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

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Abstract

This paper investigates the welfare effects of fiscal consolidation plans that involve cuts in social expenditure, using a model with heterogeneous agents and incomplete markets. The study makes two key contributions. Firstly, it proposes a new approach to modeling social expenditure consumption by households, which generates a consumption distribution consistent with empirical evidence. The provision of in-kind benefits is shown to play a critical role in reducing household income inequality. Secondly, the paper assesses the distributional welfare consequences in both the short and long term of public debt deleveraging, considering different speeds and instruments for consolidation. The findings indicate that the welfare gains in the long run associated with consolidation through social expenditure retrenchments outweigh the short-term welfare losses. Households in the lowest income quintiles benefit the most in the long run, but also experience the most significant short-term negative impacts during the consolidation if we exclude price effects. The plausibility of the price effects generated during fiscal consolidation is crucial in determining the distributional welfare consequences of such a plan, as well as the most preferred speed for consolidation. Overall, this study provides insights into the effects of fiscal policy on welfare and income inequality, which are crucial for policymakers when designing and implementing public policies.

JEL: E21, E62, H42,H51, H52, H63

Keywords: Fiscal Policy, Sovereign Debt, Government Spending, Public Expenditure, In-kind benefits

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All errors are my own.

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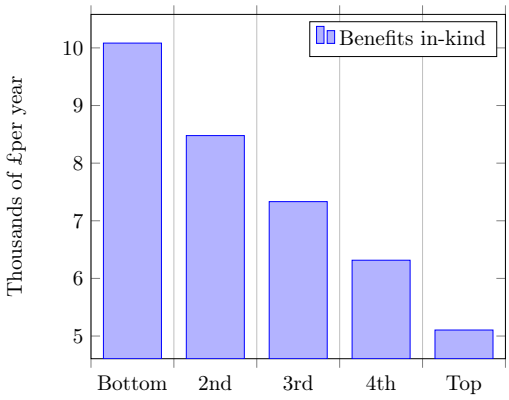
1 Introduction

During the COVID-19 pandemic, most developed economies witnessed a dramatic increase in debt-to-GDP ratios as the governments provided fiscal stimulus packages to alleviate the economic downturn caused by lockdowns. Once economies stabilize, the high and unsustainable debt accumulated during the pandemic and the increase in interest rates from central banks call for fiscal consolidation plans. The critical question is what instrument to employ to attain a lower debt level and what distributional effects they provoke in the economy. Alesina et al. (2015) showed that expenditure-based fiscal consolidations were less growth detrimental than tax-based in the short run.

Given this advantage of austerity measures, it is worth examining the items we can find in public expenditure. In particular, we can distinguish items with different natures: public goods, in-kind benefits, and cash transfers. Public goods, such as the military, are nonexcludable and nonrival and are assumed to benefit all households equally. In-kind benefits, such as public health care and education services, are goods with private nature, in the sense that they are excludable and rival but provided by the government.

Figure 1: Average imputed benefits in-kind by equivalised income quintiles for UK FYE 2017



Remarks: 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. Source: ETB.

Do households consume in-kind benefits differently according to their income profile? Figure 1 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. A sizable share of the government's

budget goes into the provision of in-kind benefits, yet the scholarship is still exploring the incidence of their redistributive role. Since households choose how much to consume of these goods to generate primary surpluses, 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.

The questions I address in this study are: What is the distributional welfare consequences of fiscal consolidations based on in-kind benefits expenditure cuts in the short and long run? Do these instruments generate different effects? How is income inequality affected by fiscal consolidation in the short and long run? What impact does the speed of the consolidation have on household welfare? 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. The paper'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 social expenditure, considering two types of instruments: the quality of provision and the user-cost 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 paper is the first to explicitly incorporate the choice of in-kind benefits consumption in a general equilibrium 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 goods, 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 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 10.96%.

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. This is because the crowding out of private capital in the economy reduces the interest rate and increases the equilibrium wage. The results suggest that the positive long-term effects are not offset by detrimental welfare effects in the short run. Specifically, households in the lowest quintiles benefit the most in the long run, while they are the most affected by the consolidation in the short run, when excluding price effects. The plausibility of the price effects resulting from fiscal consolidation is crucial in determining the distributional welfare consequences of such a plan, as they dominate the instrument effects.

The long and short run effects of an adjustment in the user cost of in-kind benefits are higher in absolute value than those of the provided quality of in-kind benefits in both general and partial equilibrium. Therefore, easing access to public health care and education is marginally preferred by households compared to improving the quality of public health care and education in the long run if factor prices adjust. However, the opposite holds in the short run. In terms of speed, the preferred fiscal consolidation speed is linear in general equilibrium. In contrast, if factor prices do not respond to the fiscal consolidation, the least welfare-detrimental speed for consolidation is back-loaded.

The remaining paper is organized as follows: In section 2, I elaborate on how this paper is connected with previously existing literature. In section 3, I explain in detail the model employed, and section 4 details the calibration of the latter. Section 5 explores the redistributive role of in-kind benefits, section 6 is devoted to the analysis of the results, and 7 concludes.

2 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.

Finally, considering the literature of fiscal consolidation plans, my paper is closely related to Romei (2017) and Rorhs and Winter (2017), as they study fiscal consolidation plans under different instruments. From Romei (2017), 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. The source of the disagreement about their preferred fiscal consolidation policy is the differences in asset holdings across types of households. In Rohrs 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. (2018) 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 Rohrs 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, Floden (2000) 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. Although the social expenditure concept that these authors consider also consists of private goods provided by the government for redistribution, assuming that social spending takes the form of a transfer has two main implications: first, the government decides how much each household consumes of this good, and second, that given the transfer, the household can decide to spend it on a good of a quality of their choice.

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.

3 The 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.

3.1 Households

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

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

Households are subject to idiosyncratic productivity shocks $\varepsilon_{i,t}$ which follow a GMAR 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 [1], households will accumulate precautionary savings in order to insure themselves against future productivity shocks.

Each household i solves the following recursive problem:

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

[1] In addition to the presence of prudence according to the utility function

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:

$$u_c(c_i, qg_i) = \frac{u_g(c_i, qg_i)}{\zeta} \tag{1}$$

$$u_c(c_i, qg_i) = \beta\left(1 + r(1-\tau)\right)\mathbb{E}_t\{u_c(c_i', q'g_i')\} \tag{2}$$

3.2 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 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:

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

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

3.3 Government

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

$$D_t(1 + r_t) + (q_t - \zeta_t)\int_{i \in I} g_{i,t} di + \Omega + tr = D_{t+1} + \tau_t(A_t r_t + w_t L_t) \tag{3}$$

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. In other words, there is a single saving instrument available

for households.

