Luxury for All: A Theory of In-kind Benefits and Inequality

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Abstract

What is the optimal size of in-kind benefits, and should governments rely on subsidies or direct provision? In-kind benefits constitute over half of government expenditure in developed countries, yet most models treat them as an exogenous parameter. We develop a new theory of public spending based on two key features: government-provided goods are luxury goods, and they generate externalities that rise with equality. We show that these two conditions are necessary and sufficient for positive optimal public provision. Using empirical evidence, we demonstrate that they hold for most publicly provided goods, particularly health and education. We then embed these findings in a quantitative heterogeneous-agent model with multiple goods consumed both privately and publicly. We find that the stronger the luxury nature of a good and the higher the inequality, the greater the optimal reliance on direct provision over subsidies. Finally, we show that optimal fiscal consolidation should focus more on reducing subsidies than cutting direct provision, especially for goods also consumed privately.

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Introduction

What is the optimal size of in-kind benefits, and should governments rely on subsidies or direct provision? In-kind benefits constitute a significant share of government expenditure, yet most models treat them as an exogenous, fixed parameter, denoted as $\bar{G}$ in the government budget constraint. The usual explanations for their existence are redistribution, externalities, or missing markets. However, none of these explanations is fully convincing: cash transfers are more efficient for redistribution, subsidies are more efficient for correcting externalities, and private markets often exist for goods provided by the government. Why, then, are in-kind benefits so large?

In this paper, we develop a new theory of in-kind benefits based on two key features: government-provided goods are luxury goods, and they generate externalities that increase with equality. Many goods fall into these categories, such as health. First, the share of health in total expenditures increases with income, making health a luxury good. Second, health generates externalities (for example, by reducing transmission of infectious diseases) that depend on the equal distribution of individual consumption (two people with one vaccine each reduce transmission more than one person with two vaccines and another with none). In this case, the externality motive creates a rationale for government intervention, but the usual Pigouvian subsidy cannot yield the desired distribution, as it primarily raises the consumption of rich households. Therefore, these two conditions are necessary and sufficient to justify an interior solution for optimal direct provision of the good, that does not rely on the "missing market" hypothesis – since households can already consume the good – nor on the redistribution motive – since cash transfers dominate in-kind transfers for redistribution purposes.

We provide analytical, empirical, and quantitative developments of our theory. First, we introduce an analytically tractable model with heterogeneous agents and the two key features above. Households consume a private good, say food, and another good that is also publicly provided, say education. This second good is a luxury good, so that its expenditure share rises with income, and some poor households consume none of it. Private and public consumption of this good generate externalities, but individual contributions are not perfectly substitutable, so the externality depends on both total consumption and its distribution. The government can use cash transfers, direct provision, subsidies of the good, and labor taxation. We use this model to derive welfare-maximizing policies for a utilitarian planner.

Second, we use empirical evidence to justify our hypotheses and test the predictions of the model. We decompose government expenditures into different goods, distinguishing between subsidies and direct provision. We then use survey, bank, and macro data to determine which goods are luxury goods. We also review empirical evidence on externalities. Finally, we study the cross-country correlation between in-kind benefits and inequality, and compare the findings to the predictions of the analytical model.

Third, we develop a quantitative heterogeneous-agent model with multiple sectors. Households consume a private good and six sectoral goods (education, health, security, housing, culture, and transportation). These goods are either subsidized or directly provided by the government. The model, calibrated to France, reproduces the observed heterogeneity in individual consumption of each good, income and wealth. We first back out the externality functions consistent with observed public policies. Then, we conduct three applications. First, we compute the optimal way to reduce public debt, using in-kind benefits, subsidies, and taxes to generate government surpluses. We characterize the optimal transition between steady states with high and low debt, re-optimizing the final steady state and approximating the Ramsey solution of the planner. Second, we propose a new methodology for the Distributional National Accounts (DINA). Unlike the standard approach, which imputes public spending to households without correcting for their utility valuation, we adjust for the fact that poor households often prefer cash transfers to in-kind transfers for goods they do not consume. Third, we analyze targeted in-kind provision, where the government conditions access to free goods on individual characteristics. Using microdata, we recover the observed functional forms of in-kind provision in different sectors and compute the optimal targeting rules. Our paper yields three key findings.

First, we show analytically that luxury goods and "imperfect-substitute" externalities are necessary and sufficient conditions for an interior solution for optimal direct provision. On one hand, without luxury goods, all households consume the good, making cash and in-kind transfers perfect substitutes. On the other hand, if externalities depend only on total consumption, subsidies dominate direct provision, as they raise consumption without over-providing for poor households. We derive the Samuelson condition and the optimal redistribution rule under each assumption, showing that both conditions are jointly necessary. Numerically, we show (i) there exists a threshold level of substitutability in the externality function above which optimal direct provision is zero, and (ii) optimal direct provision rises with inequality. Finally, we show these predictions align with observed policies: controlling for GDP per capita, inequality (measured by the top 10% wealth share) is positively correlated with total public spending as a share of GDP. Moreover, focusing on education and health, and controlling for GDP per capita and total spending, we observe a positive correlation between inequality and direct provision, consistent with our mechanism.

Second, we compute the optimal strategy for debt reduction. We discipline the externality functions so that 13 observed policies (subsidies and direct provision across major sectors, plus pure public goods) are optimal. The greater the reliance on in-kind provision, the lower the implied elasticity of substitution in the externality function. We then compute the transition from a steady state with a 100% debt-to-GDP ratio to one with 90%, re-optimizing the 13 policies at the final steady state. We find the optimal path for some policies during the transition, with and without debt shock, and take the difference of both: this "double difference" allows us to approximate the Ramsey solution. We find that goods not privately consumed (for example military, roads, justice) should bear more of the fiscal adjustment than goods with substantial private consumption (for example health, transportation, culture). The intuition is twofold: fiscal consolidation already reduces private consumption, so reducing public provision further would over-contract these goods; and since inequality rises during consolidation, cutting direct provision would worsen externality losses created by consumption dispersion.

Third, we investigate the interaction between inequality and in-kind benefits. Unlike the Samuelson rule, our model features interactions between the optimal direct provision and inequalities. First, we show that direct provision is progressive, while subsidies are regressive. As poor households do not consume some goods, they are not directly affected by subsidies, though they still pay taxes to finance them. On the opposite, direct provision of goods represents a higher increase in consumption for poor people than for rich, even if they would have preferred transfers. Second, incorporating in-kind benefits into the consumption basket reduces optimal transfers and tax progressivity, as the government already redistributes through goods. Third, we propose a correction to DINA, imputing a "utility wedge" that accounts for poorer households valuing in-kind transfers less than cash. This adjustment shows that public spending is substantially less redistributive than conventional estimates suggest. Finally, we compute the optimal targeting rule for direct provision. Allowing income-based targeting increases aggregate welfare: poor people primarily benefit from this change, but rich people also gain, as it reduces the dispersion in individual contributions and therefore increases the externality.

