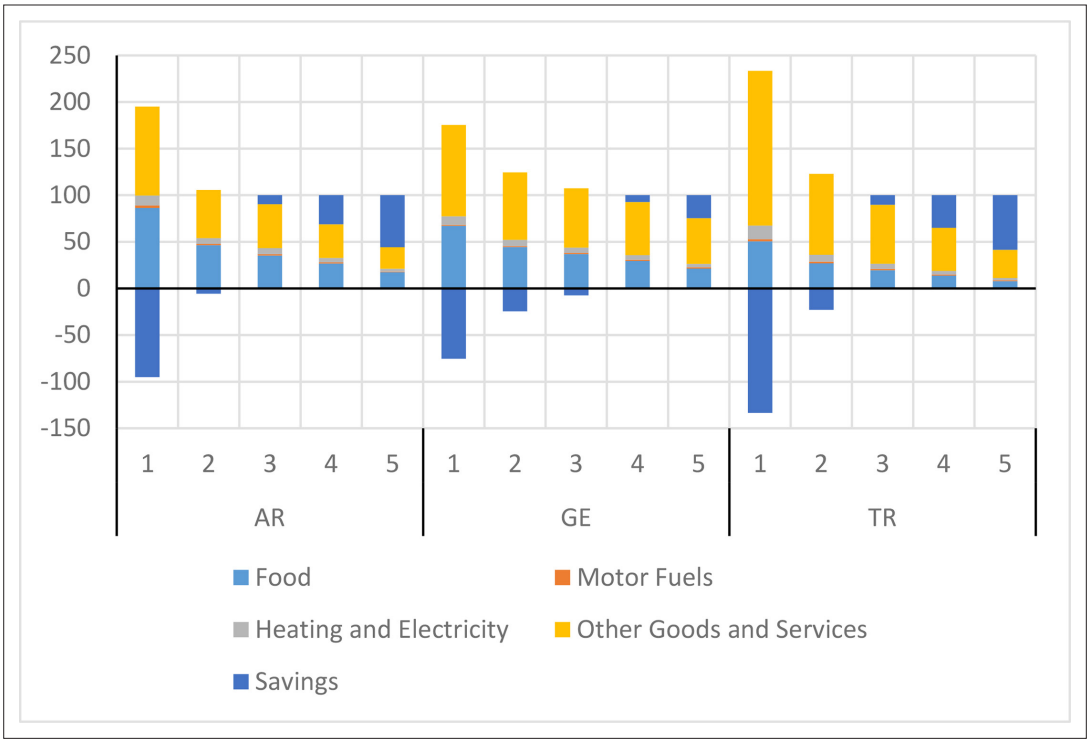

Figure 4 Budget and savings shares in household income across equivalised disposable income quintiles

The budget share for other commodities is a residual sector with the budget share rising with income, particularly the case in Georgia and with the share rising from Armenia to Georgia to Turkey accounting for the different economic situation.[8]

While the distribution of budget shares is important, a critical missing component is the gap between income and expenditure in the savings rate. While we cannot examine the capacity of households to absorb price increases from accumulated wealth, the pattern of savings across the distribution can serve as a proxy measure of this resilience to price shocks. ***Figure 4*** provides a visual representation of the relative contributions of the savings rate as well as primary expenditure subcomponents as a share of total income, broken down by quintiles of household equivalized disposable income. It is noteworthy that not only do low-income households spend a larger share of their income on food and energy, but that their savings rate is negative and are thus constrained in their ability to save. In all three countries, we find that savings rates are negative for the lowest quintile of the income distribution and gradually increase as we move up the income ladder. This observed trend is well in line with the results of previous research on the relationship between saving behaviour and income distribution (***Browning and Lusardi, 1996***). While negative savings rates at the bottom of the distribution are typical, the scale of the dissaving rate is likely to incorporate some unaccounted sources of purchasing power such as personal transfers, undeclared income or own produced consumption. It is unlikely that these households, given their high share of necessities in their consumption basket can access borrowings and are also less likely to have large accumulated savings.

Wealthier households tend to allocate a larger share of their income to saving than their lower-income counterparts. This strategic financial decision gives them the flexibility to maintain their spending habits by drawing on their accumulated savings when needed. In contrast, low- and middle-income households might choose to lower their savings rate to protect their basic wealth and social status (***Wisman, 2013***). When we compare this across the three countries, we find that Turkey has the biggest differential savings rate, with the most negative at the bottom and the most positive at the top, followed by Armenia at similar levels and Georgia with a lower differential. These differences in

8. In the Appendix, we note that neighbours Armenia and Azerbaijan, when ranked by deciles of expenditure, have the most similar budget share pattern, but with Azerbaijan having the lowest budget elasticity and declining food share over the distribution.

Table 4. Estimated inflation by main sub-components

	AR	GE	TR	AR	GE	TR
	Price Inflation			Share of Total Price inflation		
Food	16.3	10.9	46.0	0.558	0.470	0.246
Motor Fuels	0.2	0.7	4.2	0.006	0.029	0.022
Heating and Electricity	0.8	3.3	15.5	0.028	0.141	0.083
Other Goods and Services	11.9	8.4	121.6	0.408	0.359	0.649
Total	29.2	23.3	187.3			

saving behaviour are a valuable clue that we can use to investigate further the differentiated financial landscapes of these countries. Combined with the high food and energy shares, the savings rates story underscores the fact that significant fluctuations in food and energy prices can disproportionately affect these households, assuming their incomes remain constant. While at the top of the income distribution, it highlights the vulnerability of low-income households to energy price volatility in the broader context of our analysis of inflation.

3. Results

This section presents the results of our simulations. Firstly, we analyse the breakdown of aggregate inflation by its main sub-components. Next, we examine the distributional impact of inflation across equivalised disposable income by revealing the before and after behavioural responses, the redistributive effect of each commodity group, and their contribution to the progressivity or regressivity of inflation. Finally, we assess the welfare impact of inflation.