Households endogenously choose how much to consume of in-kind benefits, and the government provides all these units subject to a fixed budget cap $q_t \int_{i \in I} g_{i,t} di$. The quality of the provided in-kind benefits, q_t, is the variable of interest for the adjustment of total expenditure on in-kind benefits. q_t is the cost of the government per 1 unit of in-kind benefit production in terms of the price of private goods[2]. This specification assumes that government purchases goods in the private market and transforms them into in-kind benefits. In reality, the government also purchases services from the private sector to cover the needs for in-kind benefits provision although not the total expenditure, as this model assumes. One unit of the private good input equals $1/q_t$ units of the in-kind benefits.

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. In this paper, both q_t and ζ_t are considered variables of adjustment for the government's budget constraint.

3.4 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* $c : \mathcal{Z} \times \mathcal{M} \to \mathbb{R}$ *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 being the associated policy functions, given r and w*

[2]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, 2017) 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 implicit assumption in this setting is that the cost that the government incurs to produce one unit of in-kind benefits affect one-to-one to the perceived quality of in-kind benefits by households. In this paper, I abstract from status-seeking, intergenerational transmission, and political preferences motives for consumption of private education.

(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:*

$K + D = \int a(a, \varepsilon) d\lambda(a, \varepsilon)$

$L = \int \varepsilon l(a, \varepsilon) d\lambda(a, \varepsilon)$

$\int c(a, \varepsilon) d\lambda(a, \varepsilon) + q \int g(a, \varepsilon) d\lambda(a, \varepsilon) + \Omega = F(K, L) - K(\delta)$

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

(v) λ *remains constant for all* $(\mathcal{A}, \mathcal{E})$:

$\lambda(a', \varepsilon') = \sum_{\varepsilon \in \mathcal{E}} \pi(\varepsilon'|\varepsilon) \lambda(a, \varepsilon)$

Let the initial distribution be λ^*

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* $\{c_t, g_t, a_{t+1}\}_{t=0}^{\infty}$*, 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* $\{q_t\}_{t=0}^{\infty}$ *or user-cost of in-kind benefits* $\{\zeta_t\}_{t=0}^{\infty}$ *with a constant income tax* τ *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* $a_{t+1}(a, \varepsilon)$,$c_t(a, \varepsilon)$ *and* $g_t(a, \varepsilon)$ *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:*

$K_{t+1} + D_{t+1} = \int a_{t+1}(a, \varepsilon) d\lambda_t(a, \varepsilon)$

(iv) *Labor market clears:*

$L_t = \int \varepsilon l_t(a, \varepsilon) d\lambda_t(a, \varepsilon)$

(v) *Goods market clears:*

$\int c_t(a, \varepsilon) d\lambda_t(a, \varepsilon) + q_t \int g_t(a, \varepsilon) d\lambda_t(a, \varepsilon) + K_{t+1} - K_t(1 + \delta) + \Omega = F(K_t, L_t)$

(vi) *Goverment's budget constraint is satisfied:*

$D_t(1 + r_t) + \int_{i \in I} (q_t - \zeta_t) g_{i,t} di = D_{t+1} + \tau_t(A_t r_t + w_t L_t)$

4 Calibration

In the following table, there is a summary of the selected value of the relevant parameters for the model, accompanied by the targeted or source value. The model is calibrated to target features of the United Kingdom in 2017. The model is calibrated in annual frequency.

Parameter	Value	Source/Target
Households		
Discount factor β	0.9762	$\frac{K}{Y}$ =3.3 UK economy 2017
Risk aversion γ	2	Standard value in literature
Borrowing constraint ϕ	0	Households not allowed to borrow
d	0.155	Share of expenditure of the government in health and education to GDP 9.76%
η	-0.115	Ratio of bottom to top quintiles average consumption of in-kind benefits 1.97
φ	0.4	Bottom average consumption of in-kind benefits 10'083 £per year
Productivity process		Jointly calibrated
μ_1	0.0157	
p	0.8784	
σ_1	0.1431	
σ_2	0.6633	
ρ	0.9531	
Firms		
Capital share in GDP α	0.3	Bhattarai and Trzeciakiewicz (2017)
Depreciation rate δ	0.07	Trabandt and Uhglig (2011)
Government		
Quality of the supplied in-kind good q_t	0.56	Ratio of cost of in-kind benefits to price of the private goods
Proportional tax rate τ	0.29	Bhattarai and Trzeciakiewicz (2017)
Debt over GDP,D	0.6973	Share of securities of the UK government 2017 domestically held
User cost of in-kind good ζ	0.1804	Ratio of out-of-pocket and tuition fees to price of private goods
Residual government expenditure Ω	0.0164	Balance government's budget constraint
Lump-sum transfers tr	0.2402	Total cash transfers 12.6% of GDP

Table 1: Summary of parameter values

4.1 Households

4.1.1 Utility function

To account for a decreasing pattern of consumption of benefit in-kind with income, I considered a utility function in which one of the goods exhibits an inferior behavior. In this line, Mankiw, Rotemberg, Summers (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:

$$u(c_{i,t}, g_{i,t}) = \frac{\left(\frac{c_{i,t}^{1-\eta}}{1-\eta} + d\frac{(q_t g_{i,t})^{1-\varphi}}{1-\varphi}\right)^{1-\gamma}}{1-\gamma}$$

From the intratemporal condition, 1 we obtain:

$$g_{i,t} = \left(\frac{dq_t^{1-\varphi}}{\zeta_t} \right)^{1/\varphi} c_{i,t}^{\frac{\eta}{\varphi}}$$

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.

Parameters φ, η and d are calibrated to match some features of the distribution of imputed average kind benefits consumption by income quintiles. In particular, d is set to match the aggregate expenditure of the government in health and education services, φ to match the average imputed consumption of in-kind benefits in the first quintile of income, and η is set to match the ratio between the first and the fifth quintile.

The initial value of the parameter ζ_t measures the average user cost that the households have to incur to consume in-kind benefits over the average price of the private substitute of these goods[3]. For education, the user costs are given by university fees and health care, by the out-of-pocket money paid by households. This ratio equals 0.1804, which means the user cost of in-kind benefits represents 18.04% of the price of the private substitute.