Literature review

This paper contributes to three literatures: optimal public spending, fiscal policy under heterogeneity, and the measurement and distributional consequences of public spending.

Optimal public spending. The modern literature on the efficient provision of public goods originates with Samuelson (1954) seminal contribution, and his formula relating the marginal utility of private and public consumption G. Subsequent work has extended this framework to incorporate production inefficiencies (Diamond and Mirrlees

(1971)), tax distortions (Stiglitz and Dasgupta (1971), Atkinson and Stern (1974)), political economy considerations(Meltzer and Richard (1981), Epple and Romano (1996)), labor market frictions (Michaillat and Saez (2019)) and externalities (Sandmo (1975)). We complement these papers by relaxing three key assumptions commonly invoked to justify in-kind benefits. First, we abandon the missing market hypothesis, allowing private consumption of publicly provided goods. This removes the government's unique role in providing the good, which may be plausible for pure public goods such as defense, but not for many other sectors. Second, we allow cash transfers, making in-kind provision potentially dominated for the redistribution motive. Redistribution through direct provision may be inefficient, since it can over-provide goods that poor households value less than other necessities. Third, we allow subsidies, making G potentially dominated for the externality motive. Correcting an externality through direct provision can be inefficient when it pushes some agents at a corner solution, whereas subsidies adjust relative prices and let agents optimize. Once these three conditions are relaxed, justifying public provision becomes substantially more challenging. Remaining explanations include Currie and Gahvari (2008) who rationalize in-kind transfers through paternalistic preferences or interdependent utility, and Besley and Coate (1991) and Blackorby and Donaldson (1988), where governments provide a good with average quality so that rich people opt out, making in-kind provision an efficient way to reduce inequality. Compared to these papers, we provide a microfounded mechanism through non-homothetic preferences over government-provided goods. This creates an intrinsic link between inequality and optimal public consumption, reinforced by our assumption that the distribution of consumption, not just the average, matters for the externality.

Optimal fiscal policies and inequalities. The literature on optimal taxation with inequality, initiated by Mirrlees (1971) and refined by Saez (2001), establishes the efficiency-equity trade-off. While redistribution toward high-marginal-utility poor households is desirable, tax distortions create an interior optimum for redistribution, which rises with inequality but falls with efficiency costs. Recent extensions have examined optimal policy under heterogeneous productivity shocks (Golosov, Troshkin and Tsyvinski (2016)), human capital accumulation (Stantcheva (2017)), business cycles (McKay and Reis (2021)), and transfers (Ferriere, Grübener, et al. (2023)). While these papers have focused on the tax-and-transfer components of fiscal policy, we address the substantial remaining part: in-kind benefits and subsidies, and their redistributive role. Following the tractable heterogeneous-agent approaches of Benabou (2002) and Heathcote, Storesletten and Violante (2017), we develop a framework to study the link between public spending and inequality, and compute the optimal provision of public spending in the quantitative version of the model. Unlike these contributions, which emphasize skill investment and its effects on aggregate efficiency, we focus on the interaction between government provision, private consumption, and distributional outcomes, offering a microfounded rationale for in-kind provision.

Measurement and distributional consequences of public spending. From the Distributional National Accounts (DINA) methodology to the marginal value of public goods (MVPF), there is a growing literature on the measurement of public spending, and their distributional effects. First, public spending is not a homogeneous aggregate but a collection of sectoral expenditures with distinct characteristics. In this spirit, we systematically classify transfers, subsidies, and in-kind provision across sectors, departing from the "big G" modeling (see Cox et al. (2024)). Second, as some publicly provided goods are widely privately consumed (health, transportation), and some are not (defense, justice), each sectoral good must be allocated separately to individuals. Inspired by the contributions of Aaron and McGuire (1970), Bergstrom and Goodman (1973) or Brennan (1976), the DINA methodology in Piketty, Saez and Zucman (2018) imputes public spending to households based on individual's characteristics (age, income, location,...). In our model, because some goods are more "luxury" than others and therefore less valued by poor households, we replace monetary imputation by utility-based imputation. Third, we complement the MVPF literature and the estimation of externalities. While the approach in Hendren and Sprung-Keyser (2020) synthesizes empirical estimates across policies, we employ structural modeling to discipline externality parameters and welfare calculations. This offers three key advantages. First, it allows us to go "beyond the margin": whereas MVPF analysis implies allocating all resources to the highest-yielding policy, our framework accounts for diminishing marginal returns. Second, we are not limited to evaluating existing policies; the structural model enables counterfactual analysis of hypothetical or proposed interventions. Third, general equilibrium modeling captures the full fiscal and behavioral feedback effects of each policy, allowing for a consistent welfare analysis.

The remainder of the paper is organized as follows. Section 1 presents our analytical model and key results on the optimal provision of goods. Section 2 provides empirical evidence to justify our modeling assumptions. Section 3 presents our quantitative model and describes the calibration. Section 4 estimates the externality function in the model, and the correspondence with empirical values. Finally, our Sections 4, 7 and 8 develop quantitative applications of our theory.

1 Analytical results

In this section, we introduce a stylized, tractable model with heterogeneous agents, that highlights the typical implementation of public spending in macroeconomic models, its shortcomings, and our proposed solution. Our framework builds on Heathcote, Storesletten and Violante (2017) and Ferriere, Grübener, et al. (2023), adding non-homothetic preferences, externality and transfers.

1.1 The model

We first assume that households are heterogeneous in terms of their productivity z_i, such that $z_i \sim \text{log-Normal}\left(-\frac{\nu}{2}, \nu\right)$.[1] Households choose their consumption of the normal good c and of the luxury good g. We think of g as private education, health, security, transportation, cultural expenditures, which the government can also provide through in-kind benefits G or subsidize at rate s. Labor supply n is endogenous, implying an efficiency cost of taxation.[2] Finally, there is an externality related to the individual consumptions of the good g, that households cannot directly control. Each household i solves the following problem:

$$\max_{c_i, g_i, n_i} u_i = (1-\omega)\ln(c_i) + \underbrace{\omega \ln(g_i + G + \bar{g})}_{\text{Private consumption}} - \psi n_i + \underbrace{\frac{\chi}{\alpha} \ln\left(\int_j (g_j + G + \bar{g})^\alpha\right)}_{\text{externality}}$$

$$\text{such that } c_i + (1-s)g_i = (1-\tau)\underbrace{z_i}_{\text{heterogeneity}} n_i + T$$

$$\text{and } g_i, c_i, n_i \geq 0$$

The term $g_i + G$ implies that public and private consumptions of g are perfect substitutes, which is the most unfavorable case to justify the intervention of the government. The Stone-Geary preferences, with the luxury parameter $\bar{g}$, imply that for households with a productivity lower than a threshold $\zeta = \frac{\psi}{\omega}\frac{1-s}{1-\tau}(G + \bar{g})$, the constraint $g_i \geq 0$ binds, meaning that they do not privately consume education or health. The last externality term is a concave combination of individual contributions. The parameter χ determines the strength of the externality, and is equal to the derivative of welfare with respect to average contribution.[3] Finally, the parameter α determines the concavity of

[1] We choose this specification because the mean is independent from ν, *i.e.* $\mathbb{E}[z] = 1$, and the variance is controlled by the inequality parameter ν.

