Welfare Consequences of Fiscal Consolidations: The Role of In-kind benefits

Paula Sánchez-Gil *†

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Abstract

This paper explores the distributional welfare implications of fiscal consolidations based on in-kind benefits expenditure using a heterogeneous agents model with incomplete markets. It introduces a novel approach for modeling household public services consumption, aligning consumption distribution with empirical data and underscoring the importance of in-kind benefits in mitigating income inequality. The findings reveal that, in the long run, the benefits of fiscal consolidation based on in-kind benefits expenditure outweigh the short-term welfare losses. However, in the short run, there is a tension between the distributional welfare effects of the policy instrument and those stemming from general equilbrium. On one hand, the instrument effects, such as cuts in in-kind benefits expenditure, disproportionately affect lower-income households that rely on the consumption of these benefits to a great extent. On the other hand, price effects resulting from crowding-in affect have different impacts across income groups: lower-income households benefit from increased labor income, while higher-income households suffer from decreased capital income. The validity of these price effects during fiscal tightening is essential for understanding the distributional welfare outcomes and optimal consolidation speed.

JEL: E21, E62, H42,H51, H52, H63
Keywords: Fiscal Policy, Sovereign Debt, Government Spending, Public Expenditure, In-kind benefits

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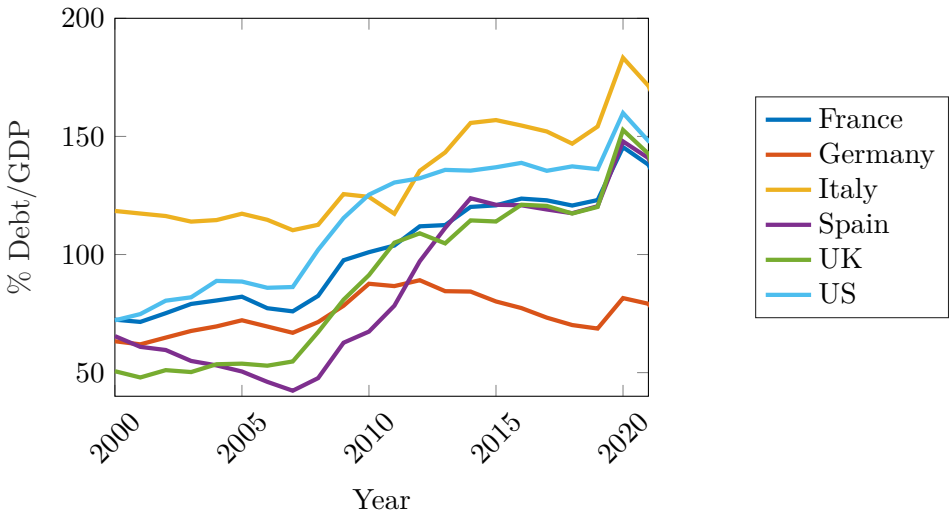
†University of Lucerne, Department of Economics. Frohburgstrasse 3, 6002 Lucerne, Switzerland.
e-mail:paula.sanchez@unilu.ch

1 Introduction

During the COVID-19 pandemic, most developed economies witnessed a dramatic increase in debt-to-GDP ratios. Once economies stabilize, the high sovereign debt accumulated during the pandemic call for fiscal consolidation plans that help decrease governments' liabilities and create fiscal space. If governments aim to decrease their debt levels, the critical question is what instrument to employ to and what distributional effects they provoke in the economy.

Figure 1: Debt-to-GDP ratios

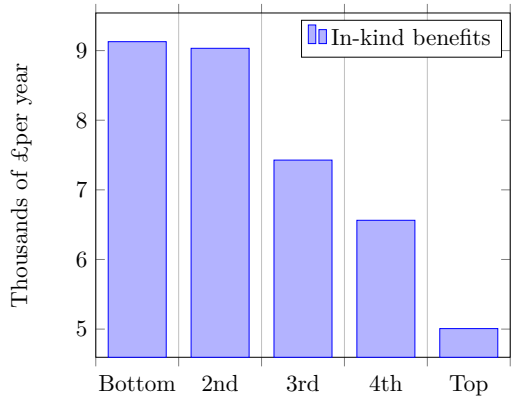


Source: OECD (2023)

Since the global financial crisis, which precipitated the European Sovereign debt crisis and subsequent austerity measures, fiscal consolidations have attracted significant scholarly attention (Alesina et al., 2015; Röhrs and Winter, 2017; Romei, 2015; Sutherland et al., 2012; Paulus et al., 2017). For example, Alesina et al. (2015) demonstrated that, in the short run, consolidations focusing on reducing government expenditure have less impact on growth than those relying on increased taxes. However, an effective evaluation of austerity measures requires consideration of two critical aspects: the specific categories of expenditure being cut and, beyond economic growth, the distributional consequences of these measures.

Despite extensive research, the role of in-kind benefits within public expenditure has not been sufficiently explored. These benefits can be categorized distinctly from other types of public expenditure, such as public goods and cash benefits. Public goods, like military services, are non-excludable and non-rival, benefiting all households equally. Cash benefits represent direct monetary transfers from the government to households. In contrast, in-kind benefits—such as public healthcare and education—are excludable and rivalrous, yet provided by the government, embodying a private nature. During 2009-2010, for instance, the UK government allocated approximately 26.6% of its GDP to public services, predominantly in education and healthcare, underscoring the substantial portion of government budgets devoted to in-kind benefits. Yet, the exploration of their redistributive impact remains an under-researched area.

Figure 2: Average imputed benefits in-kind by income quintiles



Note: The average imputed consumption of in-kind benefits corresponds to the imputed consumption of public health care and education services for non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Data from the United Kigndom for the financial year 2016-2017. Source: ETB.

Do households consume in-kind benefits differently according to their income profile? Figure 2 shows that households at the bottom of the income distribution rely on the consumption of in-kind benefits to a greater extent than those at the top. Therefore, the provision of in-kind benefits has a progressive redistributive character that should not be neglected to adequately capture how social expenditure retrenchments affect households' welfare and inequality during and after fiscal consolidations. Since households choose how much to consume of these services, the government has two adjustment instruments to satisfy its budget cap: the quality of provision or the user cost (out-of-pocket costs or tuition fees) of in-kind benefits. This paper explores the role of the quality of in-kind benefits as the instrument of adjustment in a fiscal consolidation through rationing.

The questions I address in this study are: What are the distributional welfare consequences of fiscal consolidations based on in-kind benefits expenditure cuts in the short and long run? What are the main forces that drive these effects? What impact does the speed of the consolidation have on household welfare? How is income inequality affected by the provision of in-kind benefits? This paper addresses these questions using a quantitative macroeconomics model with heterogeneous agents and incomplete markets in the spirit of Aiyagari and McGrattan (1998). The model is calibrated to the UK economy.

This study's contribution is twofold: First, it provides a novel approach to model social expenditure consumption by households, which generates a distributional consumption pattern that matches the observed one. Second, it analyzes the welfare effects of a cut in in-kind benefits expenditure, considering the quality of provision of in-kind benefits. The study distinguishes between partial and general equilibrium effects to disentangle the different distributional welfare effects, quantifies the redistributive role of in-kind benefits in reducing the Gini coefficient, and compares consolidation speed strategies: front-loaded, linear, and back-loaded consolidations.

This study is the first to explicitly incorporate the choice of in-kind benefits consumption in a general equilibrium quantitative macroeconomic model, and it offers insights into the effects of fiscal consolidations based on in-kind benefits expenditure cuts in the short and long run, and how income inequality is affected by such measures.

The findings suggest that allowing for endogenous in-kind benefits consumption decisions for households, and assuming the inferiority of in-kind benefits, leads to a distributional consumption pattern that closely matches the observed distribution. Moreover, the analysis indicates that in-kind benefits have a significant and progressive redistributive effect, leading to a reduction in income inequality. When taking into account the imputed consumption of in-kind benefits, the decrease in the Gini coefficient from post-tax income to final income amounts to 9.5 %.

In a general equilibrium setting, when the government reduces its debt, private capital crowds in, leading to a decline in real interest rates and a subsequent rise in wages. This particularly benefits households that predominantly depend on labor income over capital income. Over the long run, as the government services a smaller debt, it creates fiscal room to enhance the limit on in-kind benefits expenditure, signifying an improvement in their quality. This shift is favorable for households in the lower income quintiles as they are more dependent on in-kind benefits and labor income. Conversely, households at the higher end of the income spectrum experience welfare losses, given their relatively lower reliance on in-kind benefits and reduced capital income. In a general equilibrium setting, in-kind benefits based fiscal consolidations benefit all households except for those in the top income quintile. The most benefitted households in are households in the lowest income quintiles. However, if prices are kept constant, all households profit from higher quality of in-kind benefits in the long run.

In the short run, the welfare effects on distribution from both the policy instrument and the general equilibrium effects pull in opposite directions. The government's fiscal consolidation strategy, which entails reductions in in-kind benefits expenditure, compromises the quality of these services temporarily. Such degradation disproportionately impacts households in the lower income quintiles due to their heavy reliance on these services. Nonetheless, when analyzing the welfare changes by income quintile, the upward welfare shifts arising from crowding-in counterbalance the welfare declines linked to diminished in-kind benefits quality. Households in the higher income quintiles face significant welfare losses, primarily from price effects. In essence, top-tier income households endure welfare losses, while those in the bottom three quintiles benefit from the liquidity boost from the increase in wages.

Regarding the aggregate short-term welfare effects of fiscal consolidations, my analysis indicates a preference for a front-loaded approach, as it bolsters the liquidity for the majority of households. However, when keeping prices constant, the findings reverse: it is the households at the income base that endure the greatest hardships, and the preferred plan is the back-loaded plan. Additionally, comparing the aggregate welfare effects over the long and short terms, it emerges that the long-term benefits are not offset by short-term adverse welfare impacts.

The remaining paper is organized as follows: In section 2, I present empirical evidence on the consumption of in-kind benefits and their private substitutes. In section 3, I elaborate on how this paper is connected with previously existing literature. In section 4, I describe the model employed, and section 5 details the calibration of the latter. Section 6 explores the redistributive role of in-kind benefits, section 7 is devoted to the analysis of the policy experiments, and 8 concludes.

2 Empirical Evidence

In two-tier systems, as observed in countries such as Italy, Spain, and the United Kingdom, governments offer education and health care services at no cost or at a reduced price. At the same time, there exist a market that provides a private alternative to these public services. This

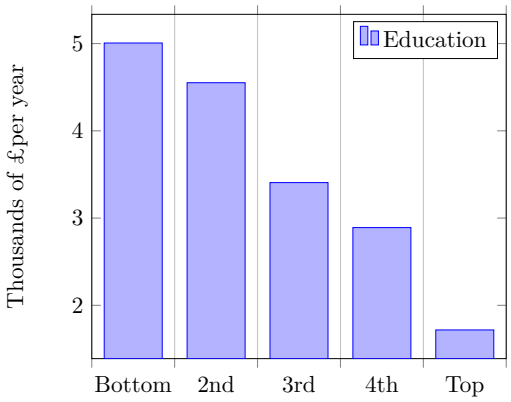
arrangement prompts households to make consumption choices based on the availability of private alternatives. How do households at different income levels access education and healthcare services, depending on whether they are provided by public or private entities? In this section, I explores the patterns of in-kind benefit utilization, specifically focusing on education and healthcare services, across different income quintiles among working-age households in the UK. This analysis draws on data from existing surveys to shed light on how these benefits are distributed and used among various income groups.

