The Macroeconomic and Welfare Effects of Household Support Packages*

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Abstract

Since 2022, governments across Europe have implemented large fiscal packages to shield households from sharp increases in food and energy prices. These packages combined price controls/subsidies with targeted fiscal transfers. We evaluate these detailed interventions in a multi-sector New Keynesian model with household heterogeneity, matched directly to micro data on income, wealth, and consumption baskets. Within this setting, we characterize the aggregate demand and supply effects of these policies and derive a micro-founded social welfare function that admits a decomposition revealing the underlying distortions. Evaluating the recent fiscal package in the United Kingdom, we find that it reduced social welfare, and that welfare losses can be more than five times as large once macro channels are accounted for.

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1 Introduction

Since the 2022 energy crisis, triggered by Russia's invasion of Ukraine, nearly all European countries introduced fiscal packages to protect vulnerable households from sharp increases in food and energy prices. These packages typically combined price controls, tax cuts and subsidies, and lump-sum transfers, sometimes targeted at specific groups. However, the desirability of such measures has been widely debated. While capping energy prices can protect poorer households, who devote a relatively large share of their budgets to energy consumption, it may also distort household decision-making by weakening incentives to reduce demand and potentially encouraging over-consumption. Moreover, fiscal measures which alter prices create broader macroeconomic distortions. By contrast, direct transfers to households may induce fewer distortions, but in practice they may be less effective at reaching those most exposed to the shock. Overall, it remains unclear whether the fiscal packages implemented across Europe ultimately succeeded in mitigating the decline in social welfare caused by the crisis.

This paper develops a framework to assess the welfare effects of these fiscal packages, accounting not only for their direct microeconomic impacts but also for their macroeconomic consequences. We show that these broader macro effects are crucial in determining overall welfare outcomes, depending on how monetary policy responds to the fiscal interventions.

To this end, we incorporate price controls and fiscal transfers into a multi-sector New Keynesian model with non-homothetic preferences and household heterogeneity, building on Olivi et al. (2026). The model is designed to allow a high degree of flexibility in preferences and steady-state distributions. This enables us to closely match the distributions of income, wealth, and consumption baskets observed in micro data, which is crucial for accurately evaluating policies with sector-specific or distributional features, such as the recent fiscal measures.

Within this framework, we then derive a social welfare function that can be decomposed into distinct components capturing distortions in aggregate out-

put, relative prices both across and within sectors, and distributional effects. This decomposition allows us not only to assess the overall welfare implications of alternative policies but also to pinpoint the specific distortions that matter most. For the distributional component, we assume a social welfare function that renders the steady-state distribution efficient, in line with the inverse-optimum taxation literature. Yet, fluctuations in the distribution do generate welfare losses. This approach enables us to isolate the welfare gains from policies insofar as they mitigate the distributional impact of aggregate or sectoral shocks.

Before evaluating the welfare effects, we first examine how a sector-specific price control transmits to inflation and the output gap, two key welfare-relevant macroeconomic variables. We show that such a control generates both aggregate demand and aggregate supply effects. To see this, note first that a temporary downward price control reduces the prices faced by households, thereby stimulating aggregate demand. More formally, the control shifts the aggregate demand curve implied by the consumption Euler equation upward. Second, the control mechanically raises real wages from the household's perspective, encouraging greater labor supply and lowering firms' marginal costs. Formally, this shifts the New Keynesian Phillips Curve downward. Together, these demand and supply channels have important macroeconomic implications, which we find to be large quantitatively. The macro implications depend on the monetary policy reaction, which may neutralize the demand effects but not the supply effects.

Next, we turn to the welfare effects of the policies. We do so based on a quantitative model calibrated to the United Kingdom, simulating the Cost-of-Living crisis of 2022. Specifically, we model two fiscal policies. The first is the Energy Price Guarantee. With this policy, the UK government capped the price of electricity and gas faced by households, while reimbursing utility companies for the difference between the capped price and the wholesale price. The second policy measure consisted of Cost-of-Living payments, some of which were paid indiscriminately to all households, whereas others were targeted to lower-income people, the elderly, and disabled people.

We begin by quantifying the direct welfare effects of the two fiscal interventions. First, we conduct a narrow calculation that abstracts from fluctuations in endogenous macroeconomic variables other than sectoral prices. In this setting, the package reduces welfare by distorting the consumption baskets, but this loss is partly offset by gains from redistribution toward households more exposed to higher food and energy prices.

We then revisit the direct welfare effects, accounting for the fact that nominal wages, interest rates, and other macro variables responded to the Ukraine shock. In this case, the redistributive component turns negative. Although price controls benefit households most exposed to higher electricity and gas prices, the shock also triggered macroeconomic adjustments with stronger distributional consequences. In particular, highly indebted households faced sharply higher interest payments following the central bank's rate hikes.[1] These households—often middle-income families with mortgages—received little benefit from the fiscal measures, as they were ineligible for transfers and did not devote especially large budget shares to energy. Yet they helped finance the interventions, leaving them worse off on net.

Finally, we evaluate the effects of the policies, taking into account their general equilibrium implications. For the energy price cap, welfare losses are substantially larger once macroeconomic adjustments are incorporated. This result arises for two reasons. First, the price control amplifies fluctuations in the output gap and inflation through its equilibrium effects. Second, the nominal interest rate responds to these additional macroeconomic pressures, which further increases welfare losses by intensifying adverse redistribution.

Overall, we find that macro effects are very important for welfare. Accounting for such effects, welfare losses can be more than five times as large as under a narrow welfare calculation which considers only the direct effects of the policy.

Although the primary focus of this paper is fiscal policy, the monetary

[1] In the calibration, mortgages are modeled as negative nominal positions. In the UK, mortgage rates are typically either fully flexible or fixed only for short periods, so the rapid increase in interest rates during 2022 quickly translated into higher mortgage payments for many households.

policy response to fiscal interventions proves to be quantitatively important. A key question is whether monetary policy should respond to the mechanical effects that a price control has on inflation. In practice, central banks often state that they "look through" such mechanical effects. We use our model to evaluate an alternative scenario in which the central bank does respond to them. In that case, welfare losses are smaller. The mechanically lower inflation reduces the increase in the nominal interest rate, which in turn mitigates the redistribution from borrowers to savers described above.

Related Literature. This paper relates to three strands of work. First, we connect to microeconomic studies evaluating the welfare effects of energy interventions, see e.g. Hahn and Metcalfe (2021) and Costa and Gerard (2021). Within this strand of literature, the most closely related paper is Levell et al. (2025) who, like us, evaluate the recent fiscal policy response in the UK. We complement their work by incorporating macroeconomic distortions into the welfare analysis, and show that these are quantitatively important and depend crucially on the monetary policy response. Moreover, we show that even when abstracting from the equilibrium effects triggered by the interventions themselves, accounting for concurrent movements in macroeconomic variables, such as nominal interest rates, can substantially affect welfare calculations.

We also relate to a growing macroeconomic literature studying the aggregate effects of the 2022 energy shock and the role of policy in shaping its transmission, often using HANK frameworks.[2] Particularly related to our work are Auclert et al. (2023) and Bayer et al. (2023), who show that energy price subsidies can stimulate aggregate demand and create international spillovers. Our paper contributes to this literature in three important ways. First, our model is flexible with regard to preferences and can be matched one-for-one to micro data, not only in terms of income and wealth distributions, but also in terms of consumption baskets. It can therefore capture micro-level exposures to shocks and policies with a similar level of detail as the micro literature

[2]See, e.g., Bachmann et al. (2022); Bayer et al. (2023); Auclert et al. (2023); Kharroubi and Smets (2024); Bobasu et al. (2025); Gnocato (2025).

mentioned above.[3] Second, we highlight the positive supply effects of price subsidies, which become apparent once we derive a welfare-relevant New Keynesian Phillips Curve. We find that these effects can be very important for welfare. Third, we derive a micro-founded welfare loss function that can be cleanly decomposed in terms of the underlying distortions, helping to clarify the drivers of the overall welfare effects. Importantly, our setup implies that policies improve welfare only to the extent that they mitigate the effects of aggregate or sector-level shocks.[4]

Our normative welfare analysis connects to the inverse-optimum taxation and revealed-preference tradition in public finance (Christiansen and Jansen, 1978; Bourguignon and Spadaro, 2012; Bargain and Orsini, 2006; Saez and Stantcheva, 2016; Hendren, 2020). Like this literature, we assume a social welfare function under which the steady-state distribution is inefficient. In our setting, however, fluctuations in the distribution further reduce social welfare. Finally, our paper relates to work emphasizing the importance of non-homothetic demand for optimal tax design (Jaravel and Olivi, 2021).

The remainder of this paper is organized as follows. Section 2 presents the model and explains the macroeconomic effects of an energy price control, based on analytical results. Section 3 presents the social welfare function and its decomposition. Section 4 discusses the calibration of the model and presents the main quantitative results, evaluating the recent cost-of-living policies in the United Kingdom.

[3]To give one example, in the third quarter of 2022, the UK government made a cost-of-living transfer specifically to disabled people. In our model, every household is precisely matched to a counterpart in the data in terms of income, wealth, and consumption in the steady state. Since we also observe which households were eligible for disability transfers, we can simulate the macroeconomic and distributional effects of this policy directly in our model.

[4]By contrast, a standard utilitarian welfare function typically implies that steady-state inequality is inefficient, and the welfare effects of policies may then be largely driven by the extent to which they reduce a steady-state distortion, which would be welfare-enh ancing to do even without aggregate shocks.

2 The Model

In this section, we introduce sector-specific price controls and cost-of-living transfers in a multi-sector New Keynesian model with generalized, non-homothetic preferences, following Olivi et al. (2026). We then explain the macroeconomic effects of the policies using analytical results.