Table 4 details the average consumer price inflation between December 2020 and December 2022, decomposed into different expenditure categories for the average household in each country, considering the household expenditure allocation and the variations in commodity prices. It is important to note that Turkey experienced the highest overall inflation among the countries studied during this period. In contrast, Georgia recorded the lowest inflation rates. However, Azerbaijan exhibited even lower inflation, as detailed in the Appendix.

The primary drivers of inflation differ substantially among countries, influenced by both good-specific inflation factors and their relative budget allocations. Armenia has the highest proportion of inflation attributable to food price increases, at 55%. Georgia, which also has a relatively high food budget share, follows with the next highest proportion at 47%. Turkey, being more affluent, has the smallest contribution from food to its overall inflation, at 25%.

In Turkey, a considerable portion of inflation is attributable to other goods and services, a category that also holds a relatively high share in the other countries. In this case, the impact on overall inflation is driven more by the high budget allocation to this category rather than by commodity-specific inflation rates. The contribution of both motor and domestic fuel inflation has been more pronounced in Turkey and Georgia. This is due to both countries having lower budget shares allocated to these items, coupled with a lower impact from commodity-specific inflation rates. In contrast, Armenia has experienced political factors affecting fuel prices in recent years, which has had a different kind of influence on its inflation landscape.[9]

Rising prices for other goods and services are observed in all three countries. These expenditures increase inflation by 8.4% in the case of Georgia, by 11.9% in the case of by Armenia and 121.6% in the case of by Turkey.

9. https://iwpr.net/global-voices/armenia-lowers-energy-prices

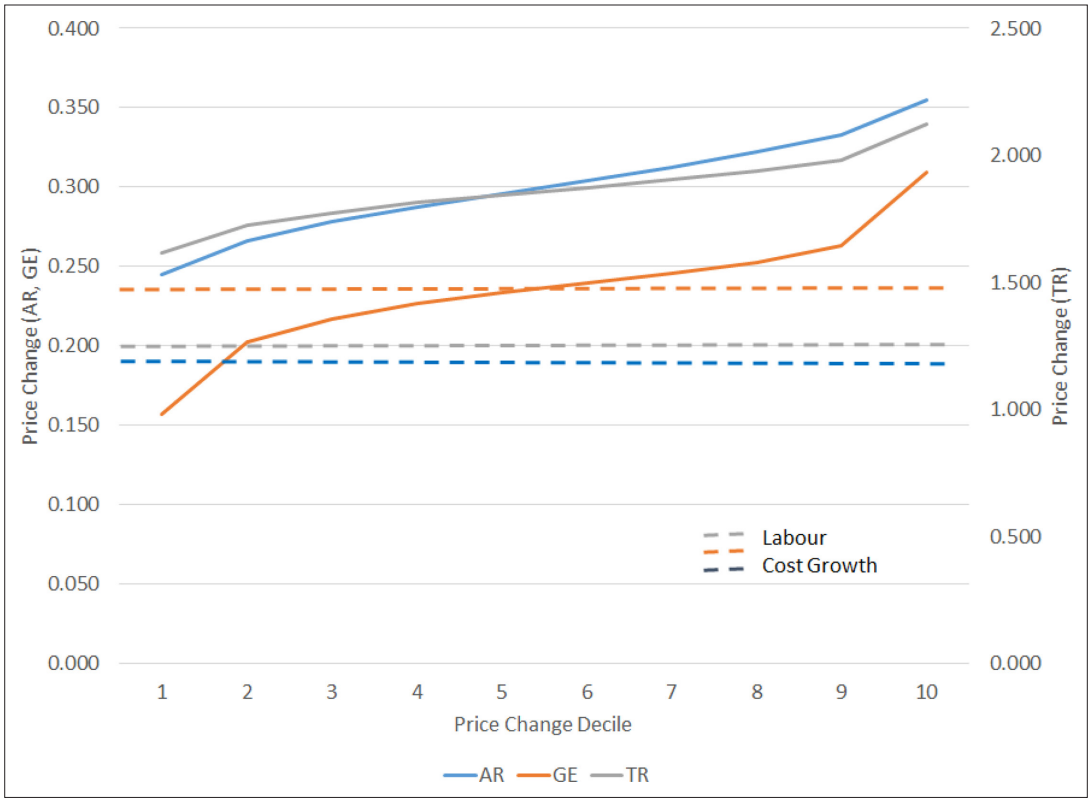

Figure 5 Average Price Change by Price Change Decile

3.1. Distributional impact of inflation

Figure 5 describes the distributional consequences of inflation, comparing December 2022 compared with December 2020, decomposed by price change decile. Thus, the top 10% are those with the highest 10% of price changes and the bottom 10% have the lowest price change. The level of the lines reflects the overall inflation rate. Although the average rate is lower in Georgia, the ratio between the top and the bottom of the distribution is the highest, with the highest variation in price. The Turkish average price growth is the highest (requiring a second axis), but the difference between those most affected and those least affected is the flattest. In each country, there is slight gradual change between the second decile and the ninth decile, with large changes between the first and second and between the ninth and tenth deciles. This may support targeted inflation mitigation measures on the relatively small proportion who are affected the most.