Figure 2 illustrates the combined imputed consumption of public education and healthcare. Even though both concepts can be classified as in-kind benefits, their difference in type of service justifies a separate examination. In the following section, I elaborate on households' consumption of public or private education and health care drawing on survey data from the United Kingdom, as it constitutes a notable example of a two-tier system.[1]

Education

With respect to education, the distribution appears markedly favorable to the less privileged in terms of income. In principle, the observed patterns could be influenced by demographic factors, suggesting that households within the lower income quintiles might have a higher number of children attending school. An alternative interpretation could be that wealthier households preferentially opt for private education. Using data from the "Living Costs and Food Survey" (LCF hereafter), I examine the distribution of consumption of public, and private education.

Figure 3: Average imputed education consumption by income quintiles



Note: The average imputed consumption of in-kind benefits corresponds to the imputed consumption of public education services for non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Source: ETB for the year 2016-2017.

Table 1 shows that public education consumption is concentrated and the bottom of the income distribution wheras private education is concentrated at the top. Moreover, in terms of participation on education, we can see that it is higher in lower income strata, suggesting a demographic component to the progressive in-kind benefits provision. To avoid differences in participation across income quintiles, we can restrict the sample to households with members that participate in education reveals distinct patterns related to choices between public and private education across

[1]For a comprehensive evaluation of the distributive role of public expenidture in the UK, see Ogden and Phillips (2023)

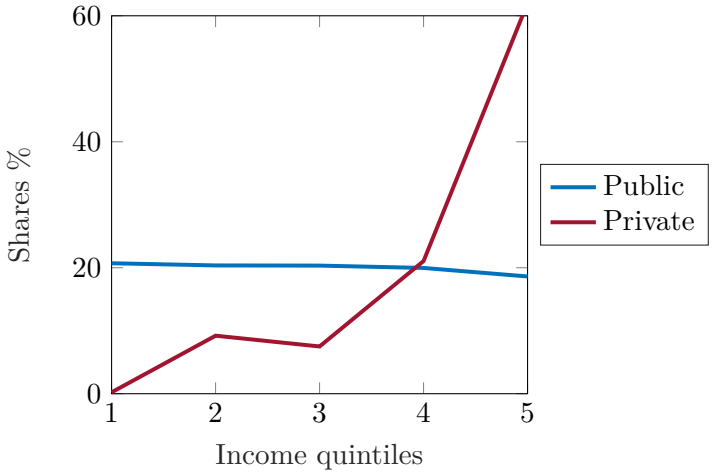
varying income brackets. This is displayed in Figure 4. Figure 4 indicates that the predilection for private educational institutions is heavily skewed towards the top quintiles, which is in line with the findings of Green et al. (2017). Meanwhile, the proportion of public education conditional on households' participation in education experiences a more gradual decline, suggesting a more homogenous distribution.

Table 1: Shares of household participation in education and provider by income quintiles

	Bottom	2nd	3rd	4th	Top
Public	31.09%	24.86%	19.62%	14.94%	9.48%
Private	3.24%	11.72%	12.36%	15.89%	56.79%
Participation	30.25%	24.38%	19.48%	14.97%	10.92%

Note: Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Source: LCF for the year 2016-2017.

Figure 4: Shares of consumption of each type of education conditional on participation in education



Note: Non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Source: LCF for the year 2016-2017.

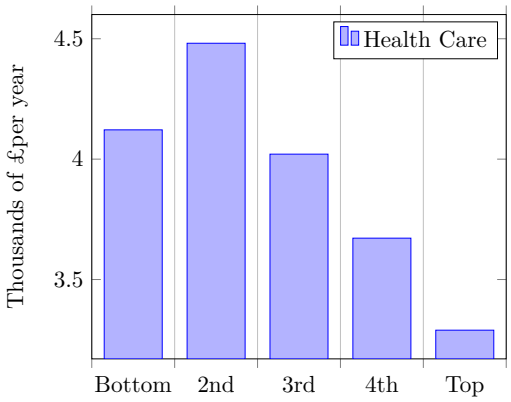
Health care

Figure 5 shows the imputed consumption of public healthcare. In contrast with the figure for education, the distribution of healthcare, while also leaning towards the income-poor households, registers an uptick in the second quintile.[2] Each year, the Office for National Statistics imputes healthcare consumption in their ETB using the "*insurance*" approach. This approach consists on imputing healthcare consumption based on household composition determined by age and gender. This methodology takes into account demographic differences across quintiles. This trend can be attributed to demographic variables. Yet, the imputed consumption exhibits a slightly progressive trend, with a modest reduction at the upper end of the spectrum. However, this imputation does not take into account the usage of private substitutes since entities like private health insurance,

[2]For more details about how ETB imputes in-kind benefits, see Appendix B.2

exemplified by BUPA, provide gateways to private healthcare providers as an alternative to public health care.

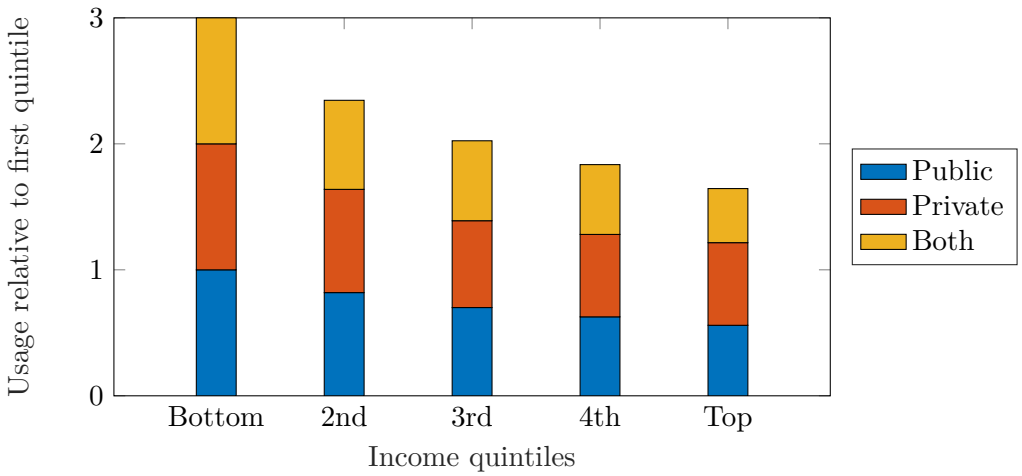
Figure 5: Average imputed health care consumption by income quintiles



Note: The average imputed consumption of in-kind benefits corresponds to the imputed consumption of public health care for non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Source: ETB for the year 2016-2017.

Drawing from the "Understanding Society" survey, it is observed that in the United Kingdom, households situated within the lowest income decile access healthcare services almost twice as frequently as their counterparts in the highest decile, as shown in Figure 6. This observation underscores the progressively redistributive nature of these services and aligns with the well-documented income-health gradient.

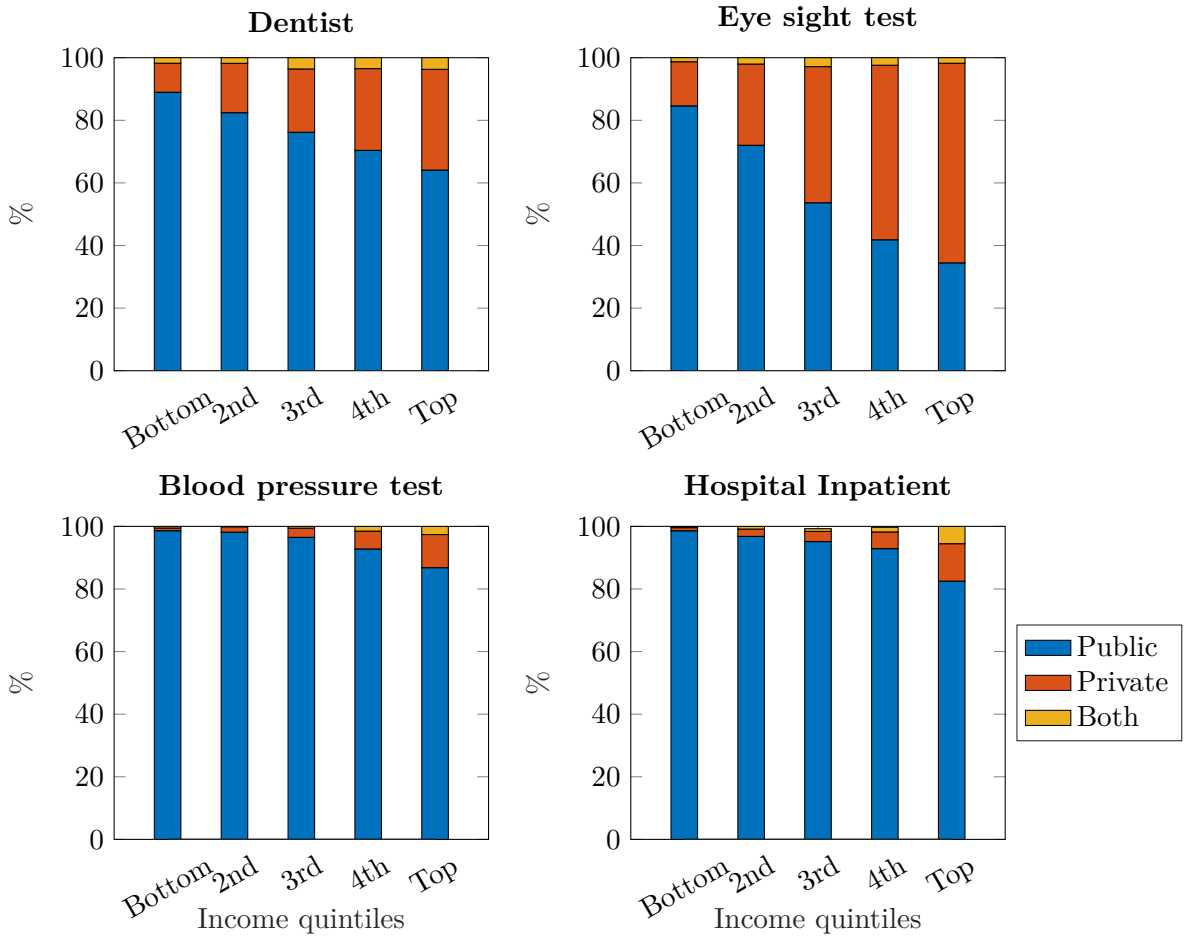
Figure 6: Usage of health care relative to the first quintile by income quintiles



Note: For each type of services, the total amount of usage is normalized by the average usage at the bottom quintile. The sample is restricted to non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Inpatient nights in the hospital are capped at 30 days. Source: Understanding Society survey 2018-2019.

Furthermore, while households in the lower income strata predominantly rely on public healthcare, those with higher incomes exhibit a propensity for private healthcare or a combination of both for a number of services. Data derived from the 2018-2019 "Understanding Society" survey reveals that households within the top income quintile reported a 63.8 % reliance on private providers for eyesight tests and 12.0 % for hospital services. In stark contrast, the corresponding figures for the bottom quintile are 14.1 % and 1.0 % , respectively. Additionally, for non-retired households, 35.6 % of households in the top quintile availed of private health insurance in 2017. This contrasts sharply with the mere 5.5 % observed in the lowest income quintile, as documented by the "Living Costs and Food" survey, as displayed in Table 2.