[2] We assume a linear disutility of labor to have closed-form solutions with transfers. We will introduce more general preferences in the quantitative model.

[3] Suppose every individual contribution is multiplied by $1 + dx$: the externality terms becomes $X = \frac{\chi}{\alpha} \ln\left(\int_j [(1+dx)(g_j + G + \bar{g})]^\alpha\right) = \chi \ln(1+dx) + ... \approx \chi dx$, so that $\frac{dX}{dx} = \chi$.

the combination, or with a CES interpretation, the elasticity of substitution between individual contributions.[4] When α approaches $-\infty$, the externality function becomes a Leontief function equal to $\chi \min_i(g_i + G + \bar{g})$.

We assume that the government finances in-kind benefits G, subsidies to private consumption s and transfers T using labor taxes, with the tax rate τ adjusting to balance the budget constraint:

$$G + T + s \int g_i = \tau \int z_i n_i$$

Finally, we assume a utilitarian planner with the welfare function $\mathbb{W} = \int_i u_i$. As shown in Appendix A, our model delivers closed-form solutions for $\mathbb{W}$. In the following, we propose three versions of the model, and discuss the associated optimal transfers and in-kind benefits chosen by the planner.

1.2 Results

In this section, we first derive the Samuelson rule in the "missing market" case. Then we get rid of this hypothesis and show that with homothetic preferences or linear externality, we cannot obtain an interior and determined solution for the optimal direct provision $G^\star$. Finally, we show that the concavity and luxury goods are necessary and sufficient conditions to obtain a solution for direct provision for $G^\star$.

Proposition 1 (**missing market**)**.** *Suppose $\omega = \bar{g} = 0$: households cannot privately consume g. The planner problem becomes:*

$$\max_{\tau, G} \mathbb{W} = \ln(1-\tau) + e^{\nu}(\tau - \psi G) + \chi \ln(G)$$

The welfare-maximizing public spending and transfer-to-GDP ratios are given by

$$\frac{G^\star}{Y^\star} = \frac{\chi}{1+\chi}$$

$$\frac{T^\star}{Y^\star} = \frac{1}{1+\chi} - e^{-\nu}$$

In this model, $g_i = 0$ for all households: they do not privately derive utility from education or health, but there is an externality associated with these goods, giving the

[4] The elasticity of substitution between two individual contributions $H_j = g_j + G + \bar{g}$ is equal to $\epsilon_{H_1,H_2} = \frac{d \ln H_1/H_2}{d \ln(X_{H_1}/X_{H_2})} = \frac{1}{1-\alpha}$.

government a unique ability to increase welfare.[5] The interpretation of welfare is as follows. The first term, $\ln(1-\tau)$, represents the crowding-out of private consumption by public consumption. The second term, $e^{\nu}(\tau - \psi G)$, captures the redistribution motive: the higher the tax and the lower the public provision, the greater the transfer and, consequently, the redistribution, depending on the inequality parameter ν. Finally, the last term, $\chi \ln(G)$, reflects the externality.

This framework provides a useful benchmark for thinking about optimal fiscal policies, as it establishes a clear dichotomy between in-kind and cash transfers: G addresses the externality, while T addresses inequality. However, it relies heavily on the "missing market" hypothesis, which assumes that households cannot privately consume certain goods, creating an obvious role for government intervention. While this may apply to goods such as defense, justice, or political institutions, it does not hold for others: households can access private schools, private hospitals, private museums, and even employ private bodyguards or militias. Therefore, it is necessary to relax this assumption and allow households to privately consume education and health.

Proposition 2 (**indeterminacy**). *Suppose $\bar{g} = 0$: g is a normal good. Transfers and public spending are indeterminate ($\frac{\partial u_i}{\partial T} = \frac{\partial u_i}{\partial G}$) and their optimal sum is given by:*

$$\frac{G^\star + T^\star}{Y^\star} = \Gamma(\nu), \quad \textit{with } \Gamma'(\nu) > 0$$

Moreover, the welfare-maximizing subsidy is given by

$$s^* = \frac{\chi}{\omega + \chi}$$

As $g_i > 0$ for every household, transfers and in-kind benefits have the same welfare effect. If the government gives households a transfer T, they will allocate a share $1 - \omega$ to increase c_i and a share ω to increase g_i. Conversely, if the government provides G in-kind, households will reduce their private consumption of g_i by ω and reallocate this amount to increase c_i by $1 - \omega$, yielding the same overall welfare.

Therefore, when all agents can privately consume the good g, T and G become perfect substitutes, raising the question of why governments would provide both. We must introduce luxury good to break this equivalence.

[5] This is sometimes referred to as a "chicken model": households like chicken, households cannot produce chicken, government can provide chicken, then we need the government to intervene.

Proposition 3 (**luxury goods**). *Suppose* $\bar{g} > 0$*: g is a luxury goods, and there is a threshold* ζ *such that* $\forall z_i \leq \zeta, g_i = 0$.
a) The optimal size of the government is equal to

$$\tau^\star = 1 - e^{-\nu}$$

b) The optimal in-kind benefit is equal to

$$G^\star = \frac{\omega + \chi}{\psi e^\nu \left(1 + \mathbb{P}(z \geq \zeta^*) \frac{\mathbb{E}[z|z \geq \zeta^*] - \zeta^*}{\zeta^*}\right)} - \bar{g} \qquad \textit{with } \zeta^* = \zeta^*(\nu, \alpha)$$