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

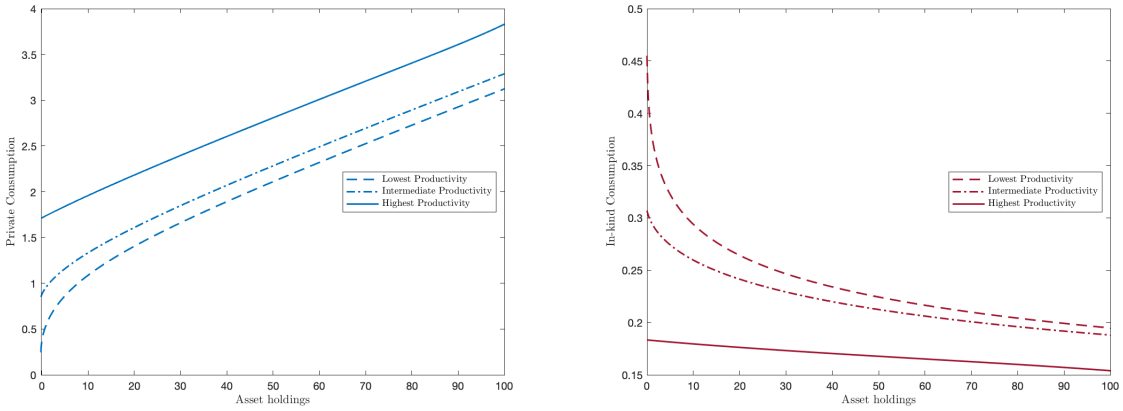


Figure 2: Private and In-kind benefits consumption policy functions

[3]Further details of the calibration can be found on the Appendix.

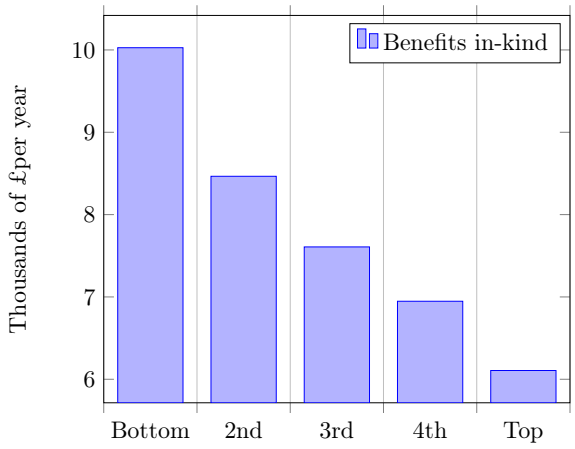


Figure 3: Average imputed benefits in-kind by income quintiles

In Figure 2, policy functions of private and publicly provided goods as a function of current asset holdings for different productivity shocks are displayed. The first thing to note is that for low asset holdings and lowest productivity state is how private and public consumption sensitively reacts in opposite directions to higher levels of asset holdings. As expected, the in-kind benefit consumption decreases for higher asset holdings and productivity levels.

Table 2: In-kind benefits consumption distribution and aggregates

	Q1	Q2	Q3	Q4	Q5	Q1/Q5	Aggregate Expenditure to GDP
Data	£ 10083.21	£ 8478.27	£ 7332.25	£ 6315.66	£ 5104.45	1.97	9.76%
Model	£ 10027.05	£ 8465.42	£ 7607.54	£ 6947.58	£ 6106.43	1.64	6.28%

In Figure 3 the average imputed consumption of in-kind benefits by income quintiles in steady state is displayed. The pattern of decrease in in-kind benefits consumption is sharp, although not enough to match the ratio of top to bottom consumption of in-kind benefits observed.

Finally, the risk aversion parameter γ is equal to 2, which is a widely used parameter in the literature, and the borrowing limit ϕ is set to zero.

4.1.2 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 calibrate $(\rho, p, \mu_1, \sigma_1, \sigma_2)$ as μ_2 is pinned down by $p\mu_1 + (1-p)\mu_2$. Regarding the calibration targets, I follow Ferriere et al. (2022) closely and target the next moments of income growth[4]: the standard deviation, 0.2694; the skewness, -0.804639; kurtosis, 13.6389; 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 3: Distribution of Original income

	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

Notes: Original income consists on earnings, private pensions and investments. Source: ETB. Data for financial year ending 2017, non retired households.

Table 4: 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

Notes: Households aged 25-65. Source: ETB

Table 5: 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	0.00%	1.91%	8.43%	22.41%	68.12%	46.77%	0.67

Notes: Households 25-65. Source: WAS

[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.

4.2 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 Uhglig(2011).

4.3 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% and the post consolidation debt level to 60% of GDP. 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 (2017).

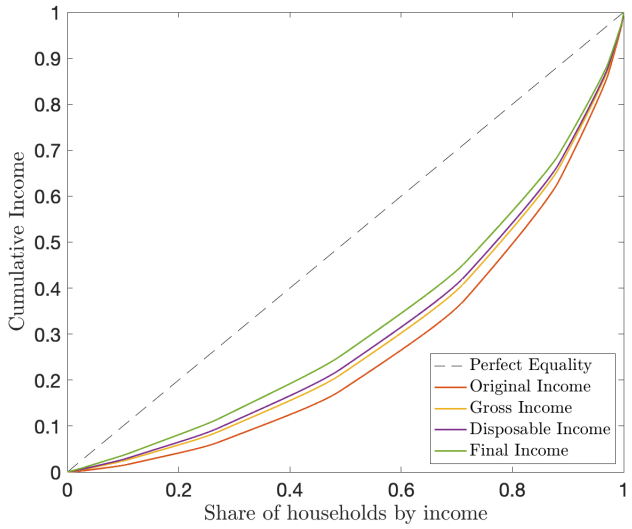
The parameter q_t measures the unit cost paid by the government for in-kind benefits. This identification strategy is consistent with the methodology employed by the ONS to compute the imputed in-kind consumption distribution. For education, the imputed cost is given by the expenditure per pupil, and for health care by expenditure per capita. The resulting parameter implies that the government pays 0.58% of the price of the private substitute for in-kind benefits. 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.

5 Redistributive role of in-kind benefits

In this section, I will quantify the redistribution impact of the tax and benefit system considered in this model. First, let us define the following income concepts: Original income (or Market income), which is the income that households obtain from capital and labor; Gross income, which includes cash transfers received by households and the Original 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].

[6]see Figure C in the Appendix

Figure 4: Lorenz Curves



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

In Figure 5, 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 0.4615 to 0.3926 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 0.3496, which represents a 24.25% decrease with respect to the original income Gini index.

	Gini
Original Income	0.4615
Gross Income	0.4104
Post-tax income	0.3926
Final Income	0.3496

Similarly to Christl 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 decreases by 10.96%, 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.

6 Results

In this section, I analyze the welfare effects of a fiscal consolidation performed through a decrease in the quality of the in-kind benefits provided by the government and a hike in the user-cost of in-kind benefits [7]. 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 or ζ_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.

6.1 Welfare Measure

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

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

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

[7] Both experiments are independently carried out.