Figure 7: Share of consumption of healthcare services by providers



Note: This graph illustrates the proportion of consumption for each provider type, given its usage. Sample is restrictred to non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Source: Understanding Society survey 2018-2019.

Table 2: Shares of household private medical insurance by income quintiles

Bottom	2nd	3rd	4th	Top
5.54%	14.95%	18.51%	25.43%	35.57%

Note: Sample is restrictred to non-retired households. Income quintiles correspond to the sum of labor and investment income. Income is equivalised using the modified OECD scale. Inpatient nights in the hospital are capped at 30 days. Source: ETB for the year 2016-2017.

A common discussion in the literature indicates that these services work together in a complementary manner. However, when identical services are offered by different entities, they intrinsically serve as substitutes. This dynamic is further complicated when governments impose rationing on services, prompting households to switch to private alternatives. The empirical evidence indicates that there is a certain degree of substitutability between public and private services. Overall, the provision of in-kind benefits appears to produce a progressive effect. It is within this context that I employ a model to enable households to select their preferred service provider, with the overarching aim of understanding the welfare implications of public service rationing across diverse income categories.

3 Literature Review

This paper is related to three streams of literature: (i) Fiscal consolidation, (ii) Fiscal policy with heterogeneous agents and (iii) Political economy models of provision of in-kind benefits.

Considering the literature of fiscal consolidation plans, this study is closely related to Romei (2015) and Röhrs and Winter (2017), as they study fiscal consolidation plans under different instruments. From Romei (2015), we learned that different fiscal consolidation policies trigger different interest rate paths, causing disagreements on the most preferred policies among different types of agents. In particular, she considers two types of policy experiments: a cut in public expenditure and an increase of proportional tax rate in labor income. She finds that for those households with low level of assets, they would typically disagree on their optimal plan for fiscal consolidation with those wealthy. In Röhrs and Winter (2017), the authors investigate the welfare effects of fiscal consolidations performed through a proportional income tax hike in an heterogeneous agents and incomplete markets environment. They highlight the relevance of the welfare change along the transition, which offsets the positive effects of the long-run analysis in a public debt deleveraging. The contribution of this paper is twofold: firstly, I account for the distributional effects on households' income, and secondly, the type of instrument employed for consolidating public finances is different. In addition, in this stream of the literature, McManus et al. (2021) study the distributional consequences of fiscal austerity in a DSGE accounting for heterogeneity. Their findings conclude that increasing labor taxes and reducing transfers and public employment are regressive measures which raise income inequality. Credit constrained agents suffer in the short run, but they are benefited in the long run, which is in line with the results of this study. Also, in accordance with Röhrs and Winter (2017), they showed that speedy austerity yields worst redistributive and output effects irrespective of its composition. Finally, Ball et al. (2013) empirically assess the effect of fiscal consolidations on income inequality during the period 1978–2009 for a sample of 17 OECD countries. Their findings point out that consolidations based on spending adjustment have more distributional impact on inequality than tax adjustments.

In the literature related to fiscal policy with heterogeneous agents and incomplete markets, the present study is built on the seminal paper by Aiyagari and McGrattan (1998). In this paper, the authors explore the non-trivial role of government debt, where the general equilibrium effects of the economy's prices ultimately enhance the liquidity of households, providing extra incentives for households to accumulate precautionary savings in the presence of incomplete markets. In a similar vein, Flodén (2001) studies how changes in public debt and transfers affect risk sharing, efficiency, and distribution of resources. Finally, Oh and Reis (2012) and Froemel (2014) model social expenditure as a transfer that households receive from the government. Social expenditure encompasses broad categories including transfers and in-kind benefits, both of which exhibit characteristics of private goods. To grasp the significance of in-kind benefits, two points should be noted: firstly, the government cannot dictate the quantity of this good each household consumes, and secondly, when given a transfer, households have the autonomy to allocate it toward a good of their desired quality. This forms the basis for the motivation behind this study.

These facts lead us to the third strand of literature about political economy models of public expenditure. In this line, Besley and Coate (1991) build a model in which households can decide discretely whether to consume a private good at some cost or to consume a publicly provided good with no cost but at a certain quality chosen by the government. This quality is set so that only households with low income self-select themselves into the consumption of publicly provided goods through an incentive compatibility constraint. This paper aims to capture the redistributional patter of self-selection of households into the consumption of in-kind benefits in a quantitative model with heterogeneous households. I assume that the households perceive publicly provided goods as an inferior good, and also that they face a user cost to consume these benefits in-kind which is smaller than the price of the private consumption good. More details are given in the following section.

4 Model

The proposed environment is an heterogeneous agents model with incomplete markets and idiosyncratic risk with no aggregate uncertainty, following the tradition of Bewley-Hugget-Aiyagari models. This economy is composed of three sectors: Households, a representative firm and a government. Agents are infinitely lived, the time is discrete, and the environment is a closed economy. In the following subsections, each of these sectors is described in detail.

4.1 Households

The economy is inhabited by a continuum of households of mass equal to one who are ex-ante identical. These households maximize their expected lifetime utility subject to their budget constraints, deriving their optimal decisions for savings, consumption of a general consumption bundle, in-kind benefits, and their private substitutes.

Each household i at period t consumes a bundle of consumption goods $c_{i,t}$, in-kind benefits $g_{i,t}$ which are provided at a certain quality q_t, private substitutes to in-kind benefits $p_{i,t}$, and save a certain amount of risk-free assets $a_{i,t+1}$. The price of the consumption good is assumed to be a numeraire. To consume in-kind benefits, households must pay an user cost ζ_t. The price of the private substitute of in-kind benefits is given by θ_t

Households are subject to idiosyncratic productivity shocks $\varepsilon_{i,t}$ which follow a Markov process. Households cannot insure against these shocks in the context of incomplete markets. Hence, in account of the presence of non insurable income risk and borrowing constraints, households will accumulate precautionary savings in order to insure themselves against future productivity shocks.

Each household i solves the following recursive problem:

$$\begin{aligned} V(a_i, \varepsilon_i) = \max_{c_i, a_i', g_i, p_i} & \{u(c_i) + v(p_i, qg_i) + \beta \mathbb{E} V(a_i', \varepsilon_i')\} \\ \text{s.t.} & c_i + a_i' + \zeta g_i + \theta p_i = (ra_i + w\varepsilon_i)(1-\tau) + a_i + tr \\ & a_i' \geq -\phi, c_i \geq 0, \end{aligned}$$

Where τ is a proportional total income tax, and tr stands for lump-sum transfers.

From which the intratemporal and intertemporal optimality conditions are given by:

$$\frac{u_c(c_i)}{v_p(p_i, qg_i)} = \frac{1}{\theta} \tag{1}$$

$$\frac{v_g(p_i, qg_i)}{v_p(p_i, qg_i)} = \frac{\zeta}{\theta} \tag{2}$$

$$u_c(c_i) = \beta \left(1 + r(1-\tau)\right) \mathbb{E}_t\{u_c(c_i')\} \tag{3}$$

To account for a decreasing pattern of consumption of benefit in-kind with income, I employ a utility function in which one of the goods exhibits an inferior behavior. In this line, Mankiw et al. (1985) propose a CRRA utility function with enough flexibility to capture inferiority of one of the goods. I consider the following version of their utility function:

$$v(p_{i,t}, g_{i,t}) = \frac{\left(\frac{p_{i,t}^{1-\eta}}{1-\eta} + d\frac{(q_t g_{i,t})^{1-\varphi}}{1-\varphi}\right)^{1-\nu}}{1-\nu}$$

Combining the intratemporal Euler equations (1) and (2) we obtain:

$$g_{i,t} = \left(\frac{\theta_t}{\zeta_t} d q_t^{1-\varphi}\right)^{1/\varphi} p_{i,t}^{\frac{\eta}{\varphi}}$$

If η and φ have the opposite sign, one of the goods will be inferior. By setting φ positive and η negative, I obtain an inferior behavior for the in-kind benefits, keeping private consumption as a normal good.

The proposed parametrization model allows us to capture the inferiority of consumption of benefits in-kind from the household perspective, while keeping the consumption of goods and the private substitute as normal goods.

4.2 Firms

Firms maximize profits subject to the following technology: $Y_t = K_t^{\alpha} L_t^{1-\alpha}$ where Y_t, K_t and L_t stand for output produced, capital and labor in efficiency units hired by the firm, respectively.

By constant returns to the scale of the production function, an indetermined number of firms can be aggregated in a representative firm. Thus, the representative firm maximizes its profits:

$$\Pi_t = K_t^{\alpha} L_t^{1-\alpha} - w_t L_t - (r_t + \delta) K_t \tag{4}$$

The output generated by this representative firm can be purchased by households becoming consumption $c_{i,t}$ and private substitutes $p_{i,t}$, by the government to provide in-kind benefits $g_{i,t}$, and investment.

4.3 Government

In this economy, the government levies taxes, provides benefits in-kind and cash transfers, and issues debt satisfying its budget constraint:

$$D_t(1 + r_t) + G_t^{IK} + \Omega + tr = D_{t+1} + \tau_t(A_t r_t + w_t L_t) + \zeta_t \int_{i \in I} g_{i,t} di \tag{5}$$

D_t stands for the government debt due at period t. D_{t+1} is the debt that the government issues at period t which is due to next period. The debt issued by the government is an additional risk free asset that can be purchased by households, such that, by a non-arbitrage condition, government bonds will yield the same interest rate than capital from firms. Therefore, government bonds and firm's capital would be perceived as homogeneous savings instruments such that there is a single saving instrument available for households.

The government provides in-kind benefits subject to a cap G^{IK}. This goods are produced in the private market, and the government transforms them into in-kind benefits according to the following technology:

$$G_t^{IK} = A_t^G \int_{i \in I} g_{i,t} di \tag{6}$$

In order to meet households demand, the government rations in-kind benefits by increasing the productivity A_t^G, which implies that the unit cost of providing one unit of in-kind benefit is given by $c_t^{IK} = 1/A_t^G$. Therefore, One unit of the private good input equals $1/c_t^{IK}$ units of the in-kind benefits. Rationing affects the quality at which in-kind benefits are provided, which in turn affects the demand of these goods on from the households' side. I assume that the quality is affected one-to-one by the unit cost of provision of In-kind benefits.[3]

$$q_t = c_t^{IK} \tag{7}$$

[3]In this model, quality is understood as the average unit cost of provision of health care and education for the government. This average unit cost also positively affects the demand for in-kind benefits on the household's side. The rationale behind this assumption is that the average cost of provision is positively correlated with the variables of interest to determine the demand for these goods for households in the UK, namely, waiting times for health care (Bíró and Hellowell, 2016) and student to teacher ratio and facility quality for education (Green et al., 2017). Clearly, hiring more workers in both sectors and expanding their capacities would increase the average cost of provision, raising therefore the perceived quality from the perspective of the households. The rationing of public services affects their perceived quality from the households' perspective. In this sense, the interpretation of quality is closer to the perception of quality by households rather than the efficacy of publicly provided services compared to private ones.

The user cost that households pay to access the in-kind benefits, ζ_t, is assumed to be collected by the government. Therefore, it is also a source of revenue for the government. The variable A_t^G is considered the variable of adjustment for the government's budget constraint, which directly affects the quality of provision of in-kind benefits q_t. Therefore, I refer to this adjustment as a *quality* adjustment.

4.4 Competitive Equilibrium

In this subsection, I define the competitive equilibrium for the long run analysis, which consists of a steady state comparison, and the short run, consisting in the transition between steady states.