c) There exists a threshold $\bar{\alpha}$ *such that*

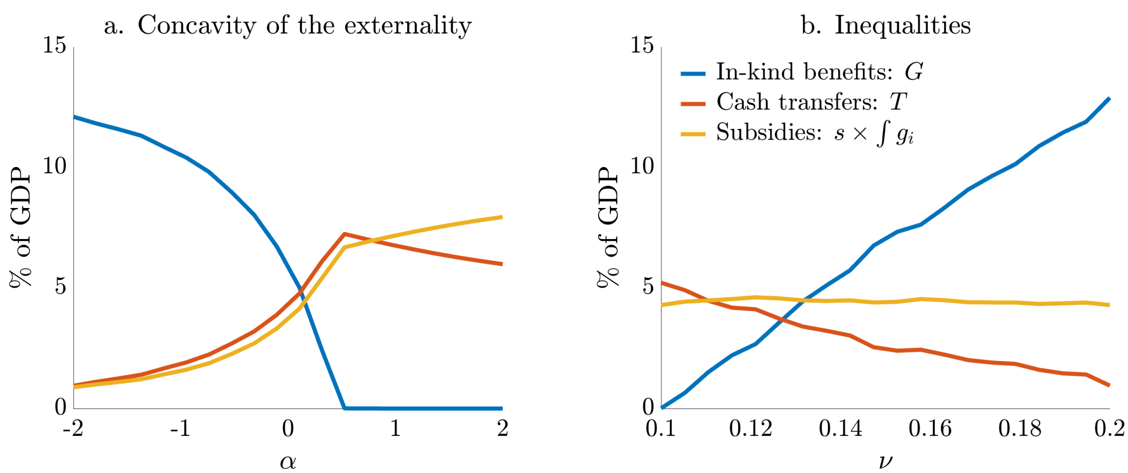
$$\alpha \geq \bar{\alpha} \implies G^\star = 0$$

The first result shows that the tax rate $\tau^\star$, or equivalently the total size of the government, only depends on the level of inequality ν, or equivalently on the variance of the productivity distribution, as $\mathbb{V}(z) = e^\nu - 1$. The higher the variance, the bigger the government. Therefore, as optimal cash transfers may also increase with inequality, the reaction of other government expenditures (direct provision and subsidies) to inequality is ambiguous. If $\nu = 0$, G and T are again indeterminate, and the planner only needs a lump-sum tax T and a subsidy s to reach the first-best.

The second result shows that the optimal direct provision $G^\star$ increases with the utility share ω (as it directly provides utility to households) and with the strength of the externality χ. The role of inequality is more ambiguous. When ν increases, the government wants to redistribute more through cash transfers, and therefore lowers its other expenditures. But when inequality increases, the share of unconstrained agents $\mathbb{P}(z \geq \zeta)$ also decreases, meaning that fewer people consume the good g, increasing the externality motive, and respond to the subsidy, increasing the need to use G rather than s. In a numerical application of our toy model (see panel b Figure 1), we find that an increase in inequalities lead to an increase in G^* and a decrease in T^*. Optimal subsidies remain relatively flat.

The third result shows the role of concavity in generating a positive, optimal $G^\star$. If α is too high, meaning that individual contributions are too substitutable, then the optimal in-kind benefit is equal to 0 (if constrained to be non-negative). The intuition is the following: if I can compensate a small contribution with a high contribution, then I prefer to use subsidies, which are less distortive as they don't overprovide the good for poor people. In this case, the best strategy to increase the total externality is to focus on rich people: as g is a luxury good, increasing the subsidy will increase their consumption by a large amount. At the same time, a high α above $\bar{\alpha}$ reduces the redistribution motive since the planner now prefers inequalities in consumption. Therefore, T^* will decrease. However, if α is small, individual contributions are less substitutable: I want to reduce the dispersion of individual consumptions by directly providing the good through G. Panel a in Figure 1 illustrates this story.

Figure 1: Optimal policies for different parameters' values



A real-life example of this model could be vaccines against infectious diseases. There is a clear externality: if I get vaccinated to protect myself, I also reduce the risk of infection for others. Moreover, this externality is concave: it is better to have two people each with one dose than one person with two doses and another with none. In this case, if vaccines are a luxury good, increasing subsidies may be inefficient: it could encourage wealthier individuals to get vaccinated twice (if doing so increases their utility), without improving access for poorer individuals. Therefore, the optimal policy may be to provide vaccines for free. This might not increase vaccination rates among the rich, or even the total number of doses administered, but it would equalize vaccine distribution, thereby amplifying the externality. Another example is schooling: being the only person with a very high level of education in my country is not optimal, because I would feel quite lonely when interacting with others, or because I would need qualified workers to implement my brilliant ideas. Finally, housing space can also generate a concave, or even Leontief, externality: society benefits more from giving a small house to someone who is homeless than from adding an extra room to an already luxurious penthouse.

Therefore, the rationale for the provision of in-kind benefits is as follows. If a good generates a positive externality, the government should aim to increase its consumption. However, if the good is also a luxury, subsidies only affect the consumption of wealthier households. When the externality depends on the distribution of individual consumption, and not just the aggregate level, the government must directly provide the good through in-kind transfers.

Calibrating the model. Finally, we propose a simple calibration of our analytical model, for five examples of luxury goods g_k also provided by the government: Health, Education, Transportation, Security and Culture. For each good k, we have 4 parameters: the weight ω_k, the luxury parameter $\bar{g}_k$, the level of the externality χ_k, and the curvature ϵ_k, with $\epsilon_k = \frac{1}{\alpha_k - 1}$ to follow the common notation of CES functions. We identify ω_k with the share of the good k in total households expenditures and $\bar{g}_k$ with the share of households with zero expenditures. For χ_k and ϵ_k, we assume that the ratios of in-kind benefits-to-GDP and subsidy-to-GDP in France are optimal and maximize the utilitarian welfare. All these targets are discussed in Section 2. The results are reported in Table 1 below:

Table 1: Calibrating the externality functions

	Observed values (%)				Parameter values			
	$\frac{g_k}{E}$	$\mathbb{P}(g_{ik}=0)$	$\frac{s_k g_k}{Y}$	$\frac{G_k}{Y}$	ω_k	$\bar{g}_k$	χ_k	ϵ_k
Health	6.2	40	4.89	4.00	0.07	0.19	0.25	3.76
Education	2.3	70	1.00	4.01	0.12	0.22	0.14	0.57
Transportation	12.8	20	1.6	0.55	0.30	0.30	0.05	0.39
Security	2.2	70	0.17	1.54	0.17	0.24	0.06	0.07
Culture	6.6	40	0.44	1.03	0.24	0.26	0.04	0.15

The higher the share of good k in government budget, the higher the level of externality χ_k, as shown for Health and Education that are the two main expenditures in France. Moreover, the higher the subsidy relative to the in-kind provision, the higher the substitutability ϵ_k. Half of health public expenditures in France are subsidies, implying a high ϵ_k, while most of education expenditures are in-kind provision, implying a low ϵ_k. We will discuss precisely these categories in Section 2.