To study the preferences for different types of households for fiscal consolidation plans, I employ one-period consumption equivalent or conditional welfare change [8]. This measure consists of the share of consumption in the first period 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.

$$u\left(c^*_{pre}(1+\vartheta), q_{pre}g^*_{pre}\right) + \mathbb{E}_0 \sum_{t=1}^{\infty} \beta^t \left(u(c^*_{pre}, q_{pre}g^*_{pre})\right) = \mathcal{W}_{post}(c^*_{post}, q_{post}g^*_{post})$$

If a given household exhibits a positive consumption equivalent, this means the carried out 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 tells 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:

[8] Typically, consumption equivalent measures the share of consumption a household is willing to give up *every period*. However, due to the non-linearity of the utility function I am choosing, a one-period consumption equivalent is better suited for a welfare analysis. Other authors also employ this measure, for instance Sims and Wolff (2018).

i) **Price effects**: As the government reduces debt, private capital crowds in the economy (Rohrs and Winter, 2017), which lowers the interest rate. 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.

ii) **Instrument effects**: As the quality of in-kind benefits increases or the user cost of decreases, this increases the welfare of all households consuming this good. If, on the contrary, there is a decrease on the quality (increase on the user-cost) of in-kind benefits, households with enough income can substitute the consumption of in-kind benefits by private consumption. 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.

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 Θ as the aggregate welfare change conditional on the initial distribution $\lambda_{t=0}(a, \varepsilon)$:

$$\Theta = \int \vartheta(a, \varepsilon)\lambda_{t=0}(a, \varepsilon) \tag{4}$$

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.

6.2 Long Run Analysis

6.2.1 Quality of in-kind Benefits

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 is calibrated to display 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. The aggregate welfare increases in the long run, holding prices constant equals 2.543%.

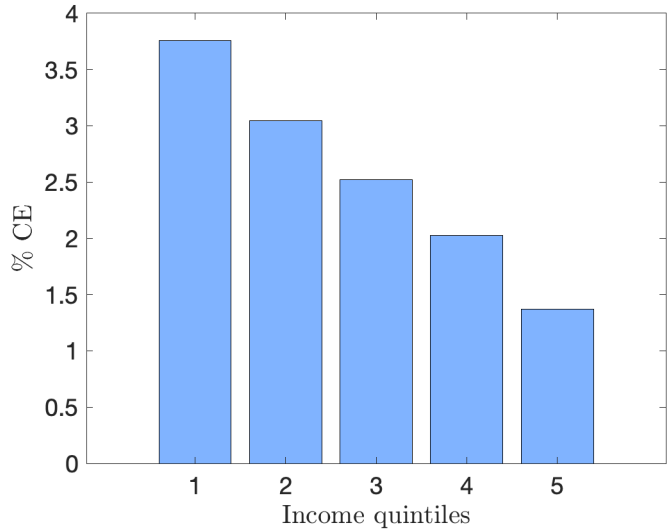


Figure 5: Long-run welfare effects in Partial Equilibrium

General Equilibrium

If we now consider price adjustments associated with the fiscal consolidation, 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 6. 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.

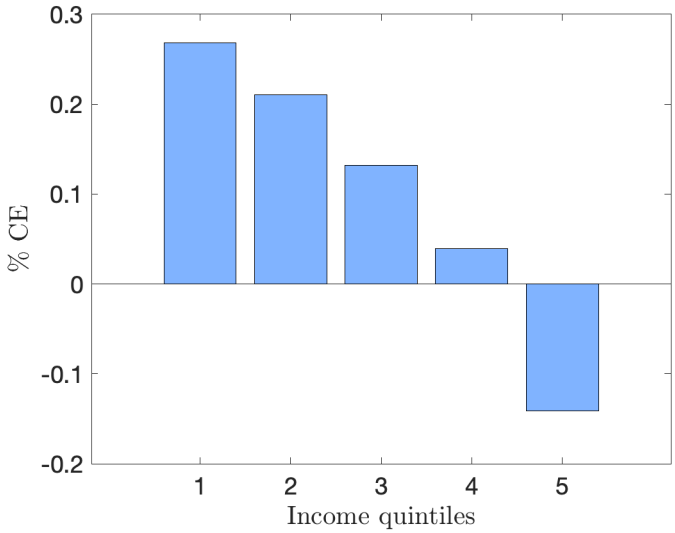


Figure 6: Long-run welfare effects in General Equilibrium

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 is 2.742%, 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. This increase in welfare in the first three quintiles offsets the negative effect of the welfare of households in the last income quintile.

6.2.2 User-cost of In-kind Benefits

Partial Equilibrium

In the long run, holding prices constant, analogously to an increase of quality of in-kind benefits, a decrease of the user cost 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.

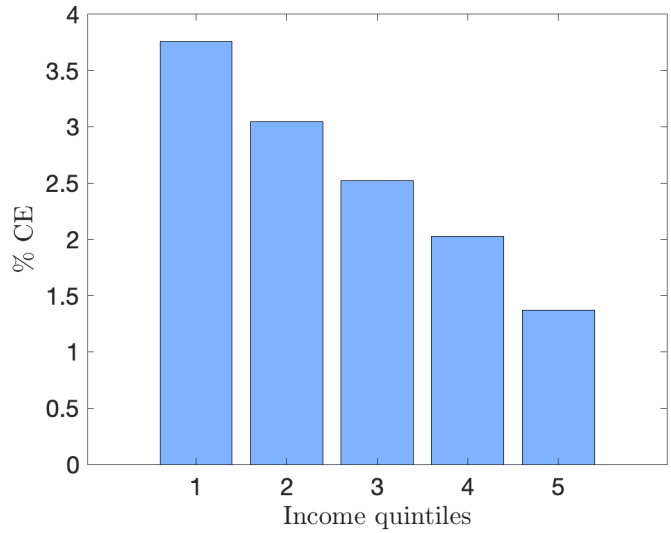


Figure 7: Long-run welfare effects in Partial Equilibrium

General Equilibrium

Figure (8) shows the welfare effects of an adjustment in the user cost of in-kind benefits in the long run. Both the distributional pattern and the magnitudes are similar to the quality of in-kind benefits adjustment.

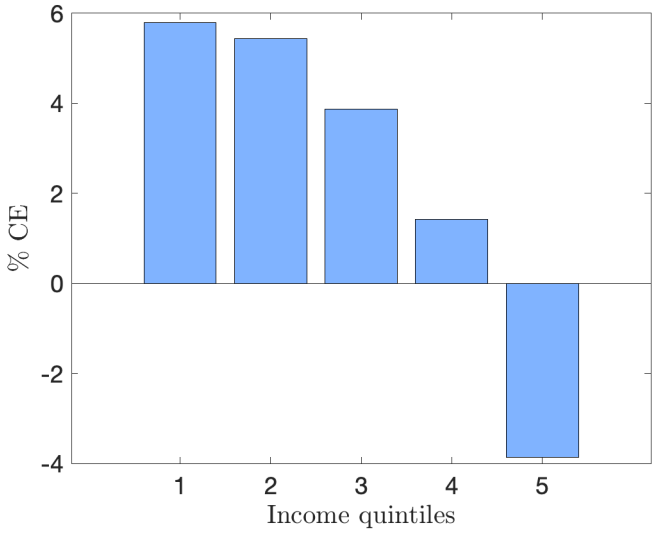


Figure 8: Long-run welfare effects in General Equilibrium

6.3 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 [9] 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.