Agents. The economy's production side consists of a finite number of sectors, indexed by $k = 1, 2, ..., K$. Within each sector, there is a unit mass continuum of varieties, which are indexed by j. Each of these varieties is produced by a different firm. On the consumption side, there is a unit mass of heterogeneous households, indexed by i. Finally, there is a government which conducts fiscal and monetary policy.

Fiscal support packages. We consider two kinds of fiscal instruments. The first is a sector-specific price control on goods sold to consumers, which takes the form of a time-varying subsidy $\tau_{k,t}$.[5] We assume that the price control does not apply to sales of intermediate goods to other firms. Let $p_{k,t}(j)$ denote the wholesale price of variety j in sector k at time t. We denote the regulated retail price paid by consumers by $q_{k,t}(j) = p_{k,t}(j)(1 - \tau_{k,t})$.

The second kind of fiscal policy we consider is a lump-sum transfer to households, denoted by $\zeta_t(i)$. Note that the transfer may vary not only over time, but also across households. In this way, the model is able to capture that the UK cost-of-living payments were partly targeted to particular groups: lower-income households, the elderly and the disabled.[6]

[5] Under the Energy Price Guarantee (EPG), the UK government capped the per-unit price of electricity and gas sold to consumers, but compensated energy suppliers for the difference between the market price and the regulated price. Therefore, the policy was a time-varying subsidy per unit of electricity and gas.

[6] In the quantitative version of the model, each household i will correspond to a household in a survey, in which we observe many characteristics from which it can be determined whether a household received a certain transfer or not.

Households. Household preferences over consumption are given by $u_i(\mathbf{c}_t(i))$, where $\mathbf{c}_t(i) = \{c_{1,t}(i), .., c_{K,t}(i)\}$ is a vector of sectoral consumption bundles and where $u_i(\cdot)$ is twice differentiable, increasing, and concave. This general specification allows for non-homotheticity over sectors as well as household-specific preference shifters. For simplicity, we assume that preferences over varieties within sectors are CES, i.e. $c_{k,t}(i) = \left(\int_0^1 c_{k,t}(i,j)^{\frac{\epsilon_k - 1}{\epsilon_k}} dj \right)^{\frac{\epsilon_k}{\epsilon_k - 1}}$, where ϵ_k is a constant but sector-specific elasticity of substitution between varieties. It follows that the wholesale price index for sector k is given by $P_{k,t} = \left(\int_0^1 p_{k,t}(j)^{1-\epsilon_k} dj \right)^{\frac{1}{1-\epsilon_k}}$, whereas the retail price index is $Q_{k,t} = P_{k,t}(1 - \tau_{k,t})$.

In every period, households decide on consumption ($\mathbf{c}_t(i)$), labor supply ($n_t(i)$), and on saving in one-period nominal bonds ($b_{t+1}(i)$). Moreover, households die with a probability $\delta \in (0,1)$ in every period, and each deceased household is replaced by a new household. Newborn households vary in a number of dimensions. As mentioned, above, their preferences and eligibility for transfers may differ. In addition, they vary in terms of their labor productivity, denoted $\vartheta(i)$, and in terms of their initial nominal wealth positions. Moreover, households own the firms and receive their dividends, but their ownership shares may vary. Finally, a household may be either Hand-to-Mouth (HtM) or non-HtM, which we treat as a permanent characteristic. [7] Finally, households discount the future at a rate $\beta \in (0,1)$.

The decision problem of a non-HtM household can be expressed as:

$$\begin{aligned} \max_{\mathbf{c}_t(i), n_t(i), b_t(i)} \quad & \mathbb{E}_t \sum_{s=0}^{\infty} (\beta(1-\delta))^{t+s} \left(u_i(\mathbf{c}_{t+s}(i)) - \chi_i \left(\frac{n_{t+s}(i)}{\vartheta(i)} \right) \right), \\ s.t. \qquad & e_t(i) + \frac{b_{t+1}(i)}{R_t} = b_t(i) + W_t n_t(i) + \sum_k \varsigma_k(i) Div_{k,t} + \zeta_t(i). \end{aligned} \tag{1}$$

where $e_t(i) = \sum_{k=1}^K e_{k,t}(i) = \sum_{k=1}^K Q_{k,t} c_{k,t}(i)$ denotes consumption expenditures, $n_t(i)$ is effective labor supply, R_t is the nominal interest rate, $Div_{k,t}$ denotes firm dividends from sector k and $\varsigma_k(i)$ is the household's ownership share

[7] Households also differ by their birth date, which we will denote later by a superscript t_0. For now, we suppress this aspect in our notation.

of that sector. Finally, $\mathbb{E}_t$ is the conditional expectations operator. Hand-to-Mouth households face the same decision problem, but with the additional constraint that $b_{t+1}(i) = b_t(i)$, i.e. these households must consume their current income.

To simplify the expressions, in the remainder of this paper we will assume that the Elasticity of Intertemporal Substitution (EIS) and the Frisch elasticity of labor supply are homogeneous across households and denote them by σ and ψ respectively.[8] We further assume that dividend shares are proportional to steady-state labor income shares.

Firms. Each firm produces a single variety in a particular sector and is therefore monopolistically competitive. In every period, a firm j in sector k decides on the amount of effective labor hired ($n_{k,t}(j)$), as well as on the amount of intermediate inputs, where $\tilde{Y}_{l,k,t}(j)$ denotes input bundles from sector l, which we assume are produced according to the same CES aggregator as the one used by the households. From this it follows that a firm's demand is given by:

$$y_{k,t}(j) = \left(\frac{p_{k,t}(j)}{P_{k,t}}\right)^{-\epsilon_k} (C_{k,t} + \sum_{l=1}^{K} \tilde{Y}_{k,l,t}), \tag{2}$$

where $C_{k,t} = \delta \sum_{t_0=-\infty}^{t} (1-\delta)^{t-t_0} \int_0^1 c_{k,t}^{t_0}(i)di$ is aggregate consumption, where the superscript t_0 denotes the household's birth date. The production function of the firm is given by

$$y_{k,t}(j) = A_{k,t} F_k(n_{k,t}(j), \tilde{Y}_{1,k,t}(j), \tilde{Y}_{2,k,t}(j), ..., \tilde{Y}_{K,k,t}(j)), \tag{3}$$

Here, $y_{k,t}(j)$ denotes output, $F_k(\cdot)$ is a sector-specific production function with constant returns to scale and $A_{k,t}$ is an exogenous, sector-specific productivity variable, which evolves according to a stationary stochastic process. The firms'

[8] This can always be achieved, see Olivi et al. (2026).

total cost of production is given by:

$$TC_{k,t}(j) = W_t n_{k,t}(j) + \sum_{l=1}^{K} P_{l,t} \tilde{Y}_{l,k,t}(j). \tag{4}$$

We introduce nominal rigidities into the model by assuming that a firm can adjust its price only with a probability $1 - \theta_k$ in a given period. The firm's optimal price setting problem is given by:

$$\max_{p_{k,t}(j), n_{k,t+s}(j), \{\tilde{Y}_{l,k,t+s}(j)\}_{l=1}^{K}} \mathbb{E}_t \sum_{s=0}^{\infty} \Lambda_{t,t+s} \theta_k^s \left(p_{k,t}(j) y_{k,t+s}(j) - (1 - \iota_k) TC_{k,t}(j) - T_{k,t+s} \right),$$

subject to (2)-(4). Here, $\Lambda_{t,t+s}$ is the firm's stochastic discount factor.[9] In the above equation, ι_k is a time-invariant, sector-specific cost subsidy which may be used by the government to correct markup distortions in the steady state, and $T_{k,t}$ is a lump-sum tax to finance the subsidy, which can be arbitrarily differentiated across sectors.

Government. Let us now consider the government, which consists of a fiscal authority and a central bank. For now, we assume that fiscal policy follows a balanced budget, an assumption we will later relax in the quantitative analysis. The fiscal authority's budget constraint is given by:

$$\int_0^1 \zeta_t(i) di + \sum_{k=1}^{K} \left(\tau_{k,t} P_{k,t} C_{k,t} + \iota_k \int_0^1 TC_{k,t}(j) dj - T_{k,t} \right) = 0, \tag{5}$$

Fiscal policy is a time path for $\{\zeta_t(i)\}_{i=0}^1, \tau_{k,t}, T_{k,t}$, such that the above constraint is satisfied at any time period.[10] Monetary policy is a time path for R_t.

[9] We assume that in the steady state $\Lambda_{t,t+s} = (1 - \delta)^s \beta^s$, but we do not need to make further assumptions since we linearize the model around a steady state without inflation.

[10] In the quantitative analysis, we will consider an extension in which the fiscal authority also uses labor income taxes.

Demographics and Market Clearing. In any period, a fraction δ of all households dies. We assume that each deceased household is replaced by a new household of the same type. A household's type is pinned down by its birth date t_0, labor productivity, $\vartheta(i)$, initial bond holdings, $b_{t_0}^{t_0}(i)$, preferences, u_i and χ_i, transfer eligibility, and HtM status. Bond market clearing implies that the average wealth of households is zero, and hence the same is true for deceased and newborn households, due to i.i.d. death probabilities. Therefore, the wealth given to newborn households can always be financed and the net inheritance from all deceased households is zero. Clearing in the labor market and the bond market requires, respectively:

$$\begin{aligned} N_t \equiv \delta \sum_{t_0=-\infty}^{t} (1-\delta)^{t-t_0} \int_0^1 n_t^{t_0}(i)di = \sum_{k=1}^{K} \int_0^1 n_{k,t}(j)dj, \\ \delta \sum_{t_0=-\infty}^{t} (1-\delta)^{t-t_0} \int_0^1 b_t^{t_0}(i)di = 0. \end{aligned} \tag{6}$$

Goods market clearing requires, for any goods variety:

$$\delta \sum_{t_0=-\infty}^{t} (1-\delta)^{t-t_0} \int_0^1 c_{k,t}^{t_0}(i,j)di + \tilde{y}_{k,t}(j) = y_{k,t}(j), \tag{7}$$

and in every sector:

$$\tilde{Y}_{k,t} = \sum_{l=1}^{K} \int_0^1 \tilde{Y}_{k,l,t}(j)dj. \tag{8}$$

An equilibrium is a law of motion for prices and allocations such that households, firms and the government behave as specified above, and markets clear. It is worth noting that in the deterministic steady state of the model, households keep their bond holdings constant over time.[11] The model is thus consistent with any arbitrary steady-state distribution of wealth, which in the calibration we will take from the data.