1.3 Stylized fact: inequality and in-kind benefits

Our analytical model and numerical simulations show that first, the optimal size of the government increases with inequality (proposition 3.a), and second, the size of in-kind benefits increase with inequality (proposition 3.b). These two predictions are different from the usual Samuelson rule, where $G^\star$ is independent from inequality. In this section, we investigate the cross-country correlation between these variables.

Validation 1: government size and inequalities. With i the country and t the year, we run the following regression:

$$\frac{\text{Gov}_{i,t}}{Y_{i,t}} = \alpha + \beta \text{ Inequality}_{i,t} + \theta X_{i,t} + \text{FE} + \epsilon_{i,t}$$

With $\frac{\text{Gov}_{i,t}}{Y_{i,t}}$ the total size of government over GDP (including in-kind benefits and transfers), Inequality measured as the share of wealth held by the top 10% of the wealth distribution, X is our controls (especially the log of GDP per capita), FE is the time and country fixed effects, and ϵ is the residual.

Table 2: Total public spending and inequalities

Dependent Variable:	Total government size (% GDP)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant	9.67			−2.28		
	(14.2)			(13.3)		
Inequality	0.279	0.200	0.450**	0.189*	0.175**	0.228***
	(0.221)	(0.196)	(0.200)	(0.096)	(0.088)	(0.083)
log(GDP per capita)				2.26*	1.59	3.90*
				(1.19)	(1.09)	(2.06)
Year FE		Yes	Yes		Yes	Yes
Country FE			Yes			Yes
Observations	3,925	3,925	3,925	3,925	3,925	3,925
R^2	0.04	0.08	0.90	0.69	0.71	0.92

*Clustered (Country) standard-errors in parentheses. Codes: ***: 0.01, **: 0.05, *: 0.1.*

For a given level of GDP per capita, we observe a positive correlation between inequality (measured as the top 10% wealth share) and the size of the government: when the top 10% holds 1% more wealth, the government size over GDP is 0.2% bigger. The predicted size was $\tau^\star = 1 - e^{-\nu}$ in our model, so increasing in inequality. Now, we must check that what is increasing is indeed in-kind benefits, not transfers.

Validation 2: in-kind benefits and inequalities. With i the country and t the year, we run the following regression:

$$\frac{\text{Health and Educ}_{i,t}}{Y_{i,t}} = \alpha + \beta \text{ Inequality}_{i,t} + \theta X_{i,t} + \text{FE} + \epsilon_{i,t}$$

With $\frac{\text{Health and Educ}_{i,t}}{Y_{i,t}}$ the sum of health and education public spending over GDP, Inequality measured as the share of wealth held by the top 10% of the wealth distribution, X is our controls (log of GDP per capita and total size of government), FE is the time and country fixed effects, and ϵ is the residual. We choose Health and Education because they are the two main government policies, and because these goods are also privately consumed, and therefore enter our theory.

Table 3: In-kind benefits and inequalities

Dependent Variable:	Public spending in health and education (% GDP)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-5.57			-8.09^{**}		
	(3.50)			(3.63)		
Top 10% wealth share	0.073	0.076	0.028^{*}	0.089^{***}	0.084^{***}	0.058^{***}
	(0.048)	(0.051)	(0.015)	(0.026)	(0.026)	(0.019)
Total gov size over GDP	0.269^{***}	0.271^{***}	0.143^{***}	0.149^{***}	0.145^{***}	0.145^{***}
	(0.025)	(0.025)	(0.013)	(0.019)	(0.020)	(0.017)
log(GDP per capita)				0.599^{*}	0.767^{**}	-0.843^{**}
				(0.317)	(0.328)	(0.338)
Year FE		Yes	Yes		Yes	Yes
Country FE			Yes			Yes
Observations	2,366	2,366	2,366	2,366	2,366	2,366
R^2	0.70	0.70	0.97	0.88	0.89	0.97

*Clustered (Country) standard-errors in parentheses. Codes: ***: 0.01, **: 0.05, *: 0.1.*

For a given GDP per capita and government size, we find a positive correlation between Inequality (measured as the top 10% wealth share) and public spending on health and education: when the top 10% holds 1% more wealth, public expenditures relative to GDP are 0.07% higher. This is consistent with Figure 1.b, where G increases with the increase in inequality.

Taking stock: Our analytical model delivers three key insights. First, both the luxury nature of the goods provided by the government, and the presence of concave externalities associated with these goods, are necessary to generate a positive level of optimal in-kind benefits. Second, the lower the substitutability between households' contributions to the externality, the greater the reliance on in-kind provision. Third, higher inequality leads to higher optimal in-kind benefits, in line with cross-country evidence.

Consequently, it is essential to identify the luxury dimension of the goods provided by the government, and to distinguish between government expenditures in the form of subsidies and those in the form of in-kind provision. We provide empirical evidence on these points in the next section.

2 Empirical evidence

Our theory of public spending posits that the government provides certain goods because they generate concave externalities and because they are luxury goods. In this section, we justify these assumptions and clearly define what we consider as transfers, in-kind benefits, and subsidies. First, we decompose public spending between between these 3 categories. Second, we provide evidence of non-homothetic preferences concerning health, education, culture and transportation, using both country-level and household-level data. Third, we discuss empirical evidence on externality in these sectors.

2.1 Decomposing public spending

Total public spending in France amounts to €1,610 billion in 2023, or 57% of GDP (see Appendix B.1 for data sources and details). First, we systematically allocate this spending into the three categories used in our quantitative model: debt repayment, cash transfers, and in-kind transfers. *Debt repayment*, denoted rd in our model, accounts for 3.1% of public spending. *Cash transfers*, denoted T, account for 39.7% of public spending: 56% of this amount is devoted to pensions, while the remainder is distributed among unemployment benefits, family allowances, and sickness transfers. Finally, the largest component is *in-kind transfers*, which include both subsidies s and direct provision G, and represent 57.2% of total public spending.

Second, we classify in-kind transfers into 7 categories. The first is *pure public goods*, denoted G^p, which corresponds to government spending without a private counterpart. Pure public goods account for 20.1% of total public spending and include, for example, 30% for executive and legislative organs and general services, 15% for defense, 35% for industries (agriculture, energy, R&D, water supply), and 8% for pollution and waste management. The remaining six categories of in-kind transfers, accounting for 37.1% of total public spending, correspond to sectoral goods with private counterparts: *health* (15.6% of total public spending), *education* (8.8%), *housing* (3.2%), *transportation* (3.9%), *culture* (2.6%), and *security* (3%).