The dotted lines represent the growth rate of labour costs during this period. For Georgia, the dotted line passes through the middle of the distribution, indicating that approximately 50% of the population have price growth above the increase in labour costs, while the remaining sees 50% decrease. In the absence of the distribution of labour cost growth across the distribution and without taking other incomes into account, it is not possible assess the distributional effect in terms of welfare. In Armenia and Turkey, the growth in labour costs was lower than even the lowest decile of price growth rates. Consequently, the post-tax growth in labour income is likely to be less than the rate of inflation, leading to a decrease in purchasing power across various income levels.[10]

In ***Figure 6***, we report the impact of inflation by quintiles of household disposable income, decomposing it by the four commodity components that make up total inflation. When sorted this way, we find differences in income distribution. The distributional impact of inflation varies across countries. In

10. In contrast, Azerbaijan appears to resemble Georgia more closely, with the average growth rate in labour costs closely aligning with the average increase in prices (as detailed in the Appendix). One possible explanation for this insulation against price inflation in Azerbaijan could be its status as a fossil fuel-exporting nation. Companies in the petroleum and natural gas sectors may have been able to increase wages in line with sales, thereby mitigating the impact of inflation on incomes.

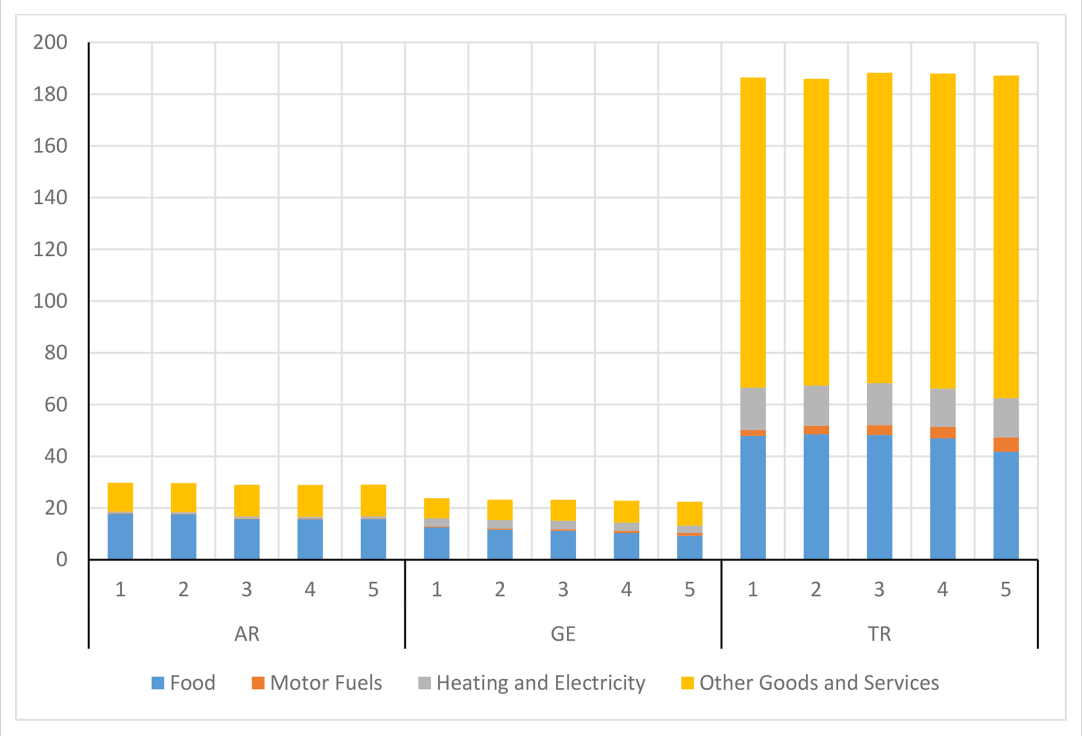

Figure 6 Distributional impact of inflation across equivalised disposable income quintiles

Armenia and in Georgia, the impact is relatively modest, and in Turkey, it is notably strong. In Armenia, in Georgia and in Turkey the impact of food inflation is relatively uniform across income groups.

3.2. Distributional metrics

To quantify the results presented in ***Figure 6*** and to gain deeper insight into the distributional consequences of inflation across countries, we compute a number of distributional metrics in ***Table 5***. These metrics are drawn from the tax literature, following the methodological adaptation in ***Sologon et al. (2022)***, and also ***Lambert (2001)***. In order to quantify inflation regressivity/progressivity, we use Reynolds Smolensky (RS) index to price changes. $RS < 0$ indicates a regressive impact of inflation, whereas $RS > 0$ implies a progressive impact of inflation. The Reynolds-Smolensky index (RS) shown in column 4 confirms that inflation in Turkey had a slightly progressive effect when expressed in terms of expenditure, i.e., it disproportionately affected the higher income groups. In the other countries, however, it had a slightly regressive effect, with Georgia having the most pronounced regressive impact. These results are consistent with the patterns observed in ***Figure 6***, where the quintile bars illustrate the distribution of the impact of inflation on the economy as a whole.

Table 5 column 4 shows the direct redistributive effects *(RS)* of inflation within each commodity group. This allows us to see which component drove the overall regressive/progressive impact. Following the methodological innovation for inflation developed by 2022, ***Sologon et al. (2022)***, based on methods used in taxation (see ***Pfähler, 1990***; ***Decoster et al., 2002***), the redistributive effect can be decomposed into the contribution of each component by decomposing *K* or the progression of inflation along the income distribution. Based on Equation 20, *K* can be decomposed into the contribution of the five commodity groups.