6.3.1 Quality of in-kind benefits

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. Once the debt is consolidated and the government pays lower interest for its debt, the government can afford higher quality in-kind benefits.

[9] 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.

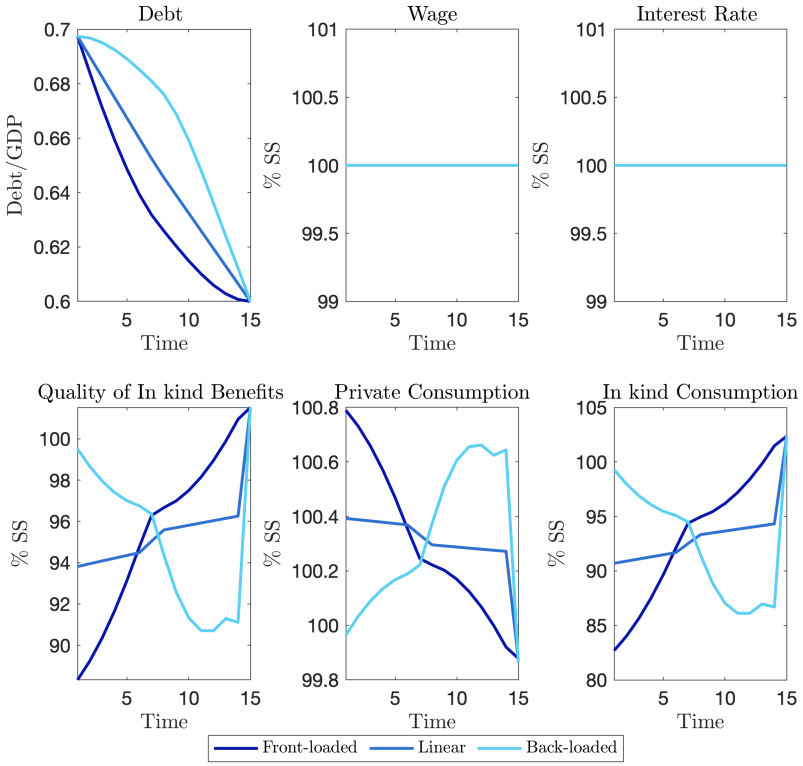


Figure 9: Transition path of aggregate variables. Partial equilibrium

Note: The dark blue line represents the front-loaded consolidation, the middle blue line linear consolidation and light blue back-loaded plan.

Figure 9 shows the path followed by the main aggregate variables in this economy. 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 private consumption 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 around 12% of its initial value in the first year, and increases faster in the first half of the consolidation period up to a difference of 4% its initial value and, smoothly increases afterwards. The value of the average cost of in-kind benefits is 1.541% higher than the pre-consolidation value. 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 4% of the initial value by half of the consolidation span 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 speed of the expansion in the quality of in-kind benefits increases three times: after the fifth year, halfway through the consolidation period, and in the final year. These changes in speed have to do with the shape of the debt path. 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.

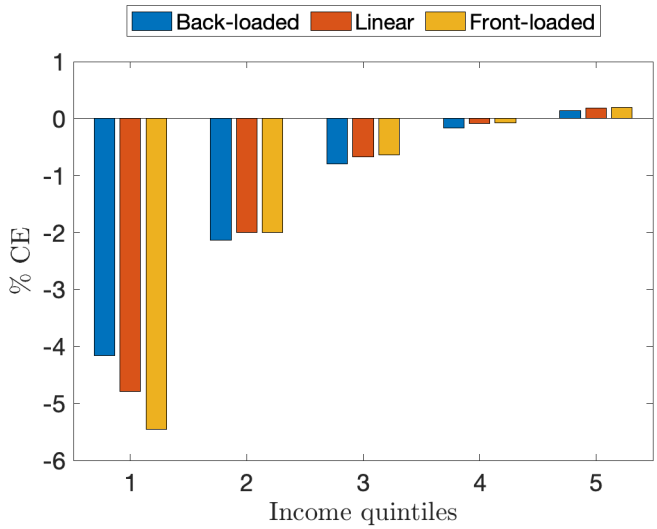


Figure 10: Welfare Effects in the Short-run. Partial equilibrium

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

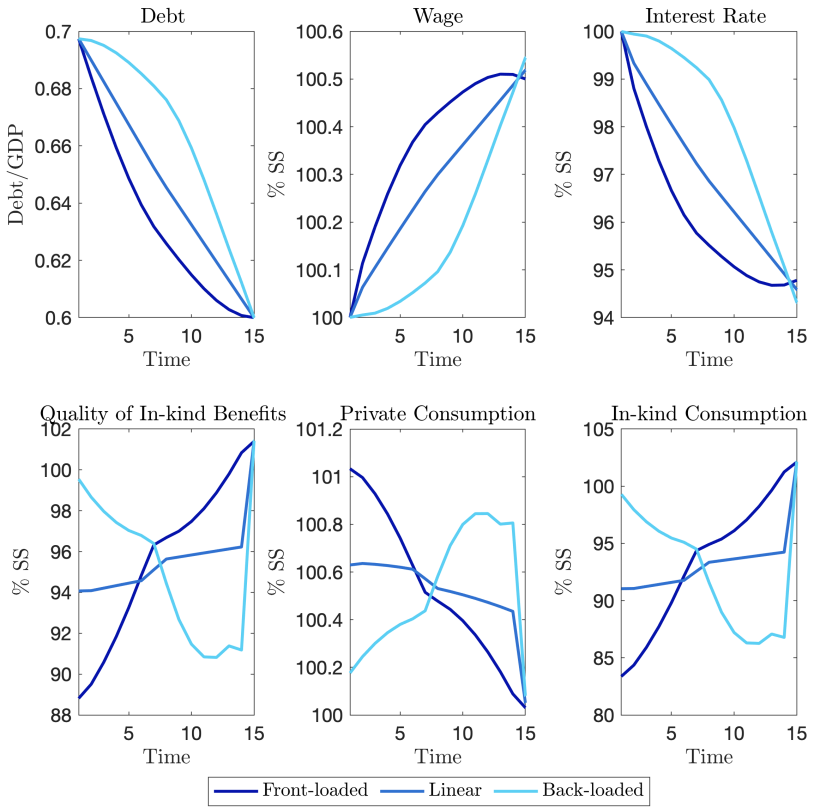


Figure 11: Transition path of aggregate variables. General Equilibrium

Note: The dark blue line represents the front-loaded consolidation, the middle blue line linear consolidation and light blue back-loaded plan.