[11] It can be shown that, in the absence of idiosyncratic income risk and aggregate shocks, the target level of wealth equals current wealth.

3 Macroeconomic Effects of Support Packages

In this section, we study how the fiscal interventions affect macroeconomic outcomes, and how this depends on the monetary policy reaction. To this end, we first derive the first-order conditions of agents' optimization problems and linearize the equations around the steady state, and aggregate appropriately. The technical details of this can be found in the appendix, which also provides the full set of linearized model equations that we use to solve the model quantitatively.

Here, we directly provide the key linearized conditions. To simplify the exposition, we abstract in this section from input-output linkages and we assume that HtM households are randomly distributed across the population. We further assume that prices are equally sticky across sectors. Moreover, monetary policy is assumed to target price stability in the steady state, and the subsidy ι_k is set to eliminate steady-state markups in all sectors. We use a hat to denote variables expressed in log deviations from the steady state, whereas variables without time subscripts denote steady-state values.

Price indices. Before studying the effects of fiscal policy, let us briefly discuss a number of important price indices that will enter the equations. First, note that consumption baskets are heterogeneous across households, due to non-homothetic preferences and idiosyncratic preference shifters. In what follows, we let $s_k(i) \equiv \frac{e_k(i)}{e(i)}$ denote the steady-state budget share of household i on sector k. The household-level Consumer Price Index (CPI) weighs sectors by these budget shares. In addition, let us define $\partial_e e_k(i) \equiv \frac{\partial e_k(i)}{\partial e(i)}$ as the household's *marginal* budget share. These marginal budget shares capture the allocation of a marginal unit of expenditure over sectors, see Olivi et al. (2026). These marginal shares differ from regular budget share once preferences are non-homothetic. In particular, at the margin households spend more on luxuries and less on necessities than they do on average.

At the aggregate level, there are four key price indices. The first is the regular Consumer Price Index, which is a retail price index given by $\hat{Q}_{cpi,t} \equiv$

$\sum \bar{s}_k \hat{Q}_{k,t}$, where $\bar{s}_k = \int_0^1 \frac{e(i)}{E} s_k(i) di$ is the aggregate expenditure weight on sector k. Note that this CPI averages regulated sectoral prices (i.e. $\hat{Q}_{k,t}$) since these are the prices relevant to consumers. Analogously, we define the *Marginal Consumer Price Index* (MCPI) as $\hat{Q}_{mcpi,t} \equiv \sum \overline{\partial_e e_k} \hat{Q}_{k,t}$, where $\overline{\partial_e e_k} = \int_0^1 \frac{e(i)}{E} \partial_e e_k(i) di$ is the aggregated marginal budget share. As discussed in Olivi et al. (2026), the MCPI is a key index associated with aggregate quantities in the model. Intuitively, when households make optimal labor supply and saving decisions, they consider on which sectors they spend on at the margin.

The third important price index is wholesale CPI, i.e. the CPI before price regulation (or subsidies) is applied. This price index is given by $\hat{P}_{cpi,t} \equiv \sum \bar{s}_k \hat{P}_{k,t}$. It will turn out that this price index will capture the "pure" welfare cost of inflation, caused by markup dispersion within sectors.[12] Fourth and finally, we define the wholesale MCPI as $\hat{P}_{mcpi,t} \equiv \sum \overline{\partial_e e_k} \hat{P}_{k,t}$.

Supply effects of fiscal policy. We are now ready to study the aggregate effects of the fiscal interventions. We start with the supply effects, based on the New Keynesian Phillips Curve (NKPC). Defining wholesale CPI inflation as $\pi_{cpi,t} \equiv \hat{P}_{cpi,t} - \hat{P}_{cpi,t-1}$, the NKPC for this inflation index is given by:

$$\pi_{cpi,t} = \lambda \left((\sigma^{-1} + \psi^{-1}) \tilde{\mathcal{Y}}_t + \mathcal{N}\mathcal{H}_t + \mathcal{F}_t \right) + \beta \mathbb{E}_t \pi_{cpi,t+1}, \tag{9}$$

where $\lambda = \frac{(1-\theta)(1-\theta/R)}{\theta}$ is a slope coefficient which depends on the degree of price stickiness. The NKPC is in terms of wholesale rather than consumer inflation, since it derives from the price-setting decision of the firms. Like the standard NK model, the NKPC relates inflation to an output gap, which captures the labor supply distortions created by markups. In our case, it is by $\tilde{\mathcal{Y}}_t = \frac{\psi}{1+\frac{\psi}{\sigma}} \left(\hat{W}_t - \sum_{k=1}^K \overline{\partial_e e_k} \hat{Q}_{k,t} - \sum_{k=1}^K \overline{\partial_e e_k} \hat{A}_{k,t} \right)$. That is, it captures the gap between households' marginal rate of substitution between leisure and consumption (which equals their marginal real wage), and the economy's

[12] Implicit in our formulation of the model is the assumption that price controls do not directly reduce markup dispersion and therefore cannot mechanically reduce the pure cost of inflation.

marginal rate of transformation from labor into goods on the other hand. As we will see later, both $\pi_{cpi,t}$ and $\tilde{\mathcal{Y}}_t$ will capture key macro distortions in the welfare loss function.

Unlike the standard NK model, however, two wedges appear. The first, $\mathcal{NH}_t = (\hat{P}_{mcpi,t} - \hat{P}^*_{mcpi,t}) - (\hat{P}_{cpi,t} - \hat{P}^*_{cpi,t})$ is a non-homotheticity wedge, studied in detail by Olivi et al. (2026). Note that under homothetic preferences, we obtain $\mathcal{NH}_t = 0$, i.e. the wedge drops out. The second is a fiscal wedge, $\mathcal{F}_t = \hat{Q}_{mcpi,t} - \hat{P}_{mcpi,t}$, is novel and captures the supply effects of a price control. Following a downward price control, $\mathcal{F}_t$ turns negative which, given inflation expectations, reduces current inflation and/or increases the output gap. Intuitively, a decline in prices increases households' real wages, akin to a reduction in labor income taxes. This induces them to increase their labor supply via a substitution effect.[13] The increase in labor supply in turn induces downward pressure on nominal wages, which lowers firms' marginal costs, which in turn reduces inflation and/or increases labor demand.

Note that a movement in the fiscal wedge on its own creates a trade-off for monetary policy, which becomes unable to jointly stabilize inflation and the output gap, i.e. the "divine coincidence" breaks down. However, if the $\mathcal{NH}$ wedge moves as well, then fiscal policy may be used strategically to offset this wedge. Olivi et al. (2026) show that following a negative supply shock to a necessity sector, such as energy, the $\mathcal{NH}$ wedge increases. A downward price control reduces $\mathcal{F}_t$ and may then offset this effect, restoring the divine coincidence. This insight provides some early indication that, when used appropriately, a price control may reduce macro distortions and thereby enhance welfare. Finally, note that the lump-sum transfers do not matter for the NKPC.[14]

Demand effects of fiscal policies. Next, let us turn to the aggregate demand effects of a price control. These effects can be understood from the

[13] Note that households pay for the price control via lump-sum taxes, which eliminates a labor supply effect, at least on average.

[14] This result breaks down once the distribution of HtM households across the population is non-random. We will allow for this in the quantitative analysis.

aggregate Euler Equation (EE) for the output gap, which can be expressed as:

$$\tilde{\mathcal{Y}}_t = -\sigma \left(\hat{R}_t - \mathbb{E}_t \pi_{mcpi,t+1} + \mathcal{F}_t - \mathbb{E}_t \mathcal{F}_{t+1} - \hat{r}_t^* \right) + \mathbb{E}_t \tilde{\mathcal{Y}}_{t+1}$$

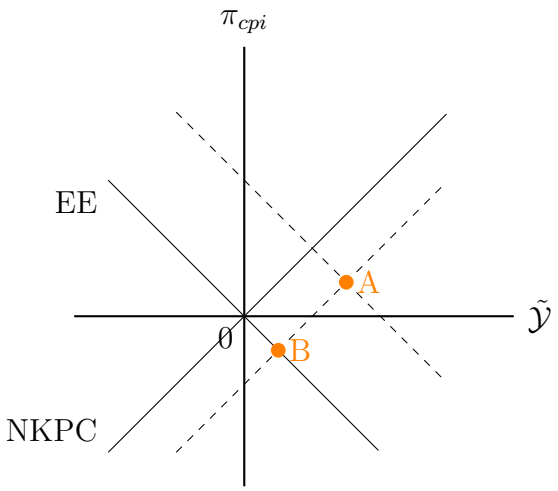
where $\hat{r}_t^* = \frac{1}{\sigma+\psi} \sum_{k=1}^{K} \left(\psi \overline{\partial_e e_k} + \bar{s}_k \right) \left(\mathbb{E}_t \hat{A}_{k,t+1} - \hat{A}_{k,t} \right)$ is the natural rate of interest. This equation is again very similar to its counterpart in the textbook NK model, with two main differences. First, the nominal interest rate is deflated an inflation index weighing sectors by marginal rather than regular budget shares (see also Olivi et al. (2026)). The second main difference is that it contains the mechanical effect of the price control on inflation, $\mathcal{F}_t - \mathbb{E}_t \mathcal{F}_{t+1}$. Intuitively, a price control mechanically causes a temporary decline in prices paid by consumers, and hence increases their inflation expectations. The latter lowers the real interest rate and stimulates aggregate demand today. Unlike the labor supply effect above, the demand effect has been emphasized in the New-Keynesian literature on the macro effects of temporary price subsidies (see e.g. Auclert et al. (2023); Bayer et al. (2023)). Note further that the demand effect may be undone by an adjustment of the nominal interest rate $\hat{R}_t$.