While the distributional effects of inflation appear relatively uniform when assessed in terms of the nominal change in expenditure relative to previous spending levels, the picture changes dramatically when these effects are evaluated in relation to disposable income. Higher rates of dissaving among the lower income deciles and increased savings among the top deciles imply that the nominal change in expenditure is more pronounced when households are dissaving and less so when they are saving. While expenditure may serve as a more accurate benchmark in a welfare analysis, the data presented in this table highlights the varying degrees of financial strain experienced by different income groups,

Table 5. Decomposition on distributional impact into base and rate effects

	CI pre-change *(X)*	CI_{Ci}	CI_{X+Ci}	RS_{Ci}	K_{Ci}	Avg. r.
	(1)	(2)	(3)	(4)	(5)	(6)
AR						
Total Expenditure	0.139	0.133	0.138	-0.001	-0.005	0.292
Food		0.112	0.135	-0.004	-0.026	0.163
Motor Fuels		0.159	0.138	0.000	0.020	0.002
Heating and Electricity		0.180	0.139	0.000	0.041	0.008
Other Goods and Services		0.158	0.140	0.002	0.020	0.119
GE						
Total Expenditure	0.212	0.202	0.211	-0.002	-0.010	0.229
Food		0.155	0.206	-0.005	-0.057	0.105
Motor Fuels		0.415	0.213	0.002	0.203	0.008
Heating and Electricity		0.188	0.211	-0.001	-0.024	0.000
Other Goods and Services		0.245	0.215	0.003	0.033	0.085
TR						
Total Expenditure	0.170	0.171	0.175	0.001	0.001	1.873
Food		0.142	0.161	-0.009	-0.028	0.460
Motor Fuels		0.314	0.176	0.006	0.144	0.042
Heating and Electricity		0.155	0.169	-0.002	-0.015	0.155
Other Goods and Services		0.180	0.000	0.005	0.009	1.216

Note: X = initial expenditure; CI_{Ci} = concentration index of the cost increase in item i, C_i; CI_{X+Ci}= CI of the increase in total expenditure due to the cost increase in item i, C_i; RS_{Ci}, K_{Ci}= Reynolds-Smolensky and Kakwani of C_i; r = average inflation rate; RS = (3)-(1); K =(2)-(1).

especially when accounting for their savings behaviour. It is important to note that this table does not factor in behavioural changes. Therefore, it serves as an indicator of the potential pressure on household behaviour and welfare, rather than a comprehensive measure of overall changes in welfare.

Table 6 summarizes the main results of our decomposition by expressing the contribution of each commodity component to total progressivity. The average inflation rate is obtained from the inflation rates for food (1), fuel (2), heating and electricity (3), and other goods and services (4). In Turkey, the progressive effect was driven primarily by heating and electricity at 0.0104% and other goods and services inflation at 0.0208 %, whereas essential goods (food and motor fuels) exerted a regressive counterbalancing effect. In Georgia, the regressive effect was predominantly driven by essential

Table 6. Contributions of the commodity groups to the progressivity of inflation

Component	Formula	Relative contribution of each component in K (%)		
		AR: Regressive	GE: Regressive	TR: Progressive
Food	$\frac{r_1}{r} * K_{C_1}$	-0.063	-0.0150	-0.0237
Motor fuels	$\frac{r_2}{r} * K_2$	0.000	0.0070	-0.0005
Heating & Electricity	$\frac{r_3}{r} * K_{C_3}$	0.005	-0.0155	0.0104
Other goods and services	$\frac{r_4}{r} * K_{C_4}$	0.037	0.0049	0.0208
Total	K	-0.20	-0.0095	0.0071

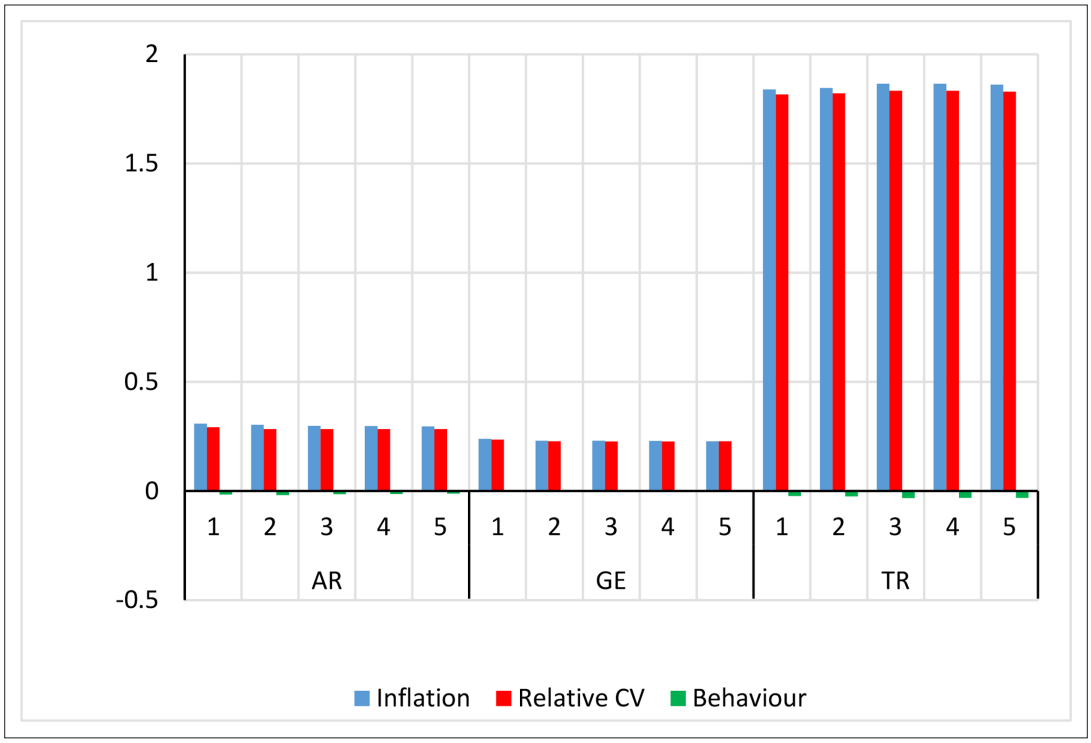

Figure 7 Welfare losses decomposition into price and behavioural adjustment

goods (food, heating and electricity) with a combined contribution of approximately 0.0305%. In Armenia, the regressive impact was primarily driven by food inflation at 0.063%.