Let λ be the current distribution of households over asset holdings a (a, ε)
Definition 1: *A stationary recursive competitive equilibrium is a value function* $V : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$ *policy functions for households* $a' : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$ *and* $c : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$, $g : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$, $p : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$, *policy functions for firms* $K : \mathcal{M} \to \mathbb{R}$ *and* $N : \mathcal{M} \to \mathbb{R}$, *pricing functions* $r : \mathcal{M} \to \mathbb{R}$ *and* $w : \mathcal{M} \to \mathbb{R}$ *and the aggregate law of motion* $H : \mathcal{M} \to \mathcal{M}$ *such that:*

(i) *V satisfies the households' Bellman equation, with a′, c, g, and p being the associated policy functions, given r and w*

(ii) *Given r and w, K and L satisfy:* $r = F_K(K, L) - \delta$ *and* $w = F_L(K, L)$

(iii) *The capital, labor and good markets clear:* $K + D = \int a(a, \varepsilon) d\lambda(a, \varepsilon)$
$L = \int \varepsilon l(a, \varepsilon) d\lambda(a, \varepsilon)$
$\int c(a, \varepsilon) d\lambda(a, \varepsilon) + G^{IK} + \theta \int p(a, \varepsilon) d\lambda(a, \varepsilon) + \Omega = F(K, L) - K(\delta)$

(iv) *Government's budget constraint is satisfied*

(v) λ *remains constant for all* $(\mathcal{A}, \mathcal{E})$:
$\lambda(a', \varepsilon') = \sum_{\varepsilon \in \mathcal{E}} \pi(\varepsilon' | \varepsilon) \lambda(a, \varepsilon)$

Definition 2: *Given an initial distribution* λ^*, *a sequence of debt* $\{D_{t+1}\}_{t=0}^{\infty}$, *a recursive competitive equilibrium is a sequence of value functions* $\{v_t\}_{t=0}^{\infty}$, *policy functions* $\{c_t, g_t, p_t, a_{t+1}\}_{t=0}^{\infty}$, *firm choices* $\{K_t, L_t\}_{t=0}^{\infty}$, *prices* $\{r_t, w_t\}_{t=0}^{\infty}$ *and quality of the in-kind benefits chosen by the government* $\{q_t\}_{t=0}^{\infty}$ *with a constant income tax* τ *and user cost of in-kind benefits* ζ *and distributions* $\{\lambda_t\}_{t=0}^{\infty}$ *such that for every period t:*

(i) *Given prices* $\{r_t, w_t\}$ *and policies* $\{D_{t+1}, q_t\}$ *the decision rules* $a_{t+1}(a, \varepsilon)$,$c_t(a, \varepsilon)$, $g_t(a, \varepsilon)$ *and* $p_t(a, \varepsilon)$ *solve the household problem, being* $v_t(a, \varepsilon)$ *the associated policy function*

(ii) *Given prices* $\{r_t, w_t\}$ *the firm hires capital and labor optimally:* $r = F_K(K, L) - \delta$ *and* $w = F_L(K, L)$

(iii) *Capital market clears:*
$K_{t+1} + D_{t+1} = \int a_{t+1}(a, \varepsilon) d\lambda_t(a, \varepsilon)$

In this study, I abstract from status-seeking, intergenerational transmission, and political preferences motives for consumption of private education.

(iv) *Labor market clears:*
$L_t = \int \varepsilon(a,\varepsilon) d\lambda_t(a,\varepsilon)$

(v) *Goods market clears:*
$\int c_t(a,\varepsilon) d\lambda_t(a,\varepsilon) + G_t^{IK} + \theta \int p_t(a,\varepsilon) d\lambda_t(a,\varepsilon) + K_{t+1} - K_t(1+\delta) + \Omega = F(K_t, L_t)$

(vi) *Goverment's budget constraint is satisfied:*
$D_t(1+r_t) + \int_{i\in I}(q_t - \zeta_t) g_{i,t} di = D_{t+1} + \tau_t(A_t r_t + w_t L_t)$

5 Calibration

In this section, I elaborate on the parameter choices, describe their estimation procedure, and subsequently assess the model's alignment with the data. To calibrate the model, I take a two-step approach. First, I base specific parameter values on observed data, also drawing from existing literature. These are the externally estimated or set parameters. Once I set these values, I internally calibrate the remaining parameters using the model. For this, I use the Simulated Method of Moments (SMM), relying on a minimum distance estimator anchored by the identity matrix. Key moments guiding this calibration include the capital to GDP ratio, the aggregate expenditure of the government in health and education services, the average imputed consumption of in-kind benefits in the first quintile of income, and the ratio between the first and the fifth quintile, the concentration of consumption of private substitute in the bottom and top quintile.

In Table 3, there is a summary of the selected value of the relevant parameters for the model. The model is calibrated to target features of the United Kingdom in 2017. The model is calibrated in annual frequency.

Table 3: Summary of parameter values

Households		**Firms**	
Discount factor β	0.958	Capital share in GDP α	0.3
Risk aversion γ	2	Depreciation rate δ	0.07
Borrowing constraint ϕ	0		
d	0.155	**Government**	
η	-0.110		
φ	0.349	Proportional tax rate τ	0.29
μ_1	0.0157	Debt over GDP,D	0.6973
p	0.8784	User cost of in-kind good ζ	0.142
σ_1	0.1431	Residual government expenditure Ω	0.0164
σ_2	0.6633	Lump-sum transfers tr	0.2402
ρ	0.914	Unit cost of in-kind benefits c^{IK}	0.682

5.1 External parameters

Households
For the utility function of consumption, I employ a standard CRRA function with risk aversion

parameter γ set to 2, as it is standard in the macroeconomics literature. I also set the risk aversion of the in-kind benefits and private substitutes utility function, ν, to 2. The borrowing limit ϕ is set to zero.

Labor income process

Recent studies on the dynamics of household labor income have shown that individual and household income growth displays negative skewness and excess kurtosis relative to a normal distribution. In order to account for these patterns, Guvenen et al. (2021) proposed employing a mixture of Gaussian distributions. Let ε_t be the logarithm of the income of the household:

$$\log \varepsilon_{i,t} = \rho log \varepsilon_{i,t-1} + \epsilon_{i,t}$$

$$\varepsilon_t = \begin{cases} \mathcal{N}(\mu_1, \sigma_1) & \text{with probability } p \\ \mathcal{N}(\mu_2, \sigma_2) & \text{with probability } 1-p \end{cases}$$

With $\mathbb{E}[\varepsilon] = 0$. Therefore, there are 5 available parameters to estimatee $(\rho, p, \mu_1, \sigma_1, \sigma_2)$ as μ_2 is pinned down by $p\mu_1 + (1-p)\mu_2$. Regarding the calibration targets, I closely follow Ferriere et al. (2023) by targeting the following moments of income growth:[4] the standard deviation, 0.269; the skewness, -0.805; kurtosis, 13.639; the difference between the 90 and 10th percentile, 0.41 and the share of labor income at the top 10 percentile, 34,11%.[5] The parameter values are estimated through the method of simulated moments in order to match the empirical values targeted. The resulting process is discretized using Farmer and Toda (2017) method.

Table 4: Productivity process: Model fit

	Model	Data
Standard deviation	0.274	0.269
Skewness	-0.849	-0.805
Kurtosis	13.552	13.639
p90-p10	0.458	0.41
p90	0.346	0.341

Firms

For the representative firm, the share of the capital income to output α is set to 0.3 and the annual depreciation rate δ to 0.07 in line with Trabandt and Uhlig (2011).

Government

The program of the government consists of deleveraging debt according to an exogenous path. The initial debt to GDP ratio level is set to 69.73% , which corresponds to the debt to GDP domestically held in the UK in 2017, and the post consolidation debt level to 60% of GDP as the target from the Stability Growth Path. Additionally, to obtain revenues, the government taxes households' total income according to a proportional tax, which is set to 0.29 following Bhattarai and Trzeciakiewicz

[4] All these moments are computed using the British Households Panel Survey for 1996-2008. Refer to the Appendix for more details.

[5] Data from labor income from ETB survey for nonretired households for the year 2017.

(2017). The lump-sum tr is set to match the observed total cash transfers to GDP, which according to the OECD database is 12.6%, and the residual government expenditure Ω is set to balance the government's budget constraint in the initial steady state.

5.2 Internally estimated parameters

In a second step, conditional on the parameter values externally set, I choose the parameter values of the model to target empirically observed moments. The estimated parameters are $\Theta = \{\beta, \varphi, \eta, d, c^{IK}, \theta\}$. The targeted empirical moments are the capital to GDP ratio, the aggregate expenditure of the government in health and education services, the average imputed consumption of in-kind benefits in the first quintile of income, and the ratio between the first and the fifth quintile, the concentration of consumption of private substitute in the bottom and top quintile. These moments are denoted by ψ^D. Given that the model relies on the exogenously set parameters χ, let us denote the simulated moments by the model as $\psi^M(\Theta, \chi)$. My objective is to find the parameter values that minimizes the distance between the simulated model, and its empirical counterpart. Effectively, this is corresponds to the Simulated Method of Moments derived by McFadden (1989). Therefore, the structural estimation of the model consists on the solution to the following problem:

$$\hat{\Theta} = \text{argmin}_{\Theta}[\psi^D - \psi^M(\Theta, \chi)]' W [\psi^D - \psi^M(\Theta, \chi)]$$

Where W stands for the weighting matrix, which is assumed to be the identity matrix. The resulting parameter values are detailed in Table 3.

5.3 Model fit

In this section, I evaluate the model's alignment with the targeted empirical moments and those not explicitly targeted. Table 5 provides a detailed comparison. Overall, the model effectively replicates the observed moments.

Table 5: MSM estimation results and fit with the data

Moment	Data	Model
Capital to output ratio	3.30	3.30
In-kind benefits expenditure to output	9.76%	6.42 %
Bottom quintile of in-kind benefits	£ 9128.08	£ 9099.98
Bottom to top quintile ratio of in-kind benefits consumption	1.96	1.79
Share of private substitute consumption in Q1	5.54%	6.43 %
Share of private substitute consumption in Q5	35.57%	39.37 %

Table 6: In-kind benefits imputed consumption distribution

	Q1	Q2	Q3	Q4	Q5	Q1/Q5
Data	£ 9128.09	£ 9032.80	£ 7427.27	£ 6562.76	£ 5007.45	1.82
Model	£ 9099.98	£ 7361.96	£ 6505.47	£ 5873.42	£ 5087.26	1.79

This inclusion informs the identification strategy, prompting it to align with certain moments of the empirical distribution. Table 6 showcases the average imputed consumption of in-kind benefits across income quintiles in a steady state. The consumption of in-kind benefits exhibits a pronounced decline.

Additionally, to align with the income distribution, the model incorporates the labor productivity process estimated from labor income data. Specifically, it includes moments that represent labor income inequality, such as the top share and the disparity with the first decile. Beyond these, the model does not explicitly target any particular moment of income distribution. Nevertheless, it accurately replicates the distributions of labor, wealth, and labor income.

Table 7: Income distribution

	Q1	Q2	Q3	Q4	Q5	Gini
Data	2.33%	9.67%	15.80%	22.57%	49.63%	0.4692
Model	4.12%	8.37%	14.00%	23.13 %	50.38%	0.4615

Note: Total income is equivalent to market income. Total Income consists on earnings, private pensions and investments. Source: ETB. Data for financial year ending 2017, non retired households.