Finally, note that the fiscal transfers again do not enter the aggregate Euler equation. This result breaks down in the full quantitative model, if there is a correlation between the fiscal transfer and HtM status across households.[15]

The role of monetary policy. From the above discussion it follows that a downward price control has both a positive aggregate supply effect and a positive aggregate demand effect. The equilibrium outcome is illustrated in Figure 1, which for simplicity takes expectations of the output gap ($\mathbb{E}_t \tilde{\mathcal{Y}}_{t+1}$) and wholesale inflation ($\mathbb{E}_t \pi_{cpi,t+1}$) as given, which would be the case if the intervention is purely transitory. The solid lines plot the NKPC and EE before the fiscal intervention, whereas the dashed line represents the two curves after a downward price control, keeping the nominal interest rate constant.

[15] We assume that transfers cannot directly be conditioned on the HtM status of households.

Figure 1: Demand and supply effect of a downward price control on wholesale inflation (π_{cpi}) and the output gap ($\tilde{\mathcal{Y}}$).



Notes: solid lines illustrate the New Keynesian Phillips Curve and Euler equation before the price control. Dashed lines are the curves after the price control. Point A illustrates the equilibrium when the nominal interest rate is kept unchanged, whereas point B illustrates a case in which monetary policy tightens to fully neutralize the aggregate demand expansion induced by the price control.

The figure illustrates that, following the price control the EE curve shifts upward due to the demand effect, whereas the NKPC shift downward, because of the supply effect. In the absence of an interest rate response, the new equilibrium is at point A, with the output gap and wholesale inflation both increasing. Thus, the demand effect dominates the inflation response in this example.

Point B illustrates a case in which the central bank raises the nominal interest rate, and does so sufficiently to undo the demand shift completely, so the EE curve remains at the solid line. The NKPC still shifts down, as the change in the nominal interest rate does not alter the supply effect of the price control. At point B, the output gap still increases, but inflation now falls.

Let us now study equilibrium outcomes more formally, under different monetary policies. To this end, let us assume that the central bank responds to

the fiscal intervention according to a rule of the following form:

$$\hat{R}_t = \phi_y \tilde{\mathcal{Y}}_t + \phi_\pi \pi_{cpi,t}.$$

with $\phi_y, \phi_\pi \geq 0$. Note that with this rule, the central bank only reacts to the output gap and wholesale inflation. Therefore, it "looks through" the mechanical effects of a price control, as typically stated by central banks in practice.

Let us now consider the effect of a purely transitory, downward price control, i.e. $\mathcal{F}_t < 0$ and $\mathcal{F}_{t+1} = \mathcal{F}_{t+2} = .. = 0$. We can derive the following result:

Proposition 1. *The responses of output gap and inflation to a transitory price control are given, respectively, by:*

$$\pi_{cpi,t} = -\frac{\lambda}{1 + \sigma\phi_y + \lambda\frac{\sigma+\psi}{\psi}\phi_\pi}\left(\sigma\phi_y - \frac{\sigma}{\psi}\right)\overline{\partial_e e}_k \tau_k,$$
$$\tilde{\mathcal{Y}}_t = \frac{\sigma\psi}{\sigma+\psi}\left(1 - \frac{\sigma\phi_y - \frac{\sigma}{\psi}}{1 + \sigma\phi_y + \lambda\frac{\sigma+\psi}{\psi}\phi_\pi}\right).$$

This result has a number of immediate implications. First, the response of the output gap to the price control is always positive, that is, $\tilde{\mathcal{Y}}_t \geq 0$. Intuitively, this reflects the fact that both demand and supply effects push the output gap upward. Second, the inflation response is negative if and only if $\phi_y > \frac{1}{\psi}$; that is, monetary policy must be sufficiently responsive to the output gap. Intuitively, the supply effect on inflation dominates only if monetary policy tightens sufficiently to dampen the demand effects. It also follows that if monetary policy does not react to the price control at all ($\phi_y = \phi_\pi = 0$), or reacts only to inflation ($\phi_y = 0$), then the inflation response to the price control is positive.

We now turn to the more general case with persistent price controls. In the Appendix, we generalize Proposition 1. It remains the case that if the central bank does not change interest rates in response to the price control, then both

the output gap and inflation increase. Moreover, inflation decreases on impact if and only if $\phi_y > \frac{1}{\psi}$.

4 Welfare

4.1 Welfare loss function

Having studied the macro effects of the fiscal interventions, our next goal is to conduct a full-blown welfare evaluation. Let social welfare take the following form, at some initial date $t = 0$:

$$\mathcal{W} = (1-\delta)\int G(V^{-}(i), i)di + \delta\mathbb{E}_0 \sum_{t_0=0}^{\infty} \beta^{t_0} \int G(V^{t_0}(i), i)di, \qquad (10)$$

where $G(\cdot, i)$ is a differentiable function which captures the social planner's aggregation of welfare levels of different households, which may condition on the household type i. In the above expression, the first term on the right-hand side corresponds to households who are already alive at $t = 0$.[16] The lifetime value of these households is given by $V^{-}(i) = \mathbb{E}_0 \sum_{s=0}^{\infty} (\beta(1-\delta))^s (u_i(\mathbf{c}_s^{-}(i)) - \chi(n_s^{-}(i)/\vartheta(i)))$. The second term corresponds to households born after time $t = 0$, where the lifetime welfare of household i born at t_0 is given by $V^{t_0}(i) = \mathbb{E}_{t_0} \sum_{s=0}^{\infty} (\beta(1-\delta))^s (u_i(\mathbf{c}_{t_0+s}^{t_0}(i)) - \chi(n_{t_0+s}^{t_0}(i)/\vartheta(i)))$.

Next, we derive a second-order approximation to $\mathcal{W}$, as a function of equilibrium variables. To this end, we must make assumptions on the first- and second-order derivatives of the social preference function G. Our first assumption follows the literature on inverse optimum taxation and implies that the steady-state distribution is efficient. This means that, absent any aggregate shocks, there is no motive for policy to manipulate distributional outcomes. This assumption is implemented via the following condition on the first-order derivative of G:

$$G'\left(V^{t_0}(i), i\right) \partial_e v_i \left(e_{t_0}^{t_0}(i), \mathbf{P}_{t_0}\right) = 1,$$

[16] We assume the economy starts from the steady state, so households of a given type i born before $t = 0$ are identical.

where $v_i\left(e(i),\mathbf{P}\right)=\max_{\mathbf{c}(i)}u_i(\mathbf{c}(i))$ s.t. $\sum_{k=1}^{K}\int_0^1 P_k(j)c_k(i,j)dj\leq e(i)$ is the indirect utility function of consumption.

While the steady-state distribution is treated as efficient, fluctuations in the distribution following aggregate shocks still create welfare losses. In order to pin these down, we must make an assumption on the second-order derivative $G''\left(V^{t_0}(i),i\right)$. For now, do not make a specific assumption, essentially treating it as a policy parameter which determines how much a social planner cares about fluctuations in the distribution. However, a natural baseline assumption is to set $G''\left(V^{t_0}(i),i\right)=0$. In this case, the social welfare function is linear (conditional on type i), which implies that the planner cares equally about utility fluctuations of all households.[17] Alternatively, one could assume that $G''<0$, which means that $G(\cdot,i)$ is concave, implying that utility fluctuations of poorer households carry more weight.[18]

We derive this function and the precise functional form in the Appendix for the full model (including input-output-linkages, non-randomly distributed HtM households, and heterogeneity in price stickiness across sectors). Since the welfare loss function is a rather large equation with some relatively unimportant components, we present here in the main text the loss function for a simplified case.

Proposition 2. *In a version of the model with homogeneous prices stickiness across sectors, no input-output linkages,* $\delta=0$, $G''\left(V^{t_0}(i),i\right)=0$, *randomly distributed HtM at rate* φ, *and no heterogeneity in marginal budget shares, the*

[17] We then obtain the linear form $\int G(V(i),i)di\propto\int G'\left(V^{t_0}(i)\right)V(i)di$, where $G'\left(V^{t_0}(i)\right)$ is the Pareto-Negishi weight.

[18] By contrast, assuming $G''>0$ seems less reasonable, as a convex social welfare function implies that a planner prefers to create utility fluctuations.

social welfare loss function is given by $\mathcal{L} = \mathcal{L}^{inflation} + \mathcal{L}^{output\ gap} + \mathcal{L}^{dist}$*, where:*

$$\mathcal{L}^{\text{inflation}} = \sum_{t\geq 0}\beta^t\left(\underbrace{\vartheta\pi^2_{cpi,t}}_{\text{within sectors}} + \underbrace{\sum_k \bar{s}_k \sum_l \bar{\rho}_{k,l}\left(\hat{Q}_{k,t}+\hat{A}_{k,t}\right)\left(\hat{Q}_{l,t}+\hat{A}_{l,t}\right)}_{\text{between sectors}}\right)$$

$$\mathcal{L}^{\text{output gap}} = \left(\psi^{-1}+\sigma^{-1}\right)\left(\underbrace{\sum_{t\geq 0}\beta^t\tilde{\mathcal{Y}}_t^2}_{\text{standard}} + \underbrace{\eta\left(\varphi\sum_{t\geq 0}\beta^t\tilde{\mathcal{Y}}_t^2 + (1-\varphi)(1-\beta)\left(\sum_{t\geq 0}\beta^t\tilde{\mathcal{Y}}_t\right)^2\right)}_{\text{heterogeneous wealth effects}}\right)$$

$$\mathcal{L}^{\text{redist}} = \underbrace{(1-\beta)(1-\varphi)\int g(i)\left(\sum_{t\geq 0}\beta^t\mathcal{I}_t(i)\right)^2 di}_{\text{non-HtM}} + \underbrace{\varphi\sum_{t\geq 0}\beta^t\int g(i)\left(\mathcal{I}_t(i)\right)^2 di}_{\text{HtM}}$$

where

$$\mathcal{I}_t(i) = \zeta_t(i) - \sum_k\left(\frac{e(i)}{E}\left(s_k(i)-\bar{s}_k\right)\right)\hat{Q}_{k,t} + \frac{b(i)}{E}\left(\frac{\hat{R}_t}{R} - \left(1-\frac{1}{R}\right)\hat{Q}_{cpi,t} - \left(1-\frac{1}{R}\right)\mathcal{Y}_t^*\right)$$

$$g(i) = \frac{E}{\sigma e(i) + Wn(i)\psi}$$

and where $\hat{\mathcal{Y}}_t^* = \sum_{k=1}^K \frac{\psi\overline{\partial_e e_k}+\bar{s}_k}{1+\psi/\sigma}\hat{A}_{k,t}$ is the natural level of aggregate demand, i.e. the level that would prevail in a version of the economy with flexible prices.