In a cross-country comparison, it is observed that food inflation exhibits a more regressive trend in Armenia than in Georgia and Turkey. Similarly, inflation associated with heating and electricity is more regressive in Georgia as compared to Turkey. On the contrary, motor fuel inflation is progressive, with Georgia leading, followed by Armenia. Inflation pertaining to other goods and services is progressive across all the mentioned countries, with a more progression in Armenia.

3.3. Welfare losses of inflation

The compensating variation quantifies the change in general welfare that results from the change in the cost of living due to price increases when we account for behavioural changes. It essentially represents the monetary compensation that households need to maintain their level of welfare (utility) in the face of price increases.

To gain insight into how this compensating change affects households with different financial resources, we plot it relative to initial total expenditures in ***Figure 7***. Using this plot, we can approximate the percentage change in the cost of living for households with different resources. The trend in welfare losses across the income distribution mirrors the distributional pattern of inflation observed in ***Figure 6***. Countries with greater wealth exhibit lower welfare losses. In general, losses are more pronounced for lower-income households than for higher-income households in all countries.

The relative compensating change (CV) in ***Figure 7*** illustrates the relative increase in income that households would need in order to maintain their utility in the new price landscape. The discrepancy between these two figures represents the adjustments that households make in their consumption patterns due to shifts in the relative prices of various commodity groups in order to maintain their utility in the face of rising prices. In simpler terms, this means the difference between the amount that the price increase would cost households financially if there were no behavioural adjustments and the amount that it would cost if one takes into account that households can change their consumption behaviour to mitigate the effects of the price increase.

In general, the behavioural response factor is found to exert a limited influence on welfare in all countries. This result is not surprising given that the strongest price fluctuations are observed in

Table 7. Welfare Changes as measured by $Y_{ede}(2)$

	Atkinson Index (2)			Mean Y_e			$Y_{ede}(2)$		
	Pre -change	Post -change	Relative change	Pre -change	Post -change	Relative change	Pre -change	Post -change	Relative change
AR	0.303	0.305	0.91%	91625	71217	-22.27%	63895	49467	-22.58%
GE	0.373	0.376	0.91%	735	598	-18.59%	461	373	-19.04%
TR	0.313	0.302	-3.35%	7676	2740	-64.31%	5274	1911	-63.76%

important categories such as energy and food, which offer households limited flexibility in adjusting their consumption behaviour. This finding is consistent with the behavioural responses estimated by ***Sologon et al. (2022)*** for selected European countries.

3.4. Welfare Impact

To assess the overall impact of price changes on the welfare of the entire population, we use the social welfare function associated with the Atkinson index, which is based on the distribution of equivalized incomes before and after price adjustments, as shown in ***Table 7***.

The analysis of the Atkinson index shows that the increase in consumer prices contributes to an increase in inequality in Armenia, while conversely it reduces inequality in Georgia and Turkey. These results are in close agreement with previous observations derived from the RS index. The largest welfare losses, as measured by equivalized income distributed equally, are observed in Turkey (63.8%), followed by Armenia (22.6%) and Georgia (19.04%).

Breaking down the welfare losses into their efficiency and equity components using the data in ***Table 7***, we see that the main reason for the welfare decline is a reduction in efficiency, which translates into a decline in average equivalized income. In particular, the small changes in consumption inequality suggest that the price increase has affected all households and to similar relative degrees.

4. Conclusions and discussions

This paper explores the distributional impact of the cost-of-living crisis in Turkey and the South Caucuses, utilising a microsimulation framework applied to household budget survey data in these countries. This study compares the distributional effects of price changes in Turkey and the South Caucasus during the ongoing cost-of-living crisis between December 2020 and 2022, utilising data from outside the COVID period. Turkey and the South Caucasus region have their own welfare systems and different price fluctuation patterns. Undertaking a comparative perspective allows us to both understand the differential distributional impact in neighbouring countries, but also to understand the significance of changes in individual countries by comparison with others. The paper is the first comparative exercise within the developing world with the only other comparative exercises occurring within the European Union.

Turkey has by far the highest inflation rate at about seven times that of Azerbaijan and Georgia, the highest in the OECD and the region. In terms of drivers, the overall rate of inflation depends upon specific price increases for various goods; while all goods experienced inflation, food and energy goods had above average inflation. The relative budget shares inform how these individual price changes impact the over price change. Reflecting differences in economic development, the food budget share in Georgia and Azerbaijan is twice that of Turkey. Domestic heating budget shares are also higher, while the share of other goods and services is much higher in Turkey. As a result, food is a much more important driver for Georgia and Azerbaijan, accounting for about half the total effect, than Turkey where it accounts for only a quarter. The price increase of other goods and services accounts for much more of the change in Turkey.

Food budget shares vary more across the distribution in Georgia and Azerbaijan than in Turkey, which is relatively flat. The difference results in a slightly more regressive differential impact on food prices over the income distribution in the former two than Turkey. Turkish inflation has historically been affected by shocks of global oil prices and exchange rates (***Can et al., 2020***). This results in a slightly progressive effect, driven primarily by motor fuel inflation following other goods and

services inflation at food, heating and electricity. With other goods and services slightly progressive in all countries, the net effect is very flat, slightly regressive in Georgia and Azerbaijan and slightly progressive in Turkey.

The much higher overall price change in Turkey dominates. In terms of the welfare impact, about half of the households in Georgia have a higher price increase than the increase in wages. However, for Turkey and Azerbaijan, nearly all households face a higher price growth than the increase in the average wage rate, indicating a loss of purchasing power.

We extend the static impact analysis in two dimensions. Firstly, we consider a behaviourally adjusted measure of welfare, comparative advantage; the amount that someone should receive to maintain utility when prices change. The behavioural component of this measure is small, with distributional value of inflation driven by the rate effect. We also utilise the Atkinson social welfare function to consider equally-distributed-equivalent income, decomposing change in welfare into the distributional effect and the size effect, with the size effect dominating the distributional effect given the flat progressivity.