Table 8: Labor income shares

	Q1	Q2	Q3	Q4	Q5	T 10 %	Gini
Data	0.29%	7.14%	15.29%	24.98%	52.30%	34.11%	0.52
Model	3.79%	9.91%	18.19%	29.49%	62.76%	40.15%	0.46

Note: Households aged 25-65. Source: ETB for the year 2016-2017

Table 9: Net worth shares

	Q1	Q2	Q3	Q4	Q5	T 10 %	Gini
Data	-0.62%	1.17%	8.18%	20.53%	70.74%	51.77%	0.71
Model	0.02 %	1.95 %	8.53 %	22.48 %	67.93 %	46.33 %	0.67

Note: Households aged 25-65. Source: WAS

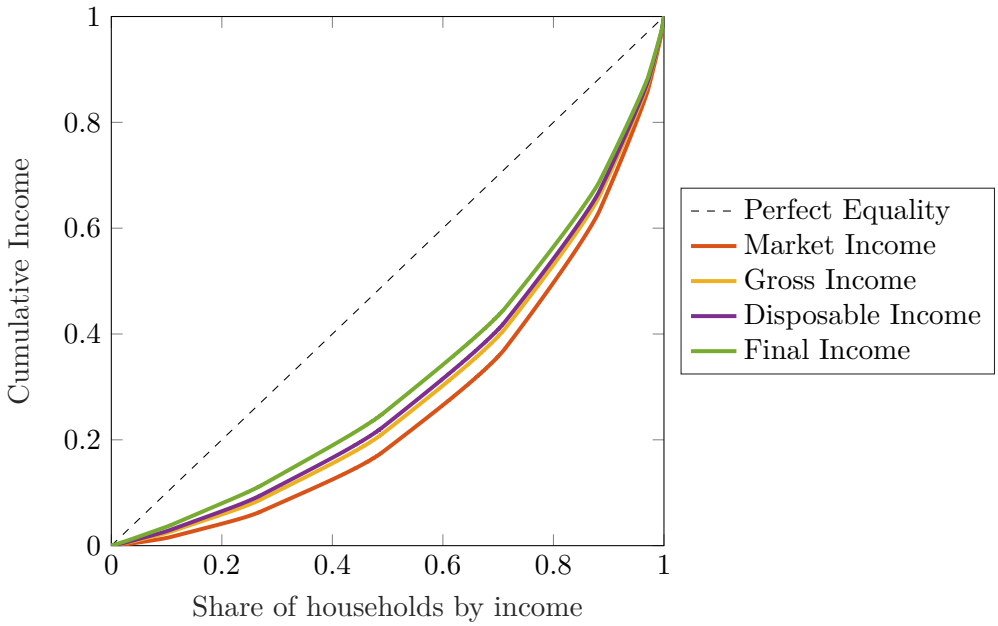
6 Redistributive role of in-kind benefits

In this section, I quantify the redistribution impact of the tax and benefit system considered in this model. First, let us define the following income concepts: Market income, which is the income that households obtain from capital and labor; Gross income, which includes cash transfers received by households in addition to the Market income; Disposable income, which is the result of subtracting direct taxes from Gross income; Final income, which adds the imputed income from the in-kind benefits consumed by households. The redistribution scheme is therefore computed in stages.[6] As

[6]see Figure 16 in the Appendix

the government offers in-kind benefits at a a low cost or free of charge, it assumes the associated expenses. Therefore, the gap between the user fee borne by the household and the actual provision cost can be viewed as an element of the redistribution scheme of the government, representing a transfer "*in-kind*".

Figure 8: Lorenz Curves



Note: The Lorenz curves are calculated for the initial steady state ($t = 0$).

In Figure 6, the Lorenz curves for the different income concepts are shown. As we move further into the tax-benefit redistribution scheme, income inequality is reduced. If we compare the Gini coefficients at different levels of redistribution, decrease from 0.46 to 0.39 considering the effects of usual instruments, such as direct taxes and lump-sum transfers. If, on top of this, we impute the in-kind benefits income, the Gini index decreases even further to 0.36 , which represents a 23.00 % decrease with respect to the original income Gini index.

Table 10: Gini coefficients at different stages of the redistributive scheme

Gini coefficients	
Market Income	0.462
Gross Income	0.410
Disposable Income	0.393
Final Income	0.355

Similarly toChristl et al. (2020), I find that the in-kind benefits have a progressive redistributive effect, reducing inequality. Note that the decrease in the Gini coefficient from the post-tax income to final income in my model amounts to 9.5 %, whereas in Christl et al. (2020), the difference after

accounting for in-kind benefits decreases the Gini coefficient by 4.6%. This may be explained as they include indirect taxation in their experiments, and the in-kind benefits income is imputed after considering the indirect taxation. Therefore, it is not a direct comparison between disposable income and disposable income after imputing in-kind benefits.

7 Results

In this section, I analyze the welfare effects of a fiscal consolidation adjusting the quality of the in-kind benefits provided by the government. In the long run analysis, I perform a steady state comparison, whereas in the short run analysis, I evaluate the transitional dynamics between the two above referred steady states. In the short run, I consider three types of fiscal consolidation plans: front-loaded, in which most of the debt is consolidated in the first periods, a linear plan, in which the debt decreases linearly within consolidation period, and back-loaded, in which the debt is reduced in the final periods.

In order to gauge the extent to which the prices' adjustment drive the welfare effects, I consider the effects of a fiscal consolidation by adjusting the fiscal instruments q_t, fixing the prices of the economy, namely the interest rate r, and wage w. The experiments are carried out for the long run as well as for the short run. The motivation for this exercise is to distringuish between instruments and general equilibrium effects. In addition, due to the global mobility of capital, the interest rates of debt are determined in equilibrium in the international capital markets. The interest rate of government bonds is influenced by the perceived default risk, which is positively correlated with the amount of debt although there are other instruments, such as Quantitative Easing, that also influence the interest rate of sovereign bonds. I present two scenarios: a constant price scenario, which I will refer to as partial equilibrium, and a scenario in which prices adjust to the decrease in government debt. In the partial equilibrium scenario, the fiscal consolidation will be entirely due to the adjustment of the instrument (q_t in this case) whereas in the general equilibrium, both the instrument and the prices adjust to the decrease in debt. In the following subsections, I will first present the partial equilibrium results and, subsequently, the general equilibrium for both instruments.

7.1 Welfare Measure

Let the welfare of a given household i characterized by states variables (a, ε) at any period t be defined as:

$$\mathcal{W}_t\left(c^*_{i,t}), p^*_{i,t}, q_t g^*_{i,t}\right) = \mathbb{E}_0 \sum_{t=0}^{\infty} \Big[u(c^*_{i,t}) + v(p^*_{i,t}, q_t g^*_{i,t}) | (a_0 = a, \varepsilon_0 = \varepsilon)\Big]$$

where u, v are the corresponding functional form specified for the utility functions, and $c^*_{i,t}$, $p^*_{i,t}$ and $g^*_{i,t}$ are the policy functions for consumption, in-kind benefits, and the private substitutes respectively at time t.

To study the preferences for different types of households for fiscal consolidation plans, I employ consumption equivalents or conditional welfare change. This measure consists of the share of consumption of the pre-policy welfare that the household must incur to be indifferent in terms of

welfare between the pre-policy and post-policy allocation. Let ϑ denote the consumption equivalent conditional on the initial states (a, ε). The consumption equivalent would be the value $\vartheta(a, \varepsilon)$ that satisfies the following equation. [7]

$$\mathcal{W}_{pre}\left(c^*_{pre}(1+\vartheta), p^*_{pre}, q_{pre}g^*_{pre}|a_0, \varepsilon_0\right) = \mathcal{W}_{post}(c^*_{post}, p^*_{post}, q_{post}g^*_{post}|a_0, \varepsilon_0)$$

If a given household exhibits a positive consumption equivalent, this means the policy increases her welfare. Thus, to be indifferent in terms of welfare between the pre-policy steady state and post-policy steady state, she would need to increase her consumption by a share of ϑ in the pre-policy steady state. On the contrary, if the consumption equivalent is negative, this suggests the household would be willing to give up a share of its pre-policy consumption ϑ in order to avoid the policy change, since she is experiencing a welfare loss after the policy. So, the greater (lower) the value of ϑ, the greater (lower) would be the preference of the household for the policy change.

In the long run analysis, the consumption equivalent expresses the preference of the household in terms of welfare between the pre and post policy steady states. As such, the policy functions are constant over time, whereas in the transition, policy functions change over time until the final steady state is reached. In particular, in the short run welfare analysis, the interpretation of the consumption equivalent is slightly different: The consumption equivalent would be the gain (loss) of consumption in the initial steady state that an agent with productivity state ε and asset holdings a would be willing to give to be indifferent between stay in the initial steady state forever or go through the transition induced by the policy reform. Therefore, in the short run analysis, $\mathcal{W}_{post}$ represents the welfare obtained by a household along the transition path, which is computed by backward induction.

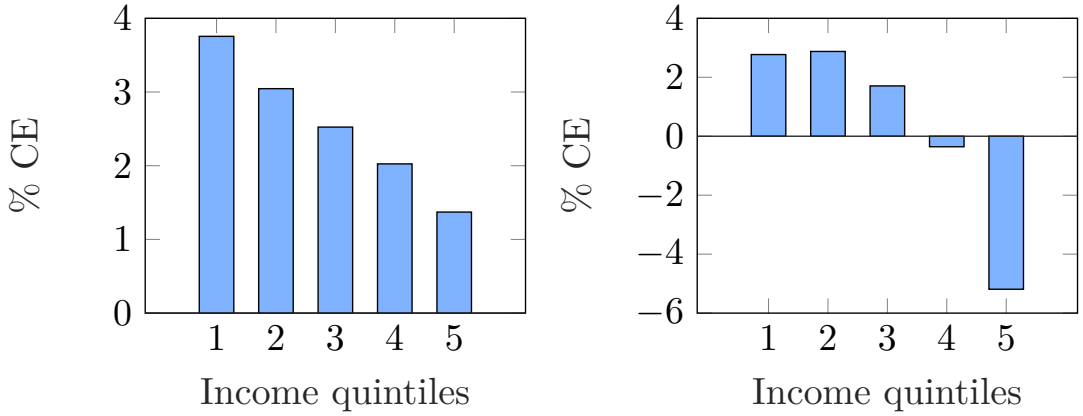
Let us distinguish between two types of effects that influence the welfare of households:

i) **Instrument effects**: As the quality of in-kind benefits increases , this increases the welfare of all households consuming this good. If, on the contrary, there is a decrease on the quality of in-kind benefits, households with enough income can substitute the consumption of in-kind benefits by consumption of the private substitute. However, as we can observe in the distribution of in-kind benefits consumption, the consumption of this good is unequal across the income distribution. As households with low income profiles rely more on consumption of in-kind benefits, an increase in the quality of such goods will positively affect their utility in a greater extent than households with higher income profiles.

ii) **Price effects**: As the government reduces debt, private capital crowds in the economy, which lowers the interest rate (Röhrs and Winter, 2017). Consequently, the marginal product of labor increases and raises wages. This effect favors the liquidity of households in the lower income quintiles, who rely typically more on labor income than in capital income. For households in the higher income quintiles, although an increase in labor income positively affects their liquidity, a decrease in the capital income adversely affects her income to a greater extent, since this type of households typically rely more on income coming from their asset holdings.