The first component in the welfare loss function, $\mathcal{L}^{\text{inflation}}$, is the inflation distortion in the textbook New Keynesian model. In the presence of aggregate shocks, nominal rigidities create price dispersion across varieties, which lowers consumer welfare. Note that this term depends on wholesale inflation, $\pi_{cpi,t}$, which excludes the mechanical effects of a price control, as such controls do not affect within-sector price dispersion.

The second term in $\mathcal{L}^{\text{inflation}}$ captures relative sectoral price distortions. If relative sectoral prices faced by consumers align perfectly (and negatively) with sectoral productivity levels, then this term is zero. A price control directly affects this component. It captures a common criticism of energy price

controls, namely that they induce over-consumption of energy. The magnitude of this distortion is governed by the elasticity of substitution between sectors, $\overline{\rho}_{k,l}$. Typically, the between-sector elasticity is smaller than the within-sector elasticity. This suggests that the equilibrium effects of the price control on within-sector inflation may dominate the direct welfare effects operating through relative sectoral prices. We explore this quantitatively in the next section.

The second welfare component, $\mathcal{L}^{\text{output gap}}$, captures welfare loss arising from labor market inefficiencies induced by the presence of markups, which distort real wages. Within this component, the second term captures heterogeneous wealth effects on labor supply. Here, $\eta \equiv \left(1-\frac{1}{R}\right)\int \frac{\frac{b(i)}{E}}{1+\frac{Wn(i)\psi}{\sigma e(i)}}\,di \geq 0$ captures the wedge between individual and representative-agent Hicksian labor supply elasticities. In our quantitative model, this second term is relatively unimportant.

Finally, $\mathcal{L}^{\text{dist}}$ captures welfare losses arising from distributional fluctuations. Within this term, $\mathcal{I}_t(i)$ is a distributional variable that is zero on average and captures changes in household i's real budget, relative to other households, due to variations in equilibrium prices and transfers. Moreover, $g(i)$ denotes the weight of household i in the social welfare function. This weight is declining in steady-state expenditures and income; that is, poorer households receive a higher weight. Intuitively, consumption fluctuations generate larger utility fluctuations and hence larger welfare losses, due to the curvature of the utility function.[19]

Next, note that $\mathcal{L}^{\text{redist}}$ is the sum of two components. The first arises from non-HtM households, which comprise a share $1-\varphi$ of the population, while the second arises from HtM households. The first term is multiplied by $1-\beta$ and therefore tends to be relatively small, since the discount factor is close to one. Intuitively, non-HtM households are able to smooth any flow income gains or losses over their entire lifetime, thereby mitigating the associated welfare loss. By contrast, HtM households must absorb any current income changes

[19] In the case in which $G''\left(V^{t_0}(i),i\right) < 0$, the welfare weight is given by $g(i) = \frac{E}{\sigma e(i)+Wn(i)\psi} - \frac{R}{R-1}\frac{G''\left(V^{t_0}(i),i\right)v'(e(i))E}{G'(V^{t_0}(i),i)}$.

through current consumption, generating a relatively large utility loss.

Finally, let us unpack the distributional variable $\mathcal{I}_t(i)$, which captures the relative effects of equilibrium prices and quantities on households' budgets. It contains several components. First, $\zeta_t(i)$ captures the direct income effect of a government transfer on household i's budget. The second component captures redistribution arising from relative sectoral prices. For example, a household that consumes a relatively large amount of energy suffers, relative to other households, from an increase in energy prices. Indeed, a key goal of the cost-of-living policies implemented in practice is precisely to compensate such households.

The remainder of $\mathcal{I}_t(i)$ is related to wealth redistribution (note that the term in large brackets is multiplied by $b(i)$). In particular, an increase in the nominal interest rate $\hat{R}_t$ directly redistributes wealth from indebted households to savers. Given that the variation in wealth in the data is much greater than the variation in consumption baskets, it may therefore be the case that the distributional effects of the monetary policy response to an energy price shock dominate the distributional effects arising from changes in energy prices and consumption basket heterogeneity. Similarly, fluctuations in the consumer price level $\hat{Q}_{cpi,t}$ generate wealth redistribution, although this effect is relatively small, as it is multiplied by the term $(1 - 1/R)$.[20] Finally, fluctuations in the natural level of output $\mathcal{Y}_t^*$ generate a distributional effect related to efficiency considerations. In particular, households differ in the extent to which they allocate additional income to consumption versus leisure. During periods of low aggregate productivity, goods are relatively costly to produce, and it is therefore efficient to redistribute toward households that consume relatively more leisure at the margin.

Direct welfare effects of price controls and transfers. The welfare loss function above is useful for understanding key policy trade-offs, as sectoral

[20]This is because valuation effects only matter to the extent that households receive flow income from an asset or change their asset positions. In the steady state, asset levels are constant. Therefore, valuation effects operate only through changes in real interest income or payments on the asset.

shocks, $A_{k,t}$, and the policy instrument, $\hat{Q}_{k,t}$, appear directly in the equations. Following a decline in productivity in a given sector, i.e. $A_{k,t} < 0$, the energy sector—the between-sector inflation term remains zero if $A_{k,t} = -\hat{Q}_{k,t}$ for every sector k. That is, the relative price of energy should increase one-for-one with the decline in energy productivity. A downward price control, however, limits the increase in energy prices, leading to overconsumption of energy relative to other goods and, consequently, generating a welfare loss. On the other hand, fluctuations in relative prices induce redistributions across households with different consumption baskets, as can be seen from the second term in $\mathcal{I}_t(i)$.

Thus, a price control may help to limit welfare losses arising from redistributions, which may dominate the welfare loss associated with exacerbating relative sectoral price distortions. However, from the expression for $\mathcal{I}_t(i)$, we also observe that redistributional welfare losses depend not only on relative sectoral prices, but also on other equilibrium variables—most notably the nominal interest rate, $\hat{R}_t$, and the natural level of output, $\mathcal{Y}_t^*$, both of which respond to the shock. It may be the case that fluctuations in these variables generate larger redistributional effects than fluctuations in sectoral prices. If households that are highly exposed to $\hat{R}_t$ and $\mathcal{Y}_t^*$ have relatively low exposure to $\hat{Q}_{k,t}$, then a price control may in fact worsen redistributional losses, as it redistributes income away from those households that are overall most affected by the shock.[21]

Next, note that a transfer $\zeta_t(i)$ has no effect on the inflation and output-gap terms in the loss function. This absence of distortionary effects has led many economists to advocate transfers over price controls. Indeed, the distributional term in the loss function can be fully eliminated by choosing $\zeta_t(i)$ such that $\mathcal{I}_t(i) = 0$ for each household. In practice, however, this may be difficult to achieve, as $\mathcal{I}_t(i) = 0$ makes clear that transfers would need to condition

[21] In our quantitative application, this turns out to be the case. The households that suffer the most are those with high levels of debt (in the data, households with adjustable-rate mortgages), who are heavily affected by the increase in interest rates. These households, which typically belong to the middle of the income distribution, do not have particularly high expenditure shares on energy. As a result, they benefit little from the price control but bear the taxes required to finance it; on net, they therefore lose from the price control, exacerbating the overall redistributional loss.

explicitly on both individual wealth levels and consumption baskets, and vary in a particular way over time. Moreover, for the reasons discussed above, an imperfect transfer scheme that addresses only some redistributional channels (for example, only those arising from changes in energy prices) may in fact reduce overall welfare.

4.2 Optimal Policy

While the main purpose of this paper is to evaluate the welfare effects of existing policies, it is instructive to understand what the optimal policy would look like in this environment. We can derive the following result:

Proposition 3. *Under the Assumptions of Proposition 2, the joint-optimal monetary-fiscal policy consists of a path of transfers, sector-level price controls, and nominal interest rates such that* $\tilde{\mathcal{Y}}_t = \pi_{cpi,t} = \mathcal{I}_t = 0$ and $\hat{Q}_{k,t} = -\hat{A}_{k,t} - \tau_t$ for all $t \geq 0$. This is achieved by setting:

$$\begin{aligned}
\tau_{k,t} &= \hat{P}_{k,t} + \hat{A}_{k,t} + \tau_t, \\
\tau_t &= \mathcal{NH}_t - \left(\hat{P}_{mcpi,t} - \hat{P}^*_{mcpi,t}\right), \\
\hat{R}_t &= \hat{r}^*_t + \mathbb{E}_t \pi_{mcpi,t+1} + \mathbb{E}_t \mathcal{F}_{t+1} - \mathcal{F}_t, \\
\zeta_t(i) &= \sum_k \left(\frac{e(i)}{E} \left(s_k(i) - \bar{s}_k \right) \right) \hat{Q}_{k,t} - \frac{b(i)}{E} \left(\frac{\hat{R}_t}{R} - \left(1 - \frac{1}{R}\right) \hat{Q}_{cpi,t} - \left(1 - \frac{1}{R}\right) \mathcal{Y}^*_t \right).
\end{aligned}$$

Intuitively, the optimal policy uses a sector-wide price control (τ_t) to offset the $\mathcal{NH}$ wedge in the NKPC, and differentiates the price control across sectors to correct relative prices ($\tau_{k,t}$). With the NKPC wedge being offset, monetary policy then exploits the "divine coincidence" to jointly stabilize CPI inflation and the output gap. Finally, optimal transfers between households correct any redistributional effects.