In the front-loaded plan, the quality of in-kind benefits decreases by 11% in the first consolidation year and then it increases all the way up to the end of the consolidation period. Around the 7th year of the consolidation period, the quality is only 3.5% lower than its initial value and, after that year, it increases smoothly until its final value, which is 1.4% higher than the initial one. In the back-loaded plan, in the first consolidation year, the quality of in-kind benefits decreases by less than 1%, and this reduction is steady until we reach the half of the consolidation period, where the cutback of the quality is remarkably fast until the 12th year, where it peaks a 9% difference with respect to the value of the initial quality and increases afterwards.

Finally, in the linear plan, the quality of the in-kind benefits is sharply reduced in the first consolidation periods by 6% and subsequently increased with a slight speed until the last years of the consolidation period, in which it increases rapidly.

During the transition, as quality of in-kind benefits adjusts, households substitute in-kind benefits for private goods. In the front-loaded plan, the aggregate consumption of in-kind benefits drops up to 16% of its initial value and private consumption rises 1%. However, the magnitude of this increase is meager, since only housesholds with high income are able to afford extra units of private consumption.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 (11% and 16% versus 9% and 12.5%). 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.

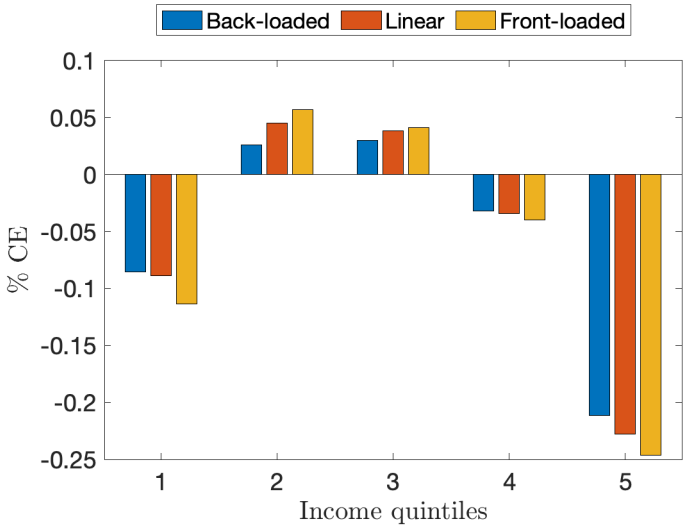


Figure 12: Welfare Effects in the Short-run. General equilibrium

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 but those in the 1st quintile. Households in the first income quintile profit both from the increase in wages (as they rely mainly on labor income), but the adverse welfare effects due to a decrease in the quality of provision of in-kind benefits 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 (2nd and 3rd quintile) and slowest for those who find it welfare-detrimental (1st and 5th).

6.3.2 User-cost of In-kind Benefits

Partial Equilibrium

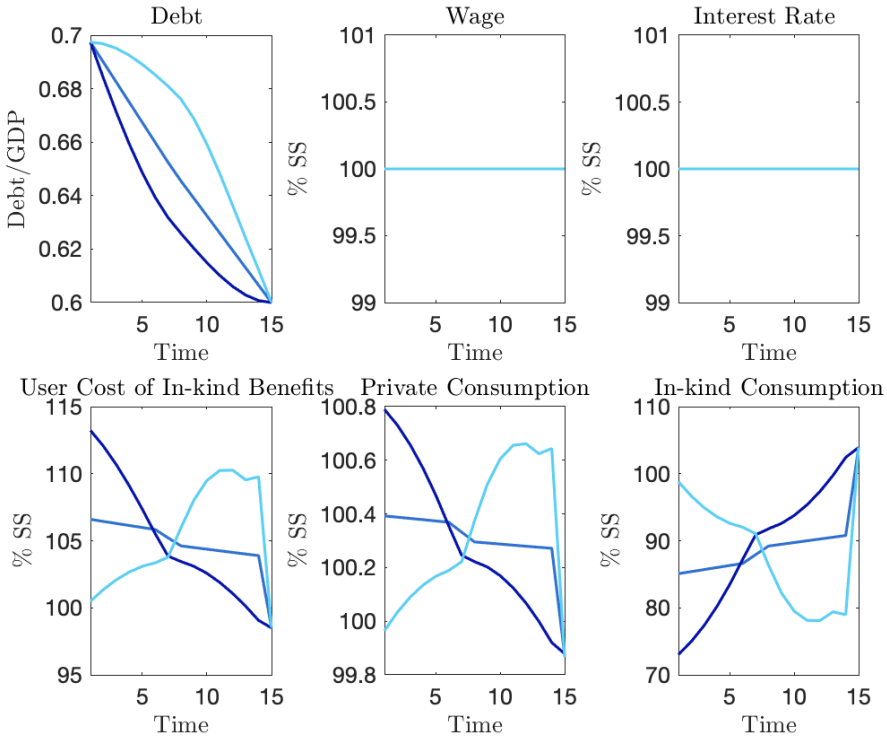


Figure 13: Transition path of aggregate variables

Note: The dark blue line represents the front-loaded consolidation, the middle blue line linear consolidation and light blue back-loaded plan.

Holding factors' prices constant, for a front-loaded fiscal consolidation, the user cost of in-kind benefits would increase by 13% in the first year and decrease fast up to half of the consolidation period, in which it would be about 4% higher than its initial amount. On the contrary, in the back-loaded plan, the initial increase is barely 0.5% of its initial amount. By the end of the consolidation period, it increases by 10% with respect to its initial price. The substitution effect of in-kind benefits by private consumption is more acute if we adjust the user cost than quality retrenchment. In the front-loaded plan, in the first year of consolidation, the aggregate demand for in-kind benefits declines by almost 27% of its initial value, whereas it was only 17% in the quality case. This suggests that a hike in the user cost of in-kind benefits, holding

quality constant, induces households to substitute these goods for their private counterparts.