However, although the price effect is reasonably flat when considered under different dimensions, the capacity to absorb these price changes is influenced by net savings. Across each of the countries, the savings rate increases over the income distribution. As a result, price increase above the rate of wage growth in the bottom of the distribution cannot be absorbed in the short term. Therefore, when the prices of these things go up, they feel it the most.

Future work is required to assess the net distributional analysis of the cost-of-living crisis. In the absence of changes in the underlying income distribution, with only average, price effects, we have not been able to evaluate the net impact at a household level. However, in Azerbaijan and Turkey, the difference between the average wage rate change and the distribution of price changes is clearly welfare reducing. Similarly, we have had to model behavioural change in the assessment of compensating variation and do not know how savings varied at a household level. The soon availability of both pre- and mid-cost-of-living crisis household budget survey data will allow us to measure the actual distributional impact in each of these dimensions.

Lastly the policy response to the cost-of-living crisis in many countries has had a material effect on the net impact in Europe (***Amores et al., 2023***). The availability of social protection instruments and their implementation in each country may have acted as a buffer against the economic shock of unemployment, or other shocks due to illness, cushioning the blow of economic shocks for some households.

It is also of interest to consider the differential response to different crises. Reflecting on recent crises, in many cases, the response to the financial crisis in 2008-2012 was characterised by austerity, while the COVID-19 crisis was characterised by solidarity (***Sologon et al., 2022***). We recognize that a solidarity-based policy response during the COVID-19 crisis played a crucial role in safeguarding living standards and strengthening confidence in institutions in many countries. Middle-income earners in service and construction may face reduced spending and higher mortgage rates. Wealthier individuals benefit from increased investment income, while fixed-income earners, especially lower earners, benefit from stable prices. With rising interest rates and debt burdens, the current cost-of-living crisis resembles the financial crisis. It is crucial to prioritize preserving living standards for the most disadvantaged middle-classes, as they tend to cut spending during financial difficulties, impacting public confidence.

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The data used in this paper is not publicly available.

References
Aizorbe AM, Jackman PC. 1993. The commodity substitution effect in CPI data, 1982-1991. *Monthly Labour Review* 25–33.
Albacete N, Gerstner I, Geyer N, Lindner P, Prinz N, Woharcik V. 2022. [Effects of interest rate and inflation shocks on household vulnerability in Austria: A microsimulation using HFCS data] Financial Stability Report.
Allen RGD. 1958. Movements in Retail Prices Since 1953. *Economica* **25**: 14. DOI: https://doi.org/10.2307/2550690
Amble N, Stewart K. 1994. Experimental price index for elderly consumers. *Monthly Labor Review* **117**: 11–16.
Amores AF, Basso HS, Bischl JS, De Agostini P, Poli SD, Dicarlo E, Flevotomou M, Freier M, Maier S, García-Miralles E, Pidkuyko M, Ricci M, Riscado S. 2023. [Inflation, Fiscal Policy and Inequality] ECB Occasional Paper. DOI: https://doi.org/10.2139/ssrn.4604418
Arrow KJ. 1958. Utilities, Attitudes, Choices: A Review Note. *Econometrica* **26**: 1. DOI: https://doi.org/10.2307/1907381
Basso B, Millar N, Price L. 2023. *Modeling the Impact of Climate Change on Agriculture in the United States*. p. 409–434. DOI: https://doi.org/10.19103/AS.2022.0115.15
Bittencourt MF. 2007. [Inflation and Finance: Evidence from Brazil] SSRN Electronic Journal. DOI: https://doi.org/10.2139/ssrn.957255
Boskin MJ, Hurd MD. 1986. [Are inflation rates different for the elderly?] NBER Working Paper Series.
Brittain JA. 1960. Some neglected features of Britain's income levelling. *American Economic Review* **50**: 593–603.
Browning M, Lusardi A. 1996. Household saving: Micro theories and macro facts. *Journal of Economic Literature* **34**: 1797–1855.
Can U, Bocuoglu ME, Can ZG. 2020. How does the monetary transmission mechanism work? Evidence from Turkey. *Borsa Istanbul Review* **20**: 375–382. DOI: https://doi.org/10.1016/j.bir.2020.05.004
Canavire Bacarreza GJ, de Ervin L, Galeano J, Baquero J. 2023. Understanding the Distributional Impacts of Increases in Fuel Prices on Poverty and Inequality in Paraguay. *SSRN Electronic Journal* **39**: 77–108. DOI: https://doi.org/10.2139/ssrn.4354398
Chafwehé B, Ricci M, Stöhlker D. 2024. The Impact of the Cost-of-Living Crisis on European Households. *SSRN* **1**: 1–47. DOI: https://doi.org/10.2139/ssrn.4834596
Crawford I, Smith Z. 2002. *Distributional Aspects of Inflation. The Institute of Fiscal Studies Commentary 90*. London: Institute of Fiscal Studies.
Creedy J, Van De Ven J. 1997. The distributional effects of inflation in Australia 1980–1995. *Australian Economic Review* **30**: 125–143. DOI: https://doi.org/10.1111/1467-8462.00012
Creedy J. 1998. Measuring the welfare effects of price changes: a convenient parametric approach. *Australian Economic Papers* **37**: 137–151. DOI: https://doi.org/10.1111/1467-8454.00011
Creedy J., Dixon R. 1998. The relative burden of monopoly on households with different incomes. *Economica* **65**: 285–293. DOI: https://doi.org/10.1111/1468-0335.00128
Creedy J. 2000. Measuring welfare changes and the excess burden of taxation*. *Bulletin of Economic Research* **52**: 1–48. DOI: https://doi.org/10.1111/1467-8586.00091
Creedy J. 2001. Indirect tax reform and the role of exemptions. *Fiscal Studies* **22**: 457–486. DOI: https://doi.org/10.1111/j.1475-5890.2001.tb00049.x
Curci N, Savegnago M, Zevi G, Zizza R. 2022. The redistributive effects of inflation: a microsimulation analysis for Italy. *In Review* **738**: 1–22. DOI: https://doi.org/10.21203/rs.3.rs-2611447/v1
Deaton A. 2003. Household Surveys, Consumption, and the Measurement of Poverty. *Economic Systems Research* **15**: 135–159. DOI: https://doi.org/10.1080/0953531032000091144
Decoster A, Standaert I, Valenduc C, Camp G. 2002. What makes personal income taxes progressive? The case of Belgium. *Cahiers Economiques de Bruxelles/Brussels Economic Review* **45**: 91–112.
Doorley K, Regan M, Roantree B. 2022. Box B: The distributional effects of inflation and prospects for income growth. *Box B in Quarterly Economic Commentary Spring*. Dublin: Economic and Social Research Institute.
Eurostat. 2022. [Annual inflation up to 9.9% in the euro area] Euroindicators, 116, Luxembourg: Eurostat.
Eurostat. 2020. [Household Budget Survey 2015 Wave EU Quality Report] Directorate F: Social Statistics – Modernization and Co-Ordination.