Note that under the optimal policy, the central bank does not merely move the nominal rate move to let the real rate mimic its natural counterpart, as in

the standard NK model. Indeed, it actively tightens in response to a temporary downward price control, in order to eliminate the aggregate demand effect discussed in the previous section. Thus, the optimal policy does not "look through" the price control.

Arguably, the joint optimal policy is not very realistic as it requires not only coordination between fiscal and monetary policy, but also complex fiscal transfers. For example the optimal transfer redistributes based simultaneously on heterogeneity in wealth and consumption baskets. Moreover, the implementation of time-varying price controls or VAT taxes/subsidies in all sectors seems unrealistic. The question is therefore what are the welfare effects of realistic policies. We evaluate this quantitatively in the next section.

5 Quantitative Results

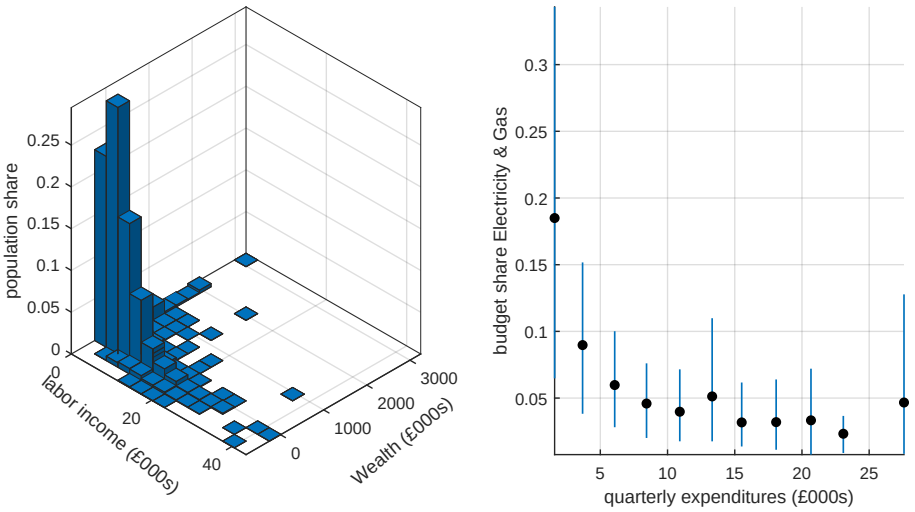
5.1 Calibration

Our ultimate objective is to quantitatively evaluate the UK's cost-of-living policies in response to the large increase in Electricity and Gas prices following the invasion of Ukraine in 2022. We evaluate these policies in the full quantitative model. The model contains eight sectors, and the time period is one quarter. We discipline the steady-state distributions of the model using micro data from the UK Living Costs and Food (LCF) Survey, which contains detailed information on around 6000 households.

The Ukraine shock. We feed productivity shocks to the sectors *Food* and *Electricity & Gas* into the model. We back out these shocks from the sector-level NKPCs expressed in terms of marginal costs, and using data on the wage and sectoral prices. We assume that the time path of the shock is announced at the time of the invasion, i.e. in the first quarter of 2022.

Energy Price Guarantee. Next, we introduce the two fiscal policies, again assuming that their time paths are announced at the time of the shock. The

Figure 2: Steady-state distribution.



Notes: Left panel: histogram of the steady-state distribution of income and wealth. Right panel: steady-state budget shares on Electricity & Gas, by deciles of total expenditure. Vertical bars denote the 10th-90th percentile ranges within each total expenditure decile.

first policy captures the UK's Energy Price Guarantee (EPG) which capped the energy bill for a typical household at £2,500 for three quarters starting on October 2022. This cap corresponded to about a 95 percent increase in energy prices relative to the OFGEM cap in January 2022, just before the shock hit.[22] We implement this in the model through a tax subsidy for energy τ_{energy} such that the increase in the price of Electricity and Gas faced by consumers is limited to 95 percent, in line with the policy.

Cost-of-Living payments. The second policy we introduce are the cost-of-living paid over the period 2022q3-2024q1. There were a number of transfers, paid out at different points in time and to different groups of households. They are summarized in Table 1. First, there were transfers paid out to house-

[22]The EPG was financed by the UK government, which compensated energy companies for the difference between the market price and the capped price. In reality, the EPG was introduced on top of a price cap set by the UK energy regulator OFGEM. This OFGEM cap, however, is designed to reflect market prices and costs of production, and therefore is not a subsidy. We can therefore think of the OFGEM cap as the market price.

holds who were eligible to certain pre-existing means-tested welfare programs. Roughly speaking, these transfers were paid to households in the bottom thirty percent of the income distribution. In the LCF, we observe whether households are currently receiving certain benefits, from which we can determine whether they are eligible for these payments. Similarly, cost-of-living payments were made to disabled people as well as to pensioner households, and the payment doubled if the pensioner was aged 80 or above. Since every household type in the model corresponds to a household in the LCF, we can calibrate directly which households received a given transfer. Finally, there were two payments made to all households.

Quarter	**Means-tested (£)**	**Disability (£)**	**Pensioner (£), no 80+**	**Pensioner (£), 80+**	**All households (£)**
2022Q1	0	0	0	0	0
2022Q2	0	0	0	0	0
2022Q3	326	150	0	0	0
2022Q4	324	0	150	300	200
2023Q1	0	0	0	0	200
2023Q2	301	150	0	0	0
2023Q3	0	0	0	0	0
2023Q4	300	0	150	300	0
2024Q1	299	0	0	0	0

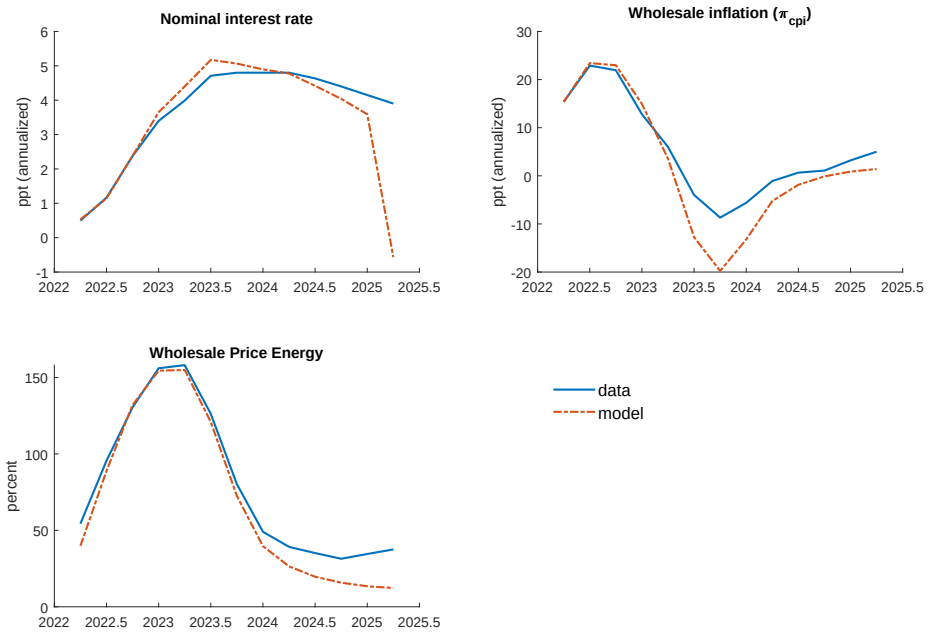
Table 1: *Notes:* Cost of Living Payments and Energy Bill Support by quarter

Monetary policy. Our assumed monetary policy rule follows Nakamura et al. (2025), who estimate the following specification for the United Kingdom:

$$\hat{R}_t = \phi_\pi \pi^{1y}_{core,t} + \phi_{\tilde{y}} \tilde{\mathcal{Y}}_t + \phi_R R_{t-1} + \varepsilon_t,$$

where $\pi^{1y}_{core,t}$ is annual core inflation. We calibrate the coefficients using the estimates reported in Nakamura et al. (2025) for the UK. To account for the fact that monetary policy likely did not strictly follow this rule in the post-2022 period, we additionally include a sequence of policy shocks, ε_t. We assume

Figure 3: Fit of the model.



these shocks are announced in 2022Q1 and calibrate their values so that the model reasonably replicates the observed paths of the nominal interest rate ($\hat{R}_t$) and wholesale inflation ($\pi_{cpi,t}$) over the sample period. Figure 3 illustrates the model fit for these two variables, as well as for the wholesale price of *Electricity & Gas*.

Preferences and steady-state distributions. We estimate a Non-Homothetic CES demand system, following Comin et al. (2021), allowing for idiosyncratic preference shifter to exactly match consumption baskets in the LCF. We set the elasticity of substitution between sectors to 0.3, following recent evidence by Levell et al. (2025). For firms, we assume the same elasticity of substitution, which is in the range of empirical estimates reported by Bachmann et al. (2022). The elasticity of intertemporal substitution and the Frisch elasticity of labor supply are both set to be common across households and equal to one.

The subjective discount factor is set to $\beta = 0.99$, and the death probability is set to $\delta = 0.0083$.

We directly match individual labor income and nominal wealth from the reported values in the LCF. Finally, the calibration of input-output linkages is done from ONS data on sectoral input-output tables and price rigidities are set following previous empirical evidence on sectoral price adjustment frequencies in the UK.