[7] For a detailed analytical derivation of the consumption equivalent, refer to the appendix D.

Figure 9: Illustration of distributional welfare effects through instrument and prices



Note: The figure on the left represents the conditional welfare change in the long run of a fiscal consolidation adjusting the quality of in-kind benefits and holding prices constant. This is equivalent to a partial equilibrium exercise. The figure on the right represent the conditional welfare change of the crowding in effect induced by a fiscal consolidation in the long run holding the quality of in-kind benefits constant.

Furthermore, in order to be able to compare the consumption equivalent distributions between the different transitional paths, it is desirable to obtain an aggregate measure of welfare change. I define Ψ as the aggregate welfare change conditional on the initial distribution $\lambda_{t=0}(a, \varepsilon)$:

$$\Psi = \int \vartheta(a, \varepsilon)\lambda_{t=0}(a, \varepsilon) \tag{8}$$

It is also important to remark that this result depends on the distribution $\lambda_{t=0}(a, \varepsilon)$ and its implied inequality are crucial to determine the aggregate result.

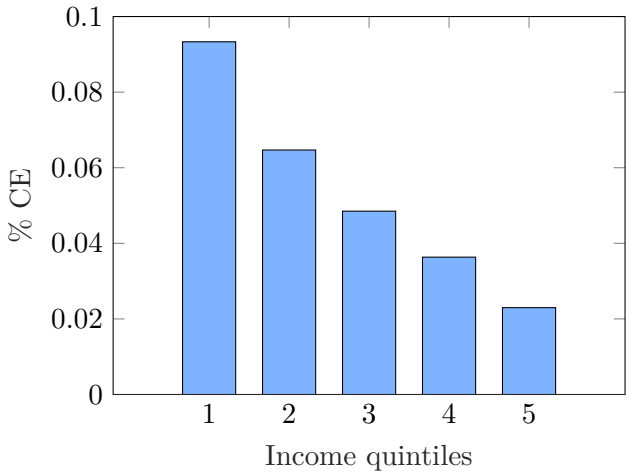
7.2 Long Run Analysis

In this section, I explore the welfare consequences of a debt deleveraging, where the adjusting instrument is the quality of the provided in-kind benefits. The long run analysis consists of comparing welfare between two steady states: an initial steady state with high debt and low quality of the benefit in-kind, and a final steady state where the amount of debt has decreased and the quality of the publicly provided good is higher. The model will simulate the effect of a fiscal consolidation from the initial debt to GDP level for the UK economy to a debt to GDP ratio of 60%. As the amount of debt decreases, the government reduces its liabilities, and for a given revenue, the quality of the in-kind benefits provided can be risen, satisfying the budget constraint.

Partial Equilibrium

In the long run, holding prices constant, an increase in the quality of in-kind benefits increases the welfare of all households, but especially those at the bottom of the income distribution, since they rely more on the consumption of these goods than income-rich households. We can see how the welfare gains phase out as we move to the right of the income distribution. The aggregate welfare increases in the long run, holding prices constant equals 0.053%.

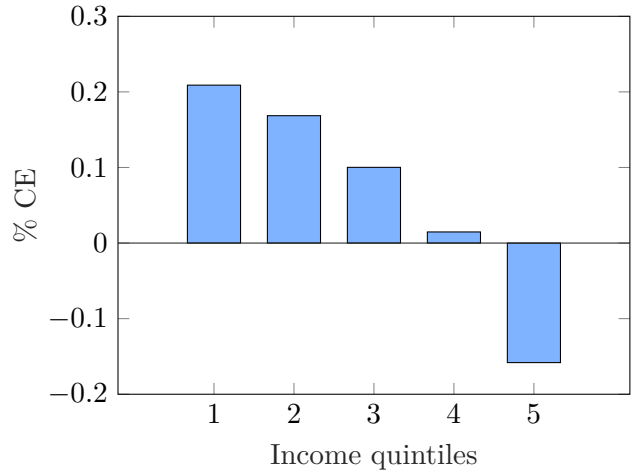
Figure 10: Long-run welfare effects in Partial Equilibrium



General Equilibrium

In general equilibrium, the combination of the price effects and the instrument effect explain the positive and sharply decreasing pattern of the consumption equivalent by income quintiles depicted in Figure 11. In both scenarios, in the long run, a fiscal consolidation though an adjustment of the quality of in-kind benefits positively affects income poor households, although by considering general equilibrium effects, income-rich households lose in terms of welfare due to their loss of capital income.

Figure 11: Long-run welfare effects in General Equilibrium



The increase in the quality of in-kind benefits increases the welfare of all households, especially those who are asset-poor and with low-productive. Welfare gains rapidly decrease as asset holdings increase. The decrease in interest rates affects negatively households in the top quintile, who hold the greater share of the economy's assets. The aggregate welfare change in general equilibrium 0.066%, which is higher than in the partial equilibrium exercise due to the combination of the price and instrument effects, which substantially increases the welfare of the households in the first

three income quintiles. On aggregate, this increase in welfare in the first three quintiles offsets the negative effect of the welfare of households in the last income quintile.

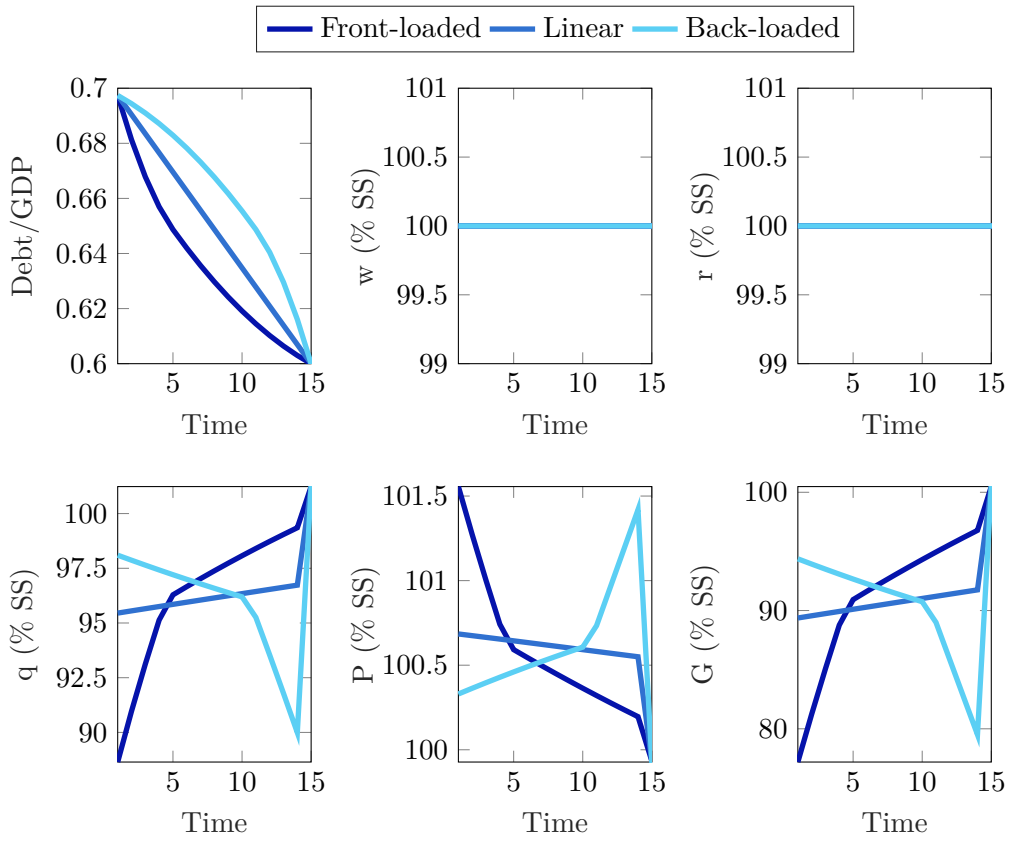
7.3 Short Run Analysis

In this subsection, I explore the welfare consequences along the transitional dynamics between the two above referred steady states. I consider a consolidation period of 15 years [8] in which public debt must be reduced from 69.73% of GDP to 60%. I consider three types of consolidation plans: back-loaded, linear and front-loaded. The remainder of the section details the features of both plans.

Partial Equilibrium
With prices being kept constant, the adjustment of the quality of in-kind benefits is sharper than in the general equilibrium. This occurs since there is no crowing-in effect and consequently the cost of debt service does not decrease other than by decreasing the amount of debt. The crowding-in effect partially relaxes the budget constrain of the government for two reasons: as private capital crowds into the market, equilibrium output rises, decreasing the debt to GDP ratio; Second, as the interest rate decreases, the government has to pay less proportional amount of interest for the same amount of debt. Once the debt is consolidated and the government pays lower interest for its debt, the government can afford higher quality in-kind benefits.

[8] This is in line with fiscal consolidation plans that were designed for the highly indebted OECD countries in the aftermath of the Global Financial crisis in 2008.

Figure 12: Transition path of aggregate variables. Partial equilibrium



Note: This figure shows the path followed by the main aggregate variables in this economy during the fiscal consolidation episode. All the variables are expressed in relative terms to their initial steady state value.

In figure 12, we can observe how aggregate consumption of benefits in-kind follows closely the shape described by the adjustment of the quality of this good being the opposite for the consumption of the private substitute path for all speeds of consolidations.

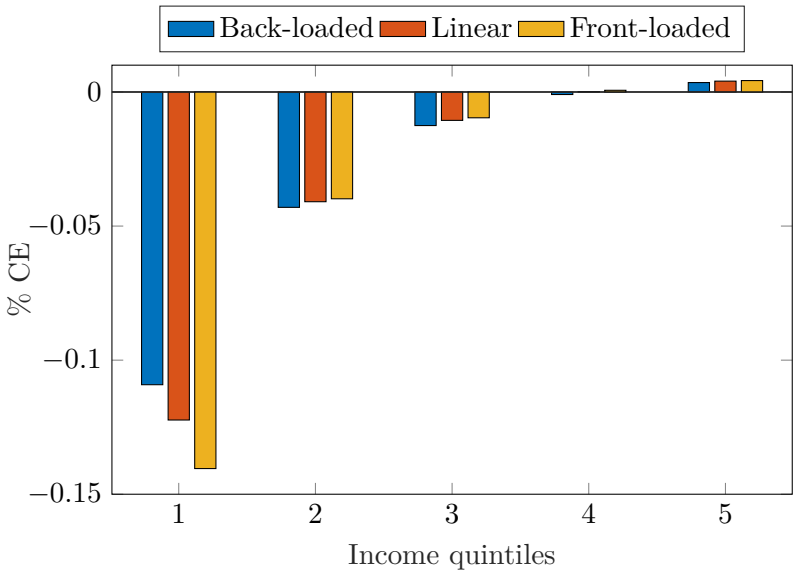
A front-loaded plan reduces most of the government debt in the initial years of the consolidation, producing a sharper adjustment of the fiscal instrument and the factor prices. Holding prices constant, the average cost of in-kind benefits is reduced by 11.35% of its initial value in the first year, and increases faster in the first third of the consolidation period up to a difference of 3.71% its pre-policy value and, smoothly increases afterwards.

A back-loaded plan slowly deleverages debt in the first consolidation periods and more quickly in the periods close to the consolidation deadline. This pattern involves a smoother adjustment of the instrument compared to the front-loaded plan. In this experiment, the quality is reduced by approximately 1.90% of the pre-policy value in the first year, and decreases abruptly to more than 10% of the initial value in less than seven years.