Fogarty J. 2006. The nature of the demand for alcohol: understanding elasticity. *British Food Journal* **108**: 316–332. DOI: https://doi.org/10.1108/00070700610657155
Frisch R. 1959. A complete scheme for computing all direct and cross demand elasticities in a model with many sectors. *Econometrica* **27**: 177. DOI: https://doi.org/10.2307/1909441
Fry VC, Pashardes P. 1985. Distributional aspects of inflation: who has suffered most? *Fiscal Studies* **6**: 21–29. DOI: https://doi.org/10.1111/j.1475-5890.1985.tb00521.x
Hobijn B, Lagakos D. 2005. Inflation inequality in the United States. *Review of Income and Wealth* **51**: 581–606. DOI: https://doi.org/10.1111/j.1475-4991.2005.00170.x
Houthakker HS. 1957. An international comparison of household expenditure patterns, commemorating the centenary of Engel's Law. *Econometrica* **25**: 532. DOI: https://doi.org/10.2307/1905382
Ivanic M, Martin W, Zaman H. 2012. Estimating the short-run poverty impacts of the 2010–11 surge in food prices. *World Development* **40**: 2302–2317. DOI: https://doi.org/10.1016/j.worlddev.2012.03.024
Jensen RT, Miller NH. 2008. Giffen behavior and subsistence consumption. *The American Economic Review* **98**: 1553–1577. DOI: https://doi.org/10.1257/aer.98.4.1553
Kakwani NC. 1977. Measurement of tax progressivity: an international comparison. *The Economic Journal* **87**: 71. DOI: https://doi.org/10.2307/2231833
Konus AA. 1939. The Problem of the True Index of the Cost of Living. *Econometrica* **7**: 10. DOI: https://doi.org/10.2307/1906997
Lambert P. 2001. *The Distribution and Redistribution of Income: Third Edition*. Manchester University Press.
Lluch C, Powell A, Williams R. 1977. *Patterns in Household Demand and Saving*. Oxford University Press.
Lokshin M, Sajaia Z, Torre I. 2023. [Who Suffers the Most from the Cost-of-Living Crisis?] Policy Research Working Paper.
Loughrey J, O'Donoghue C. 2012. The Welfare Impact of Price Changes on Household Welfare and Inequality 1999-2010. *SSRN Electronic Journal* **43**: 31–66. DOI: https://doi.org/10.2139/ssrn.1855149
Muellbauer J. 1974. Prices and Inequality: The United Kingdom Experience. *The Economic Journal* **84**: 32. DOI: https://doi.org/10.2307/2230482
Murphy E, Garvey E. 2004. [A consumer price index for low-income households in Ireland (1989-2001] Combat Poverty Agency Working Paper Series.
O'Donoghue C, Beenish A, Linden J, Lustig N, Sologon DM, Yang W. 2023. [The distributional impact of price inflation in Pakistan: A case study of A new price focused microsimulation framework, PRICES] Working papers; No. 2023-07). LISER(.
Pfähler W. 1990. Redistributive effect of income taxation: decomposing tax base and tax rates effects. *Bulletin of Economic Research* **42**: 121–129. DOI: https://doi.org/10.1111/j.1467-8586.1990.tb00295.x
Pollak RA. 1980. Group cost-of-living indexes. *The American Economic Review* **70**: 273–278.
Prais SJ. 1959. Whose Cost of Living? *The Review of Economic Studies* **26**: 126. DOI: https://doi.org/10.2307/2296170
Rodriguez L, Atamanov A. 2021. Welfare and Distributional Impacts of Inflation and the COVID-19 Outbreak in the Islamic Republic of Iran. *WB Policy Research Working Paper* **9558**: 1–26. DOI: https://doi.org/10.1596/1813-9450-9558
Shahir AA, Figari F. 2021. [The effect of fiscal drag on income distribution and work incentives: A microsimulation analysis on selected African countries] WIDER Working Paper.
Sologon Denisa Maria, O'Donoghue C, Linden J, Kyzyma I, Loughrey J. 2022. Welfare and Distributional Impact of Soaring Prices in Europe. *SSRN Electronic Journal* **4**: 1–56. DOI: https://doi.org/10.2139/ssrn.4285835
Sologon D. M., Doorley K, O'Donoghue C. 2023. Drivers of income inequality: What can we learn using microsimulation. *Handbook of Labor, Human Resources and Population Economics* 1–37. DOI: https://doi.org/10.1007/978-3-319-57365-6_392-1
Timmins C. 2006. Estimating spatial differences in the Brazilian cost of living with household location choices. *Journal of Development Economics* **80**: 59–83. DOI: https://doi.org/10.1016/j.jdeveco.2005.02.006
Tipping DG. 1970. Price Changes and Income Distribution. *Applied Statistics* **19**: 1–17. DOI: https://doi.org/10.2307/2346837
Turkstat. 2022. *Consumer Price Index*.
Wisman JD. 2013. Wage stagnation, rising inequality and the financial crisis of 2008. *Cambridge Journal of Economics* **37**: 921–945. DOI: https://doi.org/10.1093/cje/bes085
World Bank. 2023. Europe and central asia economic update, spring 2023: weak growth, high inflation, and a cost-of-living crisis. Washington, DC: World Bank. http://hdl.handle.net/10986/39617
Zhang F. 2011. [Distributional Impact Analysis of the Energy Price Reform in Turkey] World Bank Policy Research Working Paper. DOI: https://doi.org/10.1596/1813-9450-5831