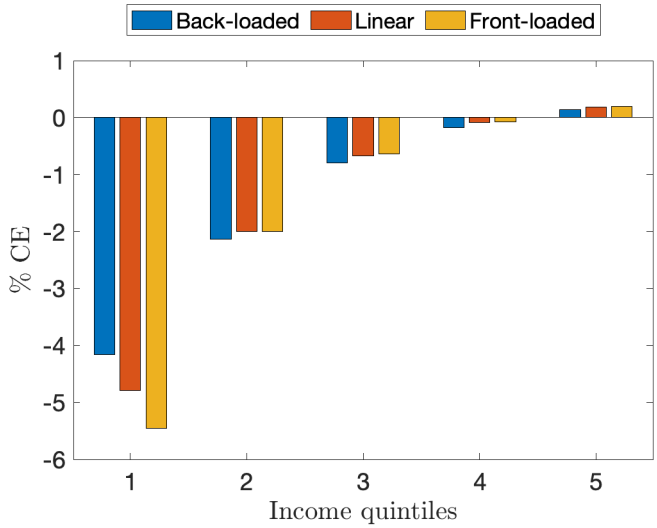


Figure 14: Welfare Effects in the Short-run. Partial equilibrium

Figure ( ) shows the welfare effects of income quintiles holding prices constant in a fiscal consolidation plan through an adjustment in the user cost of in-kind benefits. Consistently with the adjustment in the quality of provision of in-kind benefits, the households that are adversely affected are those in the initial quintiles, although the mechanism is different. The rise of the user cost of in-kind benefits hinders the capacity of income-poor households to access these goods. The welfare costs of such adjustment decrease with income. In the fifth quintile, this policy is welfare-enhancing even in the short run. There is a slight difference in the magnitude of the welfare burden of raising the cost of the price households must pay to access public education and health care compared to the quality adjustment. Increasing the user cost of in-kind benefits results in slightly more welfare-detrimental for households that adjusting the average cost of provision of such goods in the short run. This means that households prefer to keep the user cost constant,namely, tuition fees for universities and out-of-pocket expenditures for health care. and temporarily during the consolidation years and decrease the quality of in-kind benefits to raise government revenues The role of the speed is the same as in the constant-price fiscal consolidation performed through a cut in the quality of in-kind benefits: the welfare change sign stays constant across different speeds, although the preferences for the plans change. For households in the bottom income quintile, the preferred speed is the slowest possible, while for the rest of the distribution, the preferred consolidation speed is the fastest. Again, this occurs due to the lack of liquidity of households in the bottom quintiles.

General Equilibrium

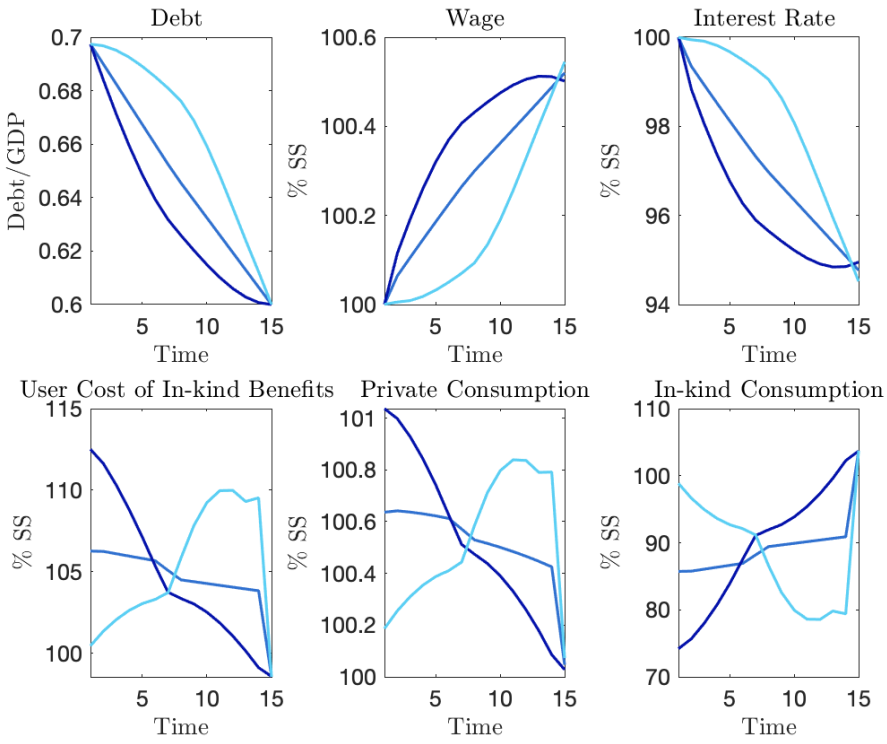


Figure 15: Transition path of aggregate variables

Note: The dark blue line represents the front-loaded consolidation, the middle blue line linear consolidation and light blue back-loaded plan.

In general equilibrium, as in the quality adjustment experiment, the correction of the user cost of in-kind benefits is not as marked as the partial equilibrium due to the crowding-in effect. The increase with respect to the initial price to access in-kind benefits ranges from less than 12% in the front-loaded case up to less than 0.5% in the back-loaded case. The same applies to the in-kind benefits consumption: the decrease ranges from around 25% in the front-loaded case to less than 1.2% in the back-loaded plan. In this case, however, private consumption is modest increases from the substitution effect of in-kind benefits given the increase of their price and the extra liquidity for households at the initial income quintile, with a very high marginal propensity to consume.

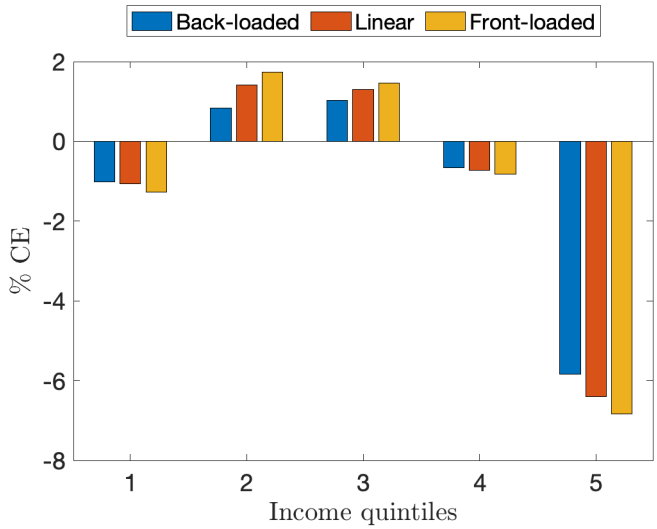


Figure 16: Welfare Effects in the Short-run. General equilibrium

Figure (16) displays the welfare effects of a fiscal consolidation allowing for price adjustments when the user cost is adjusted. The pattern resembles the welfare effects observed when the quality of in-kind benefits is adjusted: The price effects again dominate the instrument effects for all households but those in the first income quintiles. However, there are some differences in terms of magnitudes. The welfare losses are more significant for an adjustment performed through the user cost compared to the quality of in-kind benefits. As in the case of quality adjustment, speed plays a significant role: the faster the consolidation, the more intensified the gains and losses in welfare. Again, households in the bottom and middle-income quintiles prefer a fast consolidation, and households in the top quintiles prefer a slow consolidation.

6.3.3 Comparison of Instruments

Although both q and ζ affect the demand for in-kind benefits for households, they do so through different mechanisms: The quality of in-kind benefits directly impacts the marginal utility of every unit of consumption of in-kind goods whereas the user costs affect the accessibility of such goods for households. The former variable adjusts the government's expenditure, and the latter adjusts its revenues. As shown before, the welfare effects are similar across instruments for all scenarios explored in this paper. Let us compare the aggregate welfare effects in each plan under the partial and general equilibrium assumption to understand which instrument has a higher impact on households' welfare.