5.2 Baseline simulation and counterfactuals

Figure 4 presents the baseline simulation. Following the shock, producer inflation increases significantly, while the output gap initially declines and then rises.

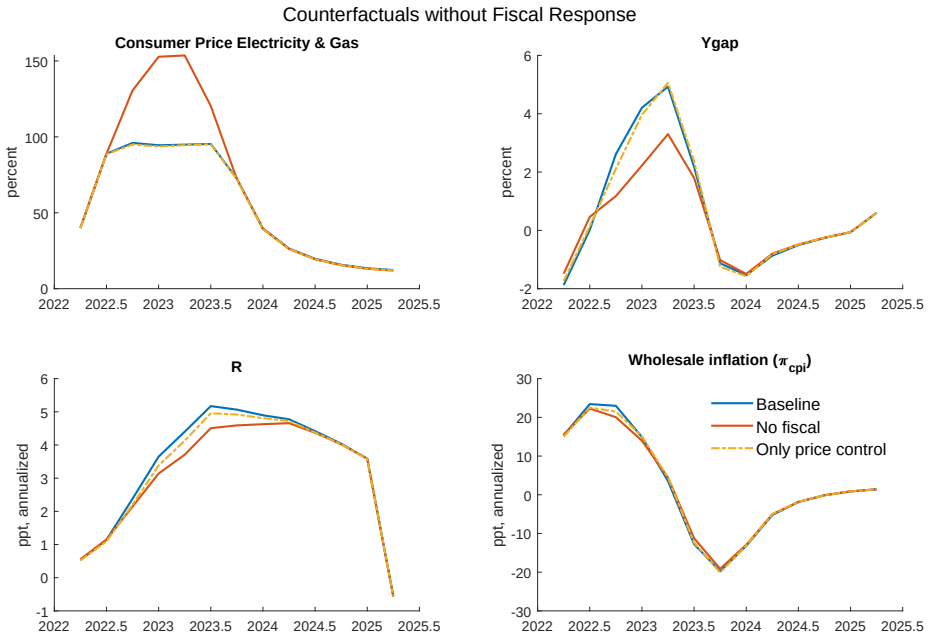
The figure also presents counterfactual scenarios. The red lines represent a simulation in which both the price control and the Cost-of-Living Payments are removed ("no fiscal"). In this case, the price of energy paid by consumers increases substantially more than under the price control. Moreover, both the output gap and producer inflation increase by several percentage points less. Note that this effect is due to equilibrium forces, as the producer price excludes the mechanical effect of the price control. Consistent with the monetary policy rule, the nominal interest rate also rises by less in this counterfactual.

These results are largely driven by the price control, as can be seen from a second counterfactual in which only the Cost-of-Living Payments are removed ("no price control"). This simulation is very similar to the baseline.

5.2.1 Supply and demand effects

The counterfactuals show that the fiscal interventions have substantial macroeconomic effects. However, as discussed previously, these effects operate through distinct supply and demand channels. To quantify these separate forces, we first simulate the effect of the fiscal intervention in isolation, i.e. without the Ukraine shock. We then consider two additional counterfactuals in which we eliminate, in turn, the fiscal wedge in the NKPC and the fiscal wedge in the

Figure 4: Baseline simulation and counterfactuals.



aggregate Euler equation for the output gap.

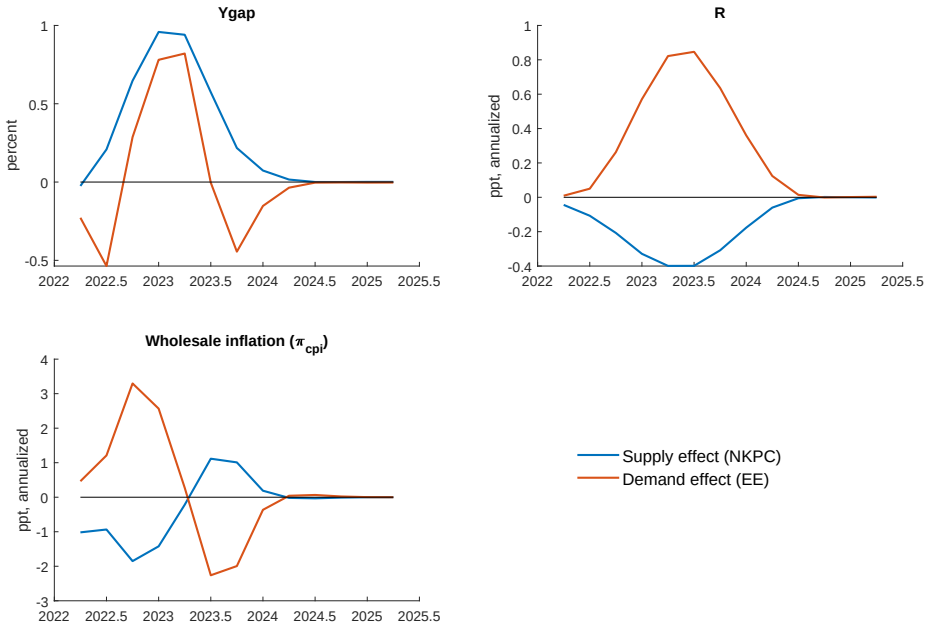
The results of this exercise are shown in Figure 5. As expected, the supply and demand effects on inflation work in opposite directions, whereas for the output gap the two forces tend to reinforce each other. Importantly, both effects are quantitatively large, underscoring the significant macroeconomic implications of the fiscal intervention. Given the monetary policy rule, the demand effects slightly outweigh the supply effects in terms of the inflation response.

5.3 Welfare evaluation

We now evaluate the welfare effects of the policies by comparing welfare losses in a baseline simulation with those in a counterfactual simulation. We compute three measures (see the Appendix for further details):

1. **Narrow direct effects.** This specification considers only the effects

Figure 5: Response to the fiscal intervention: demand and supply effects.



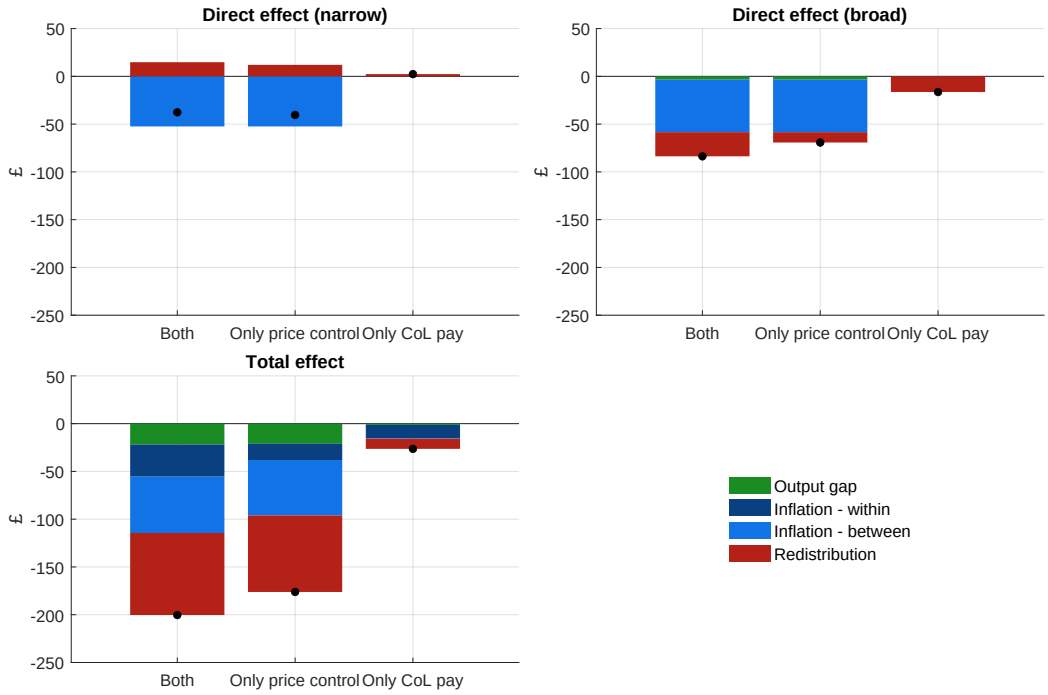
of changes in relative prices and sectoral productivity, shutting down fluctuations in aggregate macroeconomic variables (such as the output gap, inflation, and the nominal interest rate) in response to both the Ukraine shock and the fiscal response.

2. **Broad direct effects.** This specification again abstracts from the equilibrium effects of fiscal policy, but allows macroeconomic variables to respond to the Ukraine shock. Thus, it incorporates aggregate adjustments while shutting down general equilibrium effects of the fiscal measures.

3. **Total effects.** This measure captures the overall welfare effect of the policies, accounting for both macroeconomic fluctuations and the general equilibrium effects of the fiscal interventions.

In each case, we decompose welfare into four components that enter the loss function separately: the output gap, within-sector inflation, between-sector inflation (i.e., relative price changes), and redistribution. We report both the

Figure 6: Welfare effects of the support package.