Appendix A

Table A1. Composition of change in price by decile of consumption.

	AR	AR	AR	AR	AZ	AZ	AZ	AZ	GE	GE	GE	GE	TR	TR	TR	TR
	Food	H&E	Transport	Other	Food	H&E	Transport	Other	Food	H&E	Transport	Other	Food	H&E	Transport	Other
1	0.208	0.070	0.007	0.715	0.827	0.063	0.013	0.097	0.425	0.131	0.054	3.213	0.205	0.033	0.017	0.745
2	0.403	0.034	0.009	0.554	0.797	0.072	0.014	0.117	0.469	0.106	0.058	3.747	0.229	0.043	0.020	0.707
3	0.483	0.029	0.008	0.480	0.781	0.077	0.016	0.127	0.485	0.101	0.065	3.786	0.252	0.046	0.023	0.680
4	0.539	0.025	0.007	0.429	0.763	0.085	0.016	0.136	0.497	0.098	0.066	3.805	0.258	0.055	0.022	0.664
5	0.590	0.022	0.006	0.382	0.750	0.090	0.017	0.142	0.510	0.101	0.066	3.517	0.276	0.056	0.024	0.643
6	0.632	0.019	0.006	0.342	0.734	0.094	0.018	0.153	0.504	0.102	0.067	3.540	0.282	0.062	0.023	0.632
7	0.676	0.016	0.005	0.303	0.719	0.101	0.020	0.160	0.509	0.101	0.066	3.525	0.270	0.065	0.026	0.640
8	0.716	0.015	0.004	0.265	0.701	0.108	0.021	0.169	0.489	0.129	0.064	2.718	0.277	0.070	0.026	0.627
9	0.766	0.012	0.004	0.218	0.669	0.126	0.022	0.183	0.452	0.182	0.061	1.866	0.271	0.079	0.027	0.623
10	0.851	0.008	0.002	0.138	0.594	0.158	0.028	0.219	0.338	0.356	0.047	0.816	0.182	0.206	0.018	0.594

Note: H&E - Heating and Electricity

Table A2. Average change in price by decile of consumption.

	AR	AZ	GE	TR
1	0.318	0.222	0.230	1.618
2	0.308	0.210	0.235	1.724
3	0.307	0.203	0.235	1.774
4	0.302	0.195	0.236	1.815
5	0.300	0.189	0.237	1.845
6	0.299	0.183	0.241	1.873
7	0.297	0.177	0.236	1.903
8	0.296	0.170	0.235	1.936
9	0.294	0.162	0.234	1.979
10	0.283	0.144	0.226	2.124
Total	0.301	0.186	0.235	1.873
Labour Cost Growth	0.240	0.187	0.210	1.240

Table A3. Distributional impact of value of price changes relative to (before behavioural response).

Denominator	Disposable income					Expenditure				
Quintile	Food	Motor Fuels	Heating and Electricity	Other Goods and Services	Total	Food	Motor Fuels	Heating and Electricity	Other Goods and Services	Total
Armenia										
1	105.4	0.8	2.9	51.5	160.5	17.8	0.2	0.7	11.1	29.8
2	18.5	0.2	0.7	11.3	30.7	17.6	0.2	0.7	11.1	29.6
3	14.1	0.2	0.8	10.6	25.6	15.7	0.2	0.9	12.2	29.0
4	10.8	0.1	0.6	8.2	19.7	15.6	0.2	0.9	12.3	28.9
5	7.8	0.1	0.4	6.0	14.3	15.8	0.2	0.9	12.2	29.0

Denominator	Disposable income				Expenditure				
Georgia									
1	31.0	1.2	10.1	21.0	63.3	12.4	0.4	3.5	7.7	24.0
2	14.3	0.4	4.4	9.2	28.3	11.9	0.4	3.5	7.8	23.6
3	12.1	0.5	3.8	8.3	24.7	11.4	0.6	3.4	8.0	23.4
4	9.9	0.6	3.1	7.6	21.3	10.9	0.7	3.1	8.4	23.1
5	7.5	0.7	2.4	6.6	17.2	9.7	1.0	3.1	9.0	22.9
Turkey									
1	293.7	17.2	109.5	690.5	1110.8	47.9	2.3	16.3	119.9	186.4
2	62.5	4.4	21.7	157.7	246.4	48.6	3.2	15.5	118.6	185.9
3	44.4	3.8	15.7	113.5	177.4	48.2	3.8	16.2	120.0	188.3
4	31.2	3.2	10.2	83.5	128.0	47.0	4.4	14.8	121.8	188.0
5	19.3	2.6	7.2	57.4	86.5	41.7	5.6	15.1	124.8	187.2

[2] The categorization of countries is based on the World Bank's classification by per capita income. Hereinafter, the countries with high income are referred as developed countries, while the countries with upper- and lower-middle income are referred as developing countries.