Third, for each of these six sectoral policies k, we decompose in-kind transfers into direct provision G_k and subsidies s_k. We define direct provision as goods offered for free in fixed quantities, and subsidies as policies that reduce the price of a good. More details on our imputation are provided in Appendix B.1. *Health* spending consists of 45% direct provision (public hospitals, medical supplies, public health campaigns) and 55% subsidies (social security, pharmaceutical reimbursements, payments to private practices). *Education* comprises 80% in-kind benefits (teacher salaries, school infrastructure, research funding) and 20% subsidies (student housing and grants, support to private schools). *Transportation* is 25% in-kind (infrastructure investment and maintenance) and 75% subsidies (public transport services, subsidies on electric vehicles). *Housing* is 40% in-kind (construction and maintenance of public buildings and housing units) and 60% subsidies (housing assistance programs and tax credits for private residences). *Security* is 90% in-kind (police, fire protection, courts, prison) and 10% subsidies (legal aid, victim assistance, tax rebates for security-related goods). *Culture* is 70% in-kind (public museums, theaters, cultural events) and 30% subsidies (grants for artistic creation and cultural projects, tax incentives for donations). Overall, we find that direct provision accounts for 72% of total in-kind transfers, while subsidies represent 28%. Our decomposition is presented in Table 4.

Table 4: Decomposition of public spending in France, 2023

	Total	**In-kind benefits (G)**	**Subsidies (s)**
	%	**% sector**	
Public goods	20.1	100	0
Health	15.6	45	55
Education	8.8	80	20
Transportation	3.9	25	75
Housing	3.2	40	60
Security	3.0	90	10
Culture	2.6	70	30
Total in-kind	57.2	64.5	35.5
Transfer	39.7		
Debt	3.1		
Total	100		

We reproduce all these expenditures in our quantitative model in Section 3, which implies 15 instruments for the government: 6 subsidies s_k and direct provisions G_k for the sectoral goods, pure public good provision G_p, transfer T and debt repayment rd.

2.2 In-kind benefits as luxury goods

The first pillar of our theory is that goods provided by the State are luxury goods, *i.e.*, goods for which demand increases more than proportionally with income. In this section, we use country-level and household-level panel datasets to estimate several demand systems. We conclude that health, education, transportation, and culture can be considered luxury goods.

2.2.1 Cross-country analysis

Aggregate data. In this section, we build upon the broadest datasets available on sectoral expenditures (health, education, culture, and transportation). For health, we use health expenditure in US$ PPP per capita from the OECD System of Health Accounts (SHA). For education, we use total general government spending on all levels of education as a share of GDP from the UNESCO Institute for Statistics (2025). This measure includes all government spending at the relevant education level—by central, regional, and local authorities—and covers both current and capital expenditures. To impute culture and transportation consumption per capita, we use sectoral employment data from Groningen's 10-Sector Database,[6] assuming that relative sectoral consumption expenditures are proportional to relative sectoral employment shares. As a robustness check, we alternatively use real and nominal value added and find similar results.

We rely on GDP per capita estimates from the Maddison Project Database and the World Bank.[7] Demographic controls are drawn from the following sources: population, age-dependency ratios, and life expectancy data come from the UN World Population Prospects (2024), while urban characteristics data come from World Bank population estimates and urbanization ratios. We only keep countries for which we have at least 15 years of data, because short time series would lead to biased estimates due to Nickell bias in dynamic panel regressions. Combining these datasets yields final panels ranging from over 4,000 observations for health and education to around 2,000 for culture and transportation.

Empirical Strategy and Identification. We estimate the income elasticity of each good with the following equation:

$$\log(c_{i,t}) = \theta \log(y_{i,t}) + \gamma X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \tag{1}$$

where $c_{i,t}$ denotes per capita expenditures on a given good (health, education, culture, or transportation) in country i at time t, $y_{i,t}$ is real per capita income, and $X_{i,t}$ is a vector of control variables.[8] The coefficient θ can be interpreted as the income elasticity

[6]The 10-Sector Database provides a long-run, internationally comparable dataset on annual sectoral series of production, value added, and employment for 10 countries in Asia, 9 in Europe, 9 in Latin America, 10 in Africa, and the United States, covering the period from 1947 to the 2010s.

[7]Regressions for education, culture, and transportation use GDP per capita from the Maddison Project Database, while regressions for health use GDP per capita from the World Bank, maximizing sample size across panels. The Maddison Project Database covers a longer historical period, whereas World Bank estimates are more accurate, cover more countries, and are updated more regularly since 1990.

[8]Controls variables are: total-age dependency ratio and life expectancy at 80 for health; young-age dependency ratio for education; old-age dependency ratio for culture; and old-age dependency ratio and the share of urban households for transportation.

of demand: if $\theta_s > 1$, the good is classified as a luxury good. We include both country fixed effects μ_i and time fixed effects λ_t, thereby controlling for time-invariant country characteristics and global trends. Observations are weighted by country population, and standard errors are clustered at the country level.

Cross-Country Aggregate-Level Results. Table 5 reports our results with and without controls. In all categories, the estimated income elasticity θ exceeds one and is statistically significant at the 1% level. This indicates that the share of these goods in total expenditures rises with income, classifying them as luxury goods. Overall, the results provide empirical support for non-homothetic preferences in aggregate consumption: as national income increases, expenditure patterns shift toward these more income-elastic categories.

Table 5: Income elasticity

$\log(c)$	*Health*		*Education*		*Culture*		*Transportation*	
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*	*(g)*	*(h)*
θ	1.32***	1.15**	1.34**	1.38**	2.18**	2.17**	1.37***	1.32***
	(0.024)	(0.051)	(0.106)	(0.127)	(0.410)	(0.411)	(0.102)	(0.087)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	4,058	4,058	4,424	4,424	2,062	2,062	1,864	1,864
# countries	181	181	143	143	39	39	38	38
# years	23	23	54	54	63	63	53	53

Observations are weighted by population. Standard errors are clustered at the country level.
Signif. levels against $\theta = 1$: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Robustness 1: private expenditures. The education data we use covers only government spending and excludes private expenditures (e.g., private schools, private teachers). In Appendix B.2.2, we replicate the analysis using OECD data that include private expenditures, albeit for a smaller sample limited to developed countries. We use OECD expenditure on educational institutions per full-time equivalent student, measured in US$ PPP. For culture and transportation, relative sectoral consumption expenditures may not be proportional to relative sectoral employment or value-added shares. As an additional robustness check, we use annual household final consumption expenditure by purpose (COICOP 2018) in current prices, normalized by population and adjusted by annual PPP for household final consumption expenditure to obtain per capita expenditures in US$ PPP. In all cases, the results remain consistent.