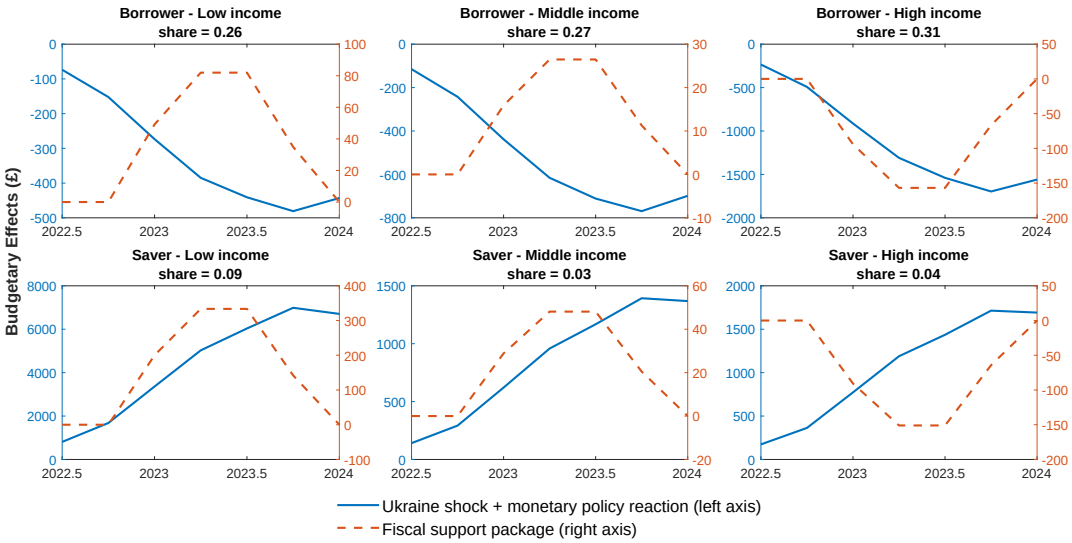
joint welfare effects of the fiscal policies and their individual contributions.

Narrow direct welfare effects. Figure 6 presents the results. We begin with the narrow direct effects, which are closest to the exercises typically conducted in the applied microeconomic literature.

The overall effect of the price control is negative, driven by the component associated with relative price distortions. By lowering the consumer price of energy, the policy induces an inefficiently high level of energy consumption relative to other goods. The redistributive component is positive, as the price control transfers resources toward households with higher energy budget shares, who were more exposed to the shock. However, this effect is quantitatively modest.

The Cost-of-Living payments generate a positive narrow direct welfare effect, entirely driven by redistribution. This effect is smaller than under the

Figure 7: Budgetary effect of shock and policy by wealth and income.



price control, reflecting the latter's larger fiscal magnitude and its implicit targeting of households with higher energy expenditure shares. The substantial heterogeneity in budget shares observed in the data makes precise targeting through transfers based solely on income and demographic characteristics inherently difficult.

Broad direct welfare effects. We next consider the broad direct effects, shown in the upper-right panel of Figure 6. In this specification, sectoral price responses to the Ukraine shock are accompanied by adjustments in aggregate variables such as nominal wages and interest rates. Under this broader perspective, welfare outcomes deteriorate, primarily because the redistribution component becomes negative. Once macroeconomic adjustments are taken into account, neither the price control nor the Cost-of-Living payments effectively compensate the households most adversely affected by the shock.

To clarify this mechanism, Figure 7 presents the budgetary effects of the shock and fiscal measures for borrowers and savers across the income distribution. Borrowers are, on average, the most adversely affected, including households in the middle and upper parts of the income distribution. A key

driver is the monetary policy response to the inflationary shock: higher policy rates substantially increase debt servicing costs, particularly for mortgage holders. By contrast, savers benefit from higher interest income.

The redistributive effects associated with higher interest rates dominate those arising from changes in relative energy prices. As a result, the price control and cost-of-living payments were not targeted towards those households who were overall most heavily affected by the Ukraine shock.

Note further that the joint welfare loss from the two policies is approximately twice as large as under the narrow specification. This comparison underscores the importance of accounting for contemporaneous macroeconomic fluctuations when evaluating fiscal support packages, even when abstracting from their general equilibrium effects.

Total welfare effects. Finally, we examine the total welfare effects of the fiscal policies, allowing the policies themselves to influence macroeconomic outcomes. These results are shown in the lower-left panel of Figure 6. The overall welfare effect is negative and substantially larger in magnitude than under either direct specification. In particular, the total welfare loss exceeds the narrow direct loss by more than a factor of five.

These larger losses are driven in part by greater fluctuations in the output gap and within-sector inflation. The demand stimulus generated by the price control amplifies movements in economic activity and producer price inflation, thereby increasing welfare costs. Moreover, the redistribution component becomes even more negative. The additional demand pressure induces the central bank to raise interest rates further (see Figure 4), which increases debt servicing burdens for indebted households—those already most adversely affected. As a result, the policies generate an even more adverse pattern of redistribution.

5.4 Looking through the price control?

As discussed above, the effects of fiscal interventions depend on how monetary policy responds to them. In practice, central banks often state that they

"look through" the purely mechanical effects that fiscal measures may have on inflation. In the baseline model, the monetary policy rule indeed looks through the mechanical effects of the price control, as it responds only to core inflation, which excludes the *Electricity & Gas* sector.

In this subsection, we consider an alternative policy reaction under which the central bank does not look through the price control. Specifically, we augment the policy rule as follows:

$$\hat{R}_t = \phi_\pi \, \pi^{1y}_{core,t} + \phi_{\tilde{\mathcal{Y}}} \, \tilde{\mathcal{Y}}_t + \phi_R \, R_{t-1} + \phi_\pi \big(\pi^{Q,1y}_{E,t} - \pi^{1y}_{E,t} \big) + \varepsilon_t,$$

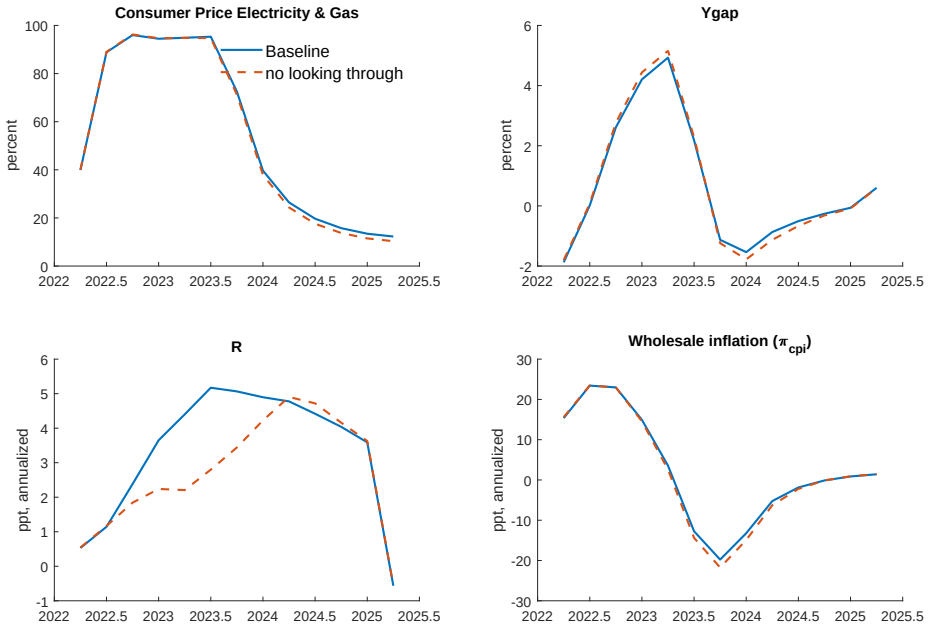
where $\pi^{Q,1y}_{E,t}$ and $\pi^{1y}_{E,t}$ denote, respectively, the one-year inflation rates of the consumer and producer prices in *Electricity & Gas*. In the absence of a price control, $\pi^{Q,1y}_{E,t} = \pi^{1y}_{E,t}$, and the rule reduces to the baseline specification. With a price control, by contrast, monetary policy responds to the policy-induced wedge in inflation in the same manner as it responds to core inflation, i.e. with coefficient ϕ_π.

Figure 8 compares a simulation under the baseline rule with one under the alternative rule ("no looking through"). Under the latter, the nominal interest rate rises by less in 2022–2023 and somewhat more in 2024. Figure 9 reports the welfare effect of looking through the mechanical price effect, which is negative and entirely driven by the redistribution component. Intuitively, when the central bank does not look through the mechanical effect, the path of the nominal interest rate is smoother and less front-loaded, limiting the rise in debt servicing costs for indebted households and thereby attenuating the adverse redistributive consequences of the shock.

6 Conclusions

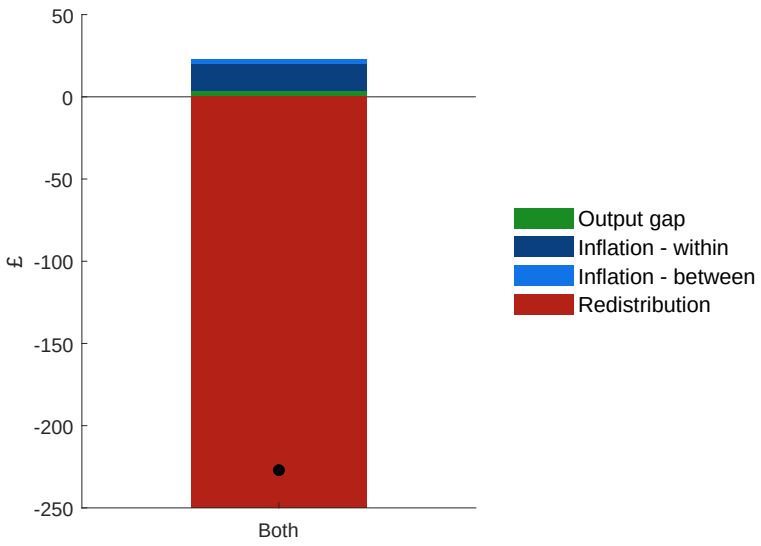
In this paper, we evaluate the welfare and macroeconomic effects of household support packages implemented during the 2022 cost-of-living crisis, with a particular focus on the United Kingdom. Using a multi-sector New Keynesian model disciplined by detailed micro data, we show that price controls and

Figure 8: Baseline versus alternative policy rule without looking through.



targeted transfers have substantial aggregate and distributional consequences that extend well beyond their direct effects on household budgets. While price caps can redistribute toward energy-exposed households, they also generate sizable macroeconomic adjustments through both demand and supply channels, especially when monetary policy responds endogenously. Quantitatively, accounting for these macro equilibrium effects significantly amplifies the welfare losses relative to partial-equilibrium assessments.

Figure 9: Welfare effect of looking through.



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