	Long run	Short run		
		Back-loaded	Linear	Front-loaded
q	2.519689	-1.441559	-1.493350	-1.620075
ζ	2.454502	-1.318991	-1.314611	-1.393663

Table 6: Aggregate welfare in Partial Equilibrium

	Long run	Short run		
		Back-loaded	Linear	Front-loaded
q	2.520517	-1.131273	-1.099606	-1.147180
ζ	2.520542	-1.131637	-1.099977	-1.147533

Table 7: Aggregate welfare in General Equilibrium

The long-run effects of an increase in the quality of in-kind benefits are higher than those of a decrease in the user cost of in-kind benefits partial equilibrium. The opposite is marginally true in general equilibrium. Therefore, in general equilibrium, easing access to public health care and education is marginally preferred by households compared to improving the quality of public health care and education in the long run if factor prices adjust. However, the opposite is true in the short run. For the three speeds considered, the welfare losses due to the adjustment of quality of provision of in-kind benefits are slightly lower than the user-cost adjustment. Allowing factor prices to adjust, the preferred fiscal consolidation speed is linear. In contrast, if factor prices do not respond to fiscal consolidation, the least welfare-detrimental speed of the plan is back-loaded if the quality of in-kind benefits adjusts or linear if the user-cost adjusts.

7 Conclusions

This study provides valuable insights into 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 insurance 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. 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.

Moreover, the study finds that the positive long-term effects of fiscal consolidation are not offset by the short-term detrimental welfare effects. However, households in the lowest quintiles suffer the most during consolidation if we rule out price effects. Thus, the plausibility of price effects generated during the fiscal

consolidation is crucial in determining the distributional welfare consequences of such a plan.

The study also shows that the long and short-run effects of adjusting the user cost of in-kind benefits are higher in absolute value than those of improving the quality of in-kind benefits in both general and partial equilibrium. Therefore, easing access to public healthcare and education is marginally preferred by households in the long run, compared to improving their quality, assuming factor prices adjust. However, the opposite holds in the short run. In terms of the preferred fiscal consolidation speed, linear consolidation is preferable in general equilibrium, while back-loaded consolidation is the least welfare-detrimental if factor prices do not respond to the fiscal consolidation. 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.

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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) or ζ (user-cost of in-kind benefits) 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).[10].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

[10]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.

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.

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.

B.3 Estimation of ζ

The interpretation of the parameter ζ in this model is the average user cost of in-kind benefits compared to the price of the private substitute. In particular, ζ measures the expenditure that the household has to incur to consume education or health expenditure that goes back to the government. There are other costs that households pay for to consume these goods, which could be considered private expenditure, e.g.: books, transportation costs etc. For education, the user costs are given by university fees, and for health care, the out-of-pocket money households must pay for local authority and some services provided by the NHS, and prescription charges.

Education

Table 8: Yearly average fees by level of education 2016-2017.

	Public	Private
Pre-primary	£ -	£ 9'576.00
Primary	£ -	£ 12'498.00
Secondary	£ -	£ 14'112.00
Tertiary	£ 9'156.25	£ 11'656.00

Sources: ISC and Reddin survey

In England, tuition fees are not charged for compulsory education. For university tuition fees, I computed the average tuition fee for the bachelor and master's level using the data provided in the Reddin survey. For private education, the average yearly tuition fee is computed by multiplying the term day fee provided in the ISC times three (number of terms in the school year). For private universities, the only private university included in the Reddin survey is the University of Buckingham. As only this observation might not be representative of the average price of private universities, I extended the sample of private universities by considering independent institutions that can provide a title by themselves[11]. The private universities I considered are the University of Buckingham, Regents University, European School of Economics, and the University of Law. Since the data of the tuition fees for the year 2017 for those universities were not available, I converted the tuition fees for the year 2021 to the price level of 2017 using the CPI annual index for education provided by the ONS. Using the CPI with base 2015, the ratio of prices for education for 2017 were 89.4% of the prices of 2021. Dividing the tuition fees of the public schools by the private schools, I get different ζs for different education levels.

Health care

For health care, the user cost is calculated as the ratio of out-of-pocket expenditure per capita. Ideally, it would be the ratio of out-of-pocket expenditure to the users (or number of uses of the services). The reason behind this is that in a duplicate (or two-tier) health care system, it is not possible to distinguish between private health insurance users and NHS users in NHS usage. For private health insurance, I divided the total expenditure in voluntary insurance by the number of users, which, according to the OECD statistics, was 10.3% of the population in 2017. The value of ζ for health care is obtained by dividing the user cost for the private good over the private good, which yields a ζ for health approximately equal to 0.3.

Finally, the aggregate ζ is given by the geometric average of the different ratios. To deal with the zeros, I followed the approach of Habib (2012). In this sense, the final parameter zeta used in the simulation is the trigonometrical average of the ratios of user cost of in-kind benefits to the price of the private substitutes.

[11] There are also other independent higher education institutions that provide titles validated by a public university.

B.4 Estimation of q

In this model, q_t stands for the unit cost paid by the government for the provision of in-kind benefits. As the variables of the model are in terms of the price of consumption good c_t, q should also be in terms of the price of the private goods. In accordance with the methodology employed by the ONS for computing the imputed distribution of in-kind benefits, for education, q_t should be related to the expenditure per pupil and in health care, with the expenditure per capita. The imputed cost of education is proxied as the expenditure per pupil, and, for health care, the expenditure per capita.

Table 9: Expenditure (£) per pupil. Computed using PESA and HESA

	England	Scotland	Wales	Northern Ireland
Pre-primary and primary	5'386.32	6'783.49	5'638.24	4'429.03
Secondary	10'853.56	10'056.99	5'949.25	7'406.72
Tertiary	2'347.13	7'468.36	3'760.28	8'082.00
Weighted average	8'187.37	8'123.59	5'605.75	6'419.77

Given the heterogeneity of expenditure per pupil across UK regions, in order to obtain a representative measure of this variable, I computed a weighted average for each education level. The weights are given by the share of expenditure in education in the region to total expenditure in education services.

Table 10: q values for different education levels

Pre-primary and Primary	Secondary	Tertiary
0.4992	0.7392	0.2289

Finally, a parameter q is computed for every education level by dividing the average expenditure per pupil for this education level by the price of the yearly tuition fee of the private substitute for the same education level.

Health care

The imputed cost of health care is computed simply by dividing the total expenditure in health care services by the UK population, which yields a value of 2'080.81 £per capita. Note this value is higher than the price of the private insurance. This occurs, as the NHS provides some services that the private market does not provide. An example of these services is the emergency health care.

Finally, the final value of q is obtained by computing a geometric average of the different values of q for health and education.

C Redistributive Scheme