The linear plan is an intermediate alternative between the front-loaded and back-loaded plans. It displays a pattern for the instrument adjustment that resembles more to the proposed front-loaded plan than to the back-loaded plan. The quality of in-kind benefits decreases by slightly more than 6% in the first year of consolidation.

The sharp drop on both the average cost of provision of in-kind benefits for the government as well as the significantly lower demand for these goods boosts the primary surpluses that allow the government to consolidate debt faster. The opposite case is the back-loaded plan, in which neither the demand for in-kind benefits nor the quality is quickly adjusted. However, the total adjustment of both the demand of in-kind benefits and quality, even at its peak, is smaller than the adjustments in the front-loaded plan. As the back-loaded plan smoothly develops, sufficient decreases in the debt service cost have been achieved by the time in which the sharp adjustments need to be made.

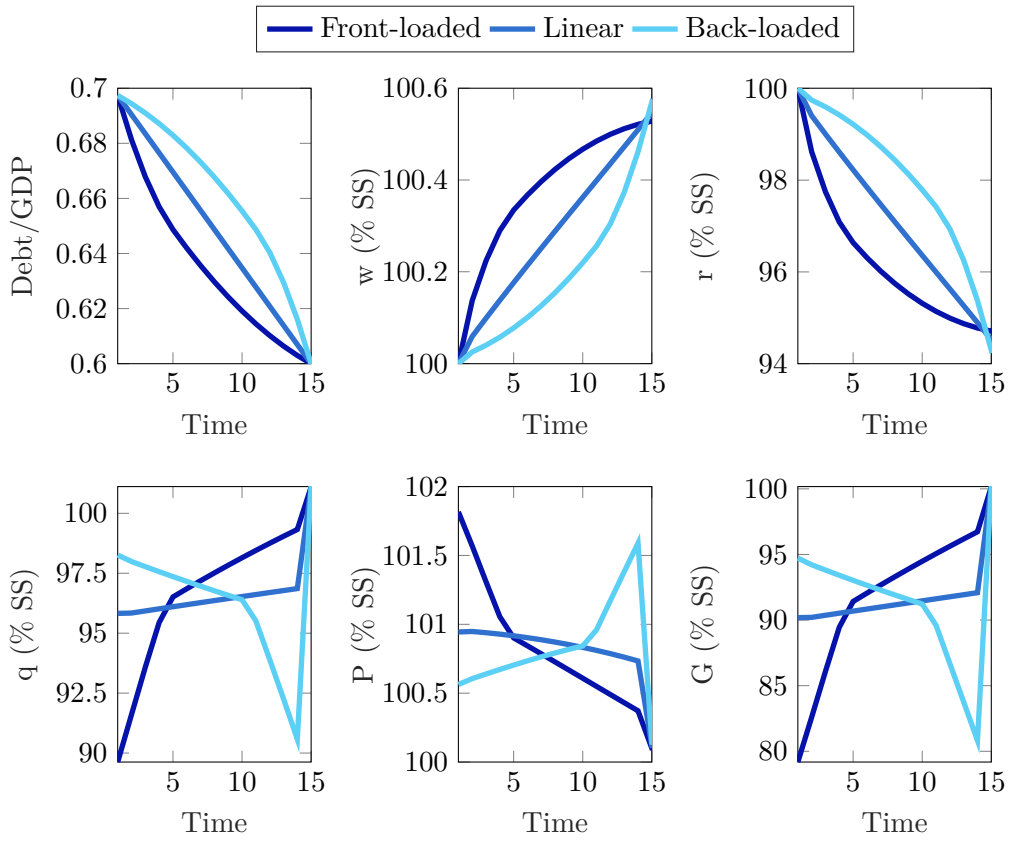
Figure 13: Welfare Effects in the Short-run. Partial equilibrium



According to their income profile, households will have heterogeneous welfare-effects, which are consistent in sign across different speeds. Holding prices constant, adjusting the quality at which in-kind benefits are provided results welfare-detrimental to households at the bottom (1st, 2nd and 3rd quintile) of the income distribution, almost welfare neutral to households in the 4rth quintile, and welfare-enhancing to the households in the upper part of the income distribution. This occurs because households at the bottom rely on the consumption of in-kind benefits to a greater extent than those at the top. Given a decrease in the quality of in-kind benefits, households with enough liquidity can afford to substitute these goods for private consumption, which yields higher utility. There are some distinctive differences in terms of preferences for the speed of fiscal consolidations, in this case: The preferred fiscal consolidation plan for the households in the first quintile is backloaded, whereas for households in all other income quintiles, the preferred fiscal consolidation plan is front-loaded. This occurs since households in the 1st quintile do not have enough income to substitute in-kind benefits by private consumption. In the 3rd, 4th and 5th quintiles, the slower the plan, the worse in terms of welfare for households as they discount the future and the rise in private consumption will materialise in a later period as a consequence of the smoother adjustment in the quality of the supplied in-kind benefits.

General equilibrium

Figure 14: Transition path of aggregate variables. General Equilibrium



Note: This figure shows the path followed by the main aggregate variables in this economy. All the variables are expressed in relative terms to their initial steady state value.

In the front-loaded plan, the quality of in-kind benefits decreases by 10% in the first consolidation year and then it increases all the way up to the end of the consolidation period. Around the 5th year of the consolidation period, the quality is only 3% lower than its initial value and, after that year, it increases smoothly until its final value.

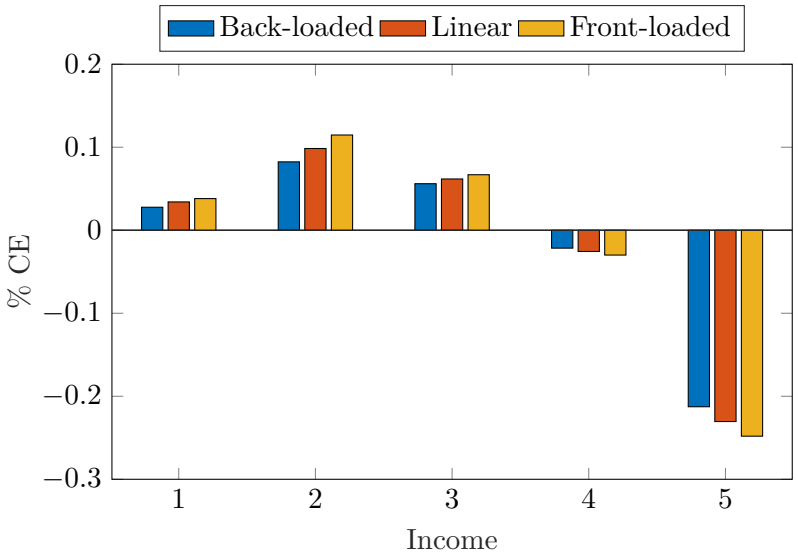
In the linear plan, the quality of the in-kind benefits is sharply reduced in the first consolidation periods by 4% and subsequently increased with a slight speed until the last years of the consolidation period, in which it increases rapidly.

Finally, in the back-loaded plan, in the first consolidation year, the quality of in-kind benefits decreases only by 2%, and this reduction is steady until we reach the 10th year of the consolidation period, where the cutback of the quality is remarkably fast until the 14th year, where it peaks a 9% difference with respect to the value of the initial quality and increases afterwards. The peak drops in the quality and aggregate demand of in-kind benefits have higher magnitudes in the front-loaded plan than in the back loaded plan. These values are lower than in the partial equilibrium analysis given that the crowding-in effects also alleviate the burden of the debt service costs by more than the amount of debt reduction.

During the transition, as quality of in-kind benefits adjusts, households substitute in-kind benefits for private goods. Across all consolidation speeds, the overall consumption of in-kind benefits

declines more significantly than the rise in consumption of its private counterpart. However, the magnitude of this increase is meager, since only housesholds with high income are able to afford extra units of private consumption.

Figure 15: Welfare Effects in the Short-run. General equilibrium



Allowing for factor prices' adjustments, the welfare effects map displays a different picture compared to the partial equilibrium outcomes. This fact suggests that general equilibrium effects dominate instrument effects for all households on aggregate, although for households in the first decile experience welfare losses. Households in the first income quintile experience negative welfare effects due to a decrease in the quality of provision of in-kind benefits although, on average, they are offset the positive effect of the increase on their liquidity. As we move to the right of the income distribution, the welfare gain becomes losses due to the negative effect of the decrease of interest rates adversely influencing their income as they rely to a greater extent on capital income.

As in partial equilibrium, the speed of fiscal consolidation plans amplifies both the gains and losses of fiscal consolidation, polarizing the outcomes of households in terms of welfare. Therefore, the preferred speed is the fastest for households that find this policy welfare-enhancing (1st, 2nd and 3rd quintile) and slowest for those who find it welfare-detrimental (4th and 5th).

In aggregate terms and under general equilibrium, the front-loaded plan emerges as the least detrimental to welfare. This approach prioritizes the welfare of most households, and the welfare reductions experienced by those in the top quintiles are outweighed by the gains seen in the bottom and middle quintiles. This stands in stark contrast to the preferred pace observed in partial equilibrium, where a back-loaded approach is favored. In both scenarios, the long-run gains associated with fiscal consolidations offset the short-run losses.

Table 11: Aggregate welfare change in partial and general equilibrium

	Long run	Short run		
		Back-loaded	Linear	Front-loaded
Partial Equilibrium	0.053 %	-0.032 %	-0.034 %	-0.037 %
General Equilibrium	0.066 %	-0.014 %	-0.013 %	-0.012 %

8 Conclusions

This paper studies the distributional welfare consequences of fiscal consolidation through a cut of public expenditure, specifically the decrease in the quality of in-kind benefits such as public health care and education. The results highlight the importance of allowing endogenous in-kind benefits consumption decisions for households and assuming inferiority of in-kind goods to accurately model consumption patterns that match the empirical distribution. The provision of in-kind benefits is shown to substantially reduce income inequality. Additionally, the analysis shows that in general equilibrium, all households except those in the top income quintile benefit from fiscal consolidation in the long run, with the lower income quintiles benefiting the most. This is due to the price effect induced by the crowding of private capital in the economy, which lowers the interest rate and raises the equilibrium wage.

In the short run, I find opposing effects: cuts on the quality of in-kind benefits disproportionately affect households at the bottom of the distribution as they rely on the consumption of these goods to a greater extent than households at the top, who are indifferent to this cut. Conversely, price changes triggered by fiscal consolidation improve the financial position of lower-income households while adversely affecting those at the top. This paper shows that in general equilibrium, price effects dominate the instrument effects. Therefore, allowing for factor prices to adjust during the fiscal consolidation yields opposite conclusions when it comes to the preferred speed: if prices are held constant, the preferred speed is back-loaded, whereas if prices adjust, the preferred speed is front-loaded. Additionally, price effects help ease the government's budget constraints, facilitating a smoother short-term adjustment even under rapid consolidation plans. Overall, this study provides crucial insights for policymakers in designing and implementing fiscal consolidation plans that minimize the detrimental welfare effects on households, particularly those in the lowest income quintiles.