Robustness 2: non-homothetic CES demand system. In this section, we estimate only an average income elasticity. However, whether a good s is a luxury or a necessity is not an intrinsic characteristic of the good. Rather, it depends on the composition of consumer expenditures and the relative ranking of goods. To account for this, we estimate a non-homothetic CES demand system, following Comin, Lashkari and Mestieri (2021). We choose this demand system for two reasons: (i) it allows for non-vanishing income effects in the long run, and (ii) it accommodates an arbitrary number[9] of goods. The methodology is detailed in Appendix B.2.3, and our results are presented in Table 6.

Table 6: Non-homothetic parameters and income elasticities

	Dependent variable: log(expenditures per capita)							
y	*Health*		*Education*		*Culture*		*Transportation*	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
non-homotheticity: ϵ_s	1.49***	1.22***	1.72***	1.44***	1.18***	0.85***	1.44***	1.36***
	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)	(0.02)	(0.04)	(0.04)
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Observations are weighted by population. Standard errors are clustered at the country level.
Signif. levels against $\theta = 1$: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p< 0.001$

3 Quantitative model

In this section, we create a heterogeneous-agent model to quantify the optimal provision of public spending. The model is focused on the public and private consumption of six goods: education, health, security, culture, transportation, housing. Households also consume a private good, save and choose their labor supply. The fiscal authority provides and subsidize goods, distributes transfer, and has access to various taxes.

3.1 Households

Households consume seven goods: a pure private good c, and six goods g_k which are perfect substitute with their public counterpart and are subsidized: education, health, security, culture, transportation, and housing. Each good k has a weight ω_k in the utility function and a non-homothetic parameter $\bar{g}_k$; the private good has a weight $\omega_c = 1 - \sum \omega_k$. Households choose their labor supply h that enters negatively in their utility function. They can save with asset a subject to a borrowing constraint. Finally, they face idiosyncratic productivity shock z that follow an exogenous stationary Markov process with transition probabilities $\pi_z(z_{t+1}|z_t)$. Each household i solves the following problem:

$$\max_{\{c_{it},\{g_{ikt}\},h_{it},a_{it}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\omega_c \ln(c_{it}) + \sum_{k=1}^{6} \omega_k \ln(g_{ikt} + G_{kt} + \bar{g}_k) - \nu \frac{h_{it}^{1+\psi}}{1+\psi} + \mathbf{X} \right]$$

[9]PIGL preferences used in Boppart (2014) only allow for two distinct income elasticities.

such that

$$\underbrace{(1+\tau^c)c_{it} + \sum_{k=1}^{6}(1-s_k)g_{ikt}}_{\text{Consumption}} + \underbrace{a_{it+1} - a_{it}}_{\text{Savings}} = \underbrace{\Gamma(w_t z_{it} h_{it}, r_t^p a_{it} + d_t(z_{it}))}_{\text{Net labor and capital income}} + \underbrace{T}_{\text{Transfer}}$$

$$\{g_{ik}\}, a_i \geq 0$$

The first equation is the household's objective function. Public (G_k) and private (g_k) consumptions of the good k are perfect substitutes, and the parameter $\bar{g}_k$ determines the non-homotheticity of the good. The parameter ν determines the labor disutility, and ψ the elasticity of labor supply with respect to net wage. Finally, an externality function $\mathbf{X}$ discussed later enters the utility function, but atomistic agents cannot influence it.

The second equation is the budget constraint. Households allocate their income to the consumption of seven goods, and save. Their labor income wzh and capital income $r^p a + d(z)$ is taxed according to a rule Γ described in the government section, with r^p the ex-post return on mutual fund assets. They receive dividend d that depends on productivity z, which is explained in the firm section. Finally, they receive cash transfers T.

The third equation is the non-negativity constraint for g_k and a. This constraint may bind for g_k due to its luxury nature, and for a if the household is at the borrowing constraint.

3.2 Government

The government has three types of expenditures: in-kind benefits G, subsidies s and transfers T. In-kind benefits are either in a pure public good with no private counterpart (G_p), or in education, health, housing, security, culture and transportation (G_k). These six goods are also subsidized (s_k). To finance these expenditures, the fiscal authority taxes consumption at rate τ^c, labor and capital income with the rule Γ, and can emit debt d. Omitting time subscript, denoting the labor income $y_i^l = wz_i h_i$ and the capital income $y_i^k = ra_i + d(z_i)$, the government budget constraint is the following:

$$(1+r)d + G_p + \sum_{k=1}^{6}(G_k + s_k g_k) + T = d' + \int_i \left[y_i^l + y_i^k - \Gamma(y_i^l, y_i^k) + \tau^c c_i \right]$$

We assume a progressive tax on labor income, with progressivity controlled by parameter τ^l, and a linear tax τ^k on capital income, so that

$$\Gamma(y^l, y^k) = \lambda (y^l)^{\tau^l} + (1-\tau^k) y^k$$

The government chooses policies $(G_p, \{G_k, s_k\}, T, \tau^l, \tau^k)$ in a discretionary manner. Debt is constant at the steady state. Finally, the budget constraint balances with labor tax λ.

3.3 Firms

A representative firm produces using capital K and labor N, according to the production function

$$Y = K^{\alpha} N^{1-\alpha}$$

We assume the firm sets its price with a markup $1/\mu$ over its marginal cost,[10] implying a profit $\Pi = Y - r^k K - wN = (1-\mu)Y$. We assume that a share γ of this profit is distributed to households depending on their productivity z, so that

$$d(z) = \frac{z^x}{\int_i z^x} \gamma \Pi$$

The rest of the profit $(1-\gamma)\Pi$ is distributed to owners of equity q. We assume capital, equity and government bonds are owned by a mutual fund in which households can invest. By no-arbitrage, the return on the equity and capital must satisfy:

$$\frac{(1-\gamma)\Pi_{t+1} + q_{t+1} - q_t}{q_t} = r_{t+1} = r^k_{t+1} - \delta$$

If I invest in equity today, it costs me q_t, I earn the future profit $(1-\gamma)\Pi_{t+1}$, plus the capital gain $q_{t+1} - q_t$, yielding the left-hand side return: by no-arbitrage, it must be equal to the return r_{t+1} of investing in public debt today, and to the return on investing in capital that depreciates at rate δ. Absent unanticipated shock, households ex-post return r^p_t is equal to r_t. If there is an unanticipated shock at period t, the no-arbitrage condition momentarily breaks, because the expected return is not equal to the realized return. Then, the ex-post household return r^p_t satisfies the condition $(1 + r^p_t)a_t = (1-\gamma)\Pi_t + q_t + (1 + r_t)d_t$.

3.4 Market clearing conditions and equilibrium

The labor market clears: labor demand N is equal to aggregate effective labor supply, so that

$$N = \int_i z_i h_i$$

Households wealth is invested in public debt, capital and equity of the mutual fund, so that the asset market clearing is

$$\bar{d} + q + K = \int_i a_i$$

[10]This can be microfounded by assuming monopolistic competition between firms, and CES demand between varieties for households, with elasticity of substitution $\epsilon = \frac{1}{1-\mu}$.