A Numerical Computation of the Model

A.1 Long Run analysis: Steady State Computation

Since this model is composed of three types of agents, the coordination of those agents is given by the competitive equilibrium. Three parts compose the main algorithm in the steady state computation:

I. *Capital market loop*: Iteration on interest rate to ensure the capital market closes. It compares the guessed interest rate with the implied interest rate by the firm's capital optimality condition. The algorithm updates the interest rate until the guess and implied interest rate coincide. The update is done by a relaxation algorithm, where the damping parameters there the guessed interest rate are given a high weight 0.95 and the implied interest rate a low weight 0.05.

   i. *Government Budget constraint loop*: Choose parameter q (quality of in-kind benefit) to satisfy the government's budget constraint. The update is also performed through a relaxation algorithm.

      i) *Households problem*: Households maximize their expected lifetime utility subject to the budget constraint and an exogenous idiosyncratic productivity shock which follows an AR(1) process. The household problem is solved by using policy function iteration.

   ii. I check the goods market also clears to ensure that the reached equilibrium is a general equilibrium.

   iii. To assess the welfare effects, iteration obtains the value function, imposing the policy functions for private consumption, in-kind benefits consumption and savings. To keep the algorithm efficient, the computation of the value function is only performed once the steady state is reached for the long run analysis.

Policy Function Iteration
To solve the household problem, I employ policy function iteration. To that purpose, I build a grid of asset holdings and savings (which are the same for simplicity) with 200 grid points in an interval between $a_{min} = 0$ (ad hoc borrowing limit) and $a_{max} = 100$. The algorithm proceeds in the following steps:

i) Guess a private consumption level.

ii) Use the intratemporal Euler equation to solve for in-kind benefits consumption as a function of private consumption.

iii) Solve for savings from the budget constraint, which imposes the guess for consumption and the implied in-kind benefits of consumption, given the prices and the grid of current asset holdings.

iv) Construct the right hand side of the Intertemporal Euler Equation with the implied savings.

v) *Optimize*: Solve for the level of consumption that satisfies the Intertemporal Euler Equation.

vi) Iterate until the private consumption policy function reaches a fixed point for a tolerance level of 10^{-10}.

A.1.1 Transitions

The transition dynamics are solved using a shooting algorithm. First, to fix the path the instrument will follow, the quality will clear the government budget constraint of the in-kind good, as in the steady state.
The algorithm consists of the following steps:

1. Given a path of debt consolidation, quality of in-kind benefits, initial and final prices, guess a path for the prices along the transition.
2. Capital market loop:
   - Government budget constraint loop: Choose a path of the instrument to ensure that the budget constraint of the government is satisfied every period.
     i. *Backwards iteration*: Given the right hand side of the Euler Equation in the final steady state for each asset holding and productivity levels, with the price guess and quality (user-cost) of in-kind good path, solve the household problem by backwards iteration. That is, we construct the path of value functions from the final period T up to the initial one.
     ii. *Forward iteration*: Given the policy functions obtained in the previous step, we can construct the path of aggregate variables (consumption, in-kind benefits, assets) along the transition. This can be done either by Monte Carlo simulation or by using the pmf $\lambda(a, \epsilon)$ distribution. I employ the last option, given that it yields more efficient results.
     iii. *Update*: Compute the implied value of the instrument along the transition, and if the maximum discrepancy between the guess of the instrument path and the implied value is higher than the tolerance level chosen (10^{-6}), then the instrument path is updated using a relaxation algorithm.
   - Given the capital path supplied by households, we subtract from the of government's debt, and this difference accounts for the capital hired by the firm. We compute, then, the interest rate implied by this capital level at each period of the transition.
   - *Update*: We compare the discrepancies between the initial guess and the implied guess for interest rate paths, and if they are greater than the tolerance considered, we update the guess by a fixed coefficient method: Giving a weight of 0.9 to the initial guess of the interest rate path and 0.1 to the implied path. If the discrepancies are lower than the tolerance level (10^{-6}), then the transition path is obtained.

B Data

B.1 Earnings process

To estimate the earnings process, I use data from the British Household Panel Survey (BHPS) from 1996-2008. The results are based on observations only from the original BHPS sample. The letter w denotes the wave. As the waves used for this analysis correspond to 1996-2008, the letters are f-r.

I depart from the whole sample of the original BHPS from 1996-2008 following De Nardi et al. (2019). First, observations that yield partial and not complete interviews are dropped. Following De Nardi et al. (2019), I drop observations of labor income lower than 5% of the median of the corresponding year. In 2008, these were heads of households with a yearly income lower than £1072.35 in 2015. Furthermore, I trim the top and bottom 1% of the resulting income growth distribution as in Angelopoulos et al. (2020) and Storesletten et al. (2004). This leads to a total of 20.918 observations.

The variables employed for this analysis are individual yearly labor income wfiyrl for the head of the household whoh. The variables wsex, wage, wregion, and wqfedhi indicate the sex, age, region of residence, and education level of the respondent.

First, income in nominal terms is converted to real terms using the CPI for 2015. Then, it is converted to its natural logarithm. The logarithm of yearly labor income is then is residualized by regressing education, age, year, gender of the head of the households, and region effects as in Angelopoulos et al. (2020).[9].The residualized income is used to compute labor income growth statistics. Income growth is calculated as the difference in the logarithm of income. As the sample comes from a complex survey design and is therefore not a random sample, survey weights are used for the estimation. The earnings process is estimated by the method of simulated moments, an algorithm that searches the parameter values that yield a closer fit to the target empirical moments and is given a specified model through a minimum distance criterium. In this case, the model is GMAR. The weighting matrix is the identity matrix.

B.2 In-kind benefits imputed income distribution

In order to investigate the redistributive role of the provision of in-kind benefits, I employ the textitEffect of taxes and benefits on household income dataset provided by the Office of National Statistics. The effects of taxes and benefits on household income (ETB) is an annual dataset from 1977 onwards. ETB provides a quantitative analysis of the effects of government intervention (through taxes and benefits) on the income of private households in the UK. ETB uses data from the Living Cost and Food Survey (LCF). Since 2017, it also includes income information from the Survey on Living Conditions (SLC), allowing a sample size of approximately 17000 households. Furthermore, since this survey does not cover sufficiently the wealthiest households, using information from the HM Revenues 'Survey of Personal Incomes', the database is adjusted to represent incomes and the number of households more accurately at the top of the income distribution.

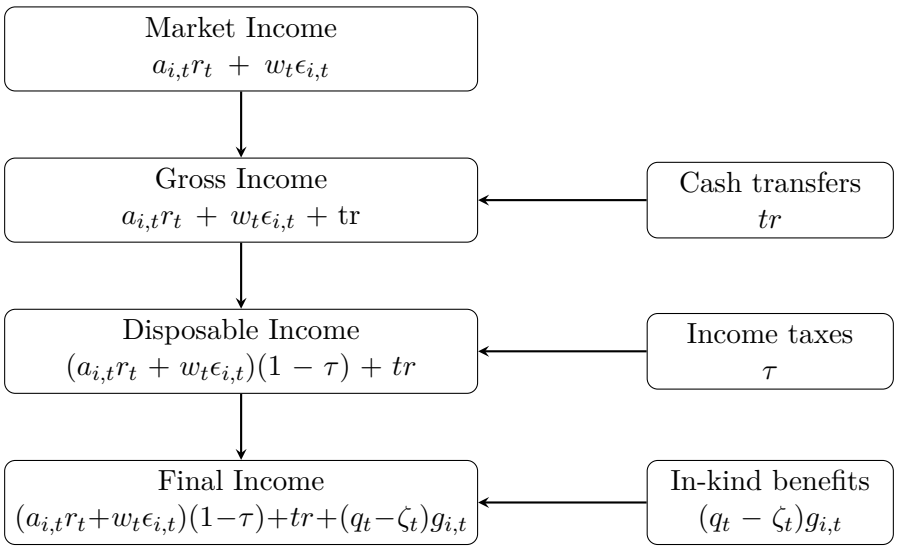
[9]The statistics for income growth are robust to the inclusion of education, year, age squared and region of the head of the household as well as the inclusion of fixed effects.

The imputation of in-kind benefits comes from the information provided in the LCF. The ETB imputes the cost yield by the government to households if, according to their information, there is a reasonable basis for allocating such costs. In short: the education imputed cost is allocated to households that report that have children in state education in the LCF survey. Households that report children in private schools are not allocated such costs. The NHS cost is imputed according to the estimated usage of NHS by groups of age and sex, also accounting for a deprivation factor that depends on the region in which the household lives.

I consider data for the financial year ending 2017 and nonretired households. First, the values of the variables are annualized in line with the calibration frequency. The initial distribution of average in-kind benefits imputed consumption is obtained by summing the yearly values of imputed in-kind benefits consumption for Education and National Health Service and computing means by equivalized original income quintiles. Original income refers to the sum of income from labor (employment and self-employment), investment income, private pensions, and annuities. Equalization is done using the modified OECD scale. As the observations from the survey do not come from a random sample, the survey weights are used for this analysis.

C Redistributive Scheme

Figure 16: Redistributive scheme



D Consumption Equivalent

Let the lifetime utility of household i with assets a and productivity ϵ in the initial steady state be denoted by $V_i(a, \epsilon)$, and defined as follows:

$$V_i(a,\epsilon) = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \Big\{ \frac{c_{i,t}^{1-\gamma}}{1-\gamma} + \frac{\left(\frac{p_{i,t}^{1-\eta}}{1-\eta} + d\frac{(q_t g_{i,t})^{1-\varphi}}{1-\varphi} \right)^{1-\gamma}}{1-\gamma} | a, \epsilon \Big\} \right]$$

$$U_i^{\vartheta}(a,x) = \mathbb{E}_0\left[\sum_{t=0}^{\infty}\beta^t\Big\{\frac{[c_{i,t}(1+\vartheta)]^{1-\gamma}}{1-\gamma} + \frac{\left(\frac{p_{i,t}^{1-\eta}}{1-\eta} + d\frac{(q_t g_{i,t})^{1-\varphi}}{1-\varphi}\right)^{1-\gamma}}{1-\gamma}\Big\}\right]$$

$$= \mathbb{E}_0\left[\sum_{t=0}^{\infty}\beta^t\Big\{\frac{[c_{i,t}(1+\vartheta)]^{1-\gamma}}{1-\gamma} - \frac{c_{i,t}^{1-\gamma}}{1-\gamma} + \frac{c_{i,t}^{1-\gamma}}{1-\gamma} + \frac{\left(\frac{p_{i,t}^{1-\eta}}{1-\eta} + d\frac{(q_t g_{i,t})^{1-\varphi}}{1-\varphi}\right)^{1-\gamma}}{1-\gamma}\Big\}\right]$$

$$= \mathbb{E}_0\left[\sum_{t=0}^{\infty}\beta^t\Big\{[(1+\vartheta)^{1-\gamma}-1]\frac{c_{i,t}^{1-\gamma}}{1-\gamma}\Big\}\right] + V_i(a,\epsilon)$$

$$= [(1+\vartheta)^{1-\gamma}-1]\mathcal{C}(a,\epsilon) + V_i(a,\epsilon)$$

where $\mathcal{C}(a,\epsilon) = \frac{c_{i,t}^{1-\gamma}}{1-\gamma}$ is computed using policy function iteration in the initial steady state.

Let the value function of household i in the post-policy economy be denoted by $V_i^1(a,\epsilon)$. The consumption equivalent for household i $\vartheta_i(a,\epsilon)$ is defined as:

$$\vartheta_i(a,\epsilon) = \left[\frac{V_i^1(a,\epsilon) - V_i^0(a,\epsilon)}{\mathcal{C}(a,\epsilon)} + 1\right]^{\frac{1}{1-\gamma}} - 1$$

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