Finally, output is consumed by households (c and g_k) government (G_p and G_k) or invested ($I_t = K_{t+1} - (1-\delta)K_t$), so that the good market clearing condition is

$$Y = \int_i \left(c_i + \sum_{k=1}^{6} g_{ik} \right) + G_p + \sum_{k=1}^{6} G_k + I_t$$

Given a sequence for government policies $\{G_p, \{G_k, s_k\}_k, T, \tau^l, \tau^k, d\}$, we define the equilibrium as paths for households decisions $\{c_t, g_{kt}, a_t, h_t\}_t$, firm decisions $\{N_t, K_t, Y_t, \Pi_t\}_t$, and aggregate prices and quantities $\{q_t, r_t, \lambda_t, w_t\}_t$, such that, for every period t, (i) households and firms maximize their objective functions taking as given equilibrium prices and taxes, (ii) the government budget constraint holds, and (iii) all markets clear.

3.5 Calibration

The three key ingredients in our model are the consumption basket for households, the households heterogeneity, and the composition of government expenditures. The calibration of the externality function is discussed in Section 4. All parameter values and target can be found in Table 14.

3.5.1 Households expenditures

In this section, we explain the calibration of our utility parameters related to goods k. The weights ω_k are used to match the share of good k in total households expenditures, while the non-homothetic parameter $\bar{g}_k$ controls the share of households with zero consumption of the good k. To obtain the targets for each good, we use various sources. The first is the French consumption budget survey, *Enquête Budget des Famille 2017*, with detailed consumption for 15,000 households. The second is transaction-level bank data from *La Banque Postale* in 2023. For details of these two database, see Appendix C.1. We also use other sector-specific household-level datasets, and administrative reports. Our method for each good is described below, and our targets and model fit are shown in Table 7.

Table 7: Target and model fit for households parameters

	Share in consumption (ω_k)		Share with $g_i = 0$ ($\bar{g}_k$)	
	Data	Model	Data	Model
Health	3.3%	3.3%	15%	14.7%
Education	1.0%	1.0%	80%	79.6%
Transportation	16%	16%	20.5%	20.6%
Housing	15%	15%	0.5%	0.5%
Security	0.5%	0.5%	25%	25.0%
Culture	8%	8%	60%	59.6%

Health: for *average consumption*, we use 3 sources: government report, consumption survey and bank data. In 2024 National Account DREES report, health expenditures are 325 billion euros (11.5% of GDP): 249 billions for consumption of treatment and medical goods, and 76 billions of other expenditures, mostly long-term care. Among treatment and medical goods, 80% is paid by the government (79.5% by the Social Security, 0.5% by the State) and 20% by the private sector (12.5% by private complementary insurance, 7.5% remaining charge for households). We assume other expenditures follow the same public/private proportion. This means that $325 * 20\% = 65$ billions of euros are paid by households. As households consumption is 1,985 billion,[11] this means that health represents 3.3% of households expenditures. In households budget survey, it is 1.83% of households' expenditures; in bank data, it is 4.41% (see Table 29). Then, we choose 3.3%, the aggregate value, between survey and banking data.

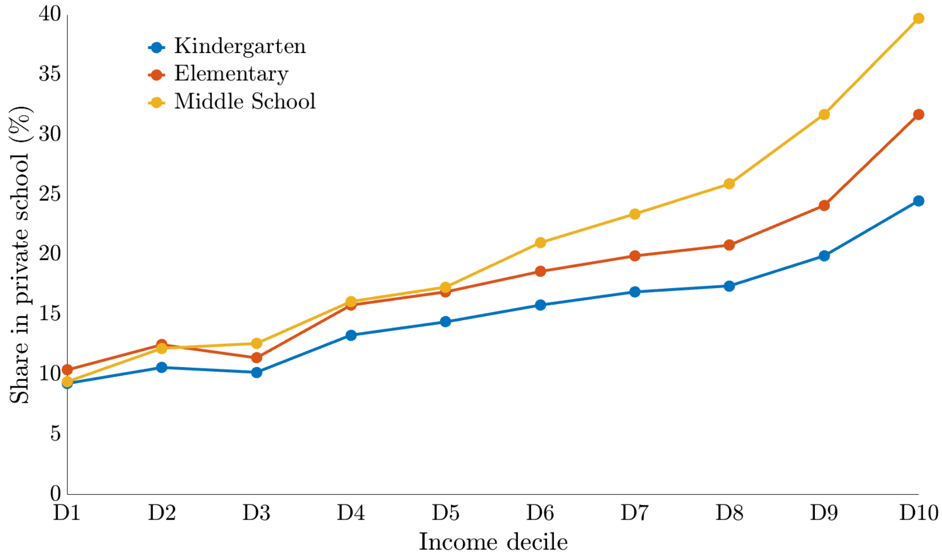
For the *share of households with zero consumption*, we use consumption survey, bank data, and health statistics. For consumption survey, Table 30 reports the share of households spending less than €10 on health. We find that 20% of households, with a strong income gradient: 35% in the lowest income quintile (Q1) versus 11% in the highest (Q5). These low values may reflect under-reporting, measurement error, or simply the absence of health needs. Bank data show similar patterns: nearly 8% of households spend under €10 annually, declining from 13.2% in the lowest quintile to just 2% in the highest. Based on this evidence, we target a share of 15% of households with $g_i = 0$. This figure is consistent with related statistics. According to the Commonwealth Fund's 2023 International Health Policy Survey, 16% of French adults with low or average incomes report skipping or delaying care due to cost, compared to 6% among higher-income individuals. Similarly, the 2023 EU-SILC survey finds that 6% of people aged 16+ report unmet needs for medical care, and 10% for dental care.

[11] National account 2023.

Education: for *average consumption*, we use 3 sources: government report, consumption survey and bank data. In 2023 French report, education expenditures are 190 billion euros (6.7% of GDP): 82% is paid by the government (55% by the State, 23% by local authorities, 4% by other public services) and 18% by the private sector (10% by firms, 8% by households). This means that $190 * 18\% = 32$ billions of euros are paid in fine by households, which represents 1.7% of households' expenditures. In households budget survey, it is 0.73 % of households' expenditures; in bank data, it is 0.46% (see Table 29). Then, we choose 1%, a middle point between report, survey and banking data.

For the *share of households with zero consumption*, we use the surveys *Panel d'élèves du premier degré: 2011-2016* and *Panel d'élèves du second degré: 2007-2017*. These panel datasets regroup 15,188 students from kindergarten to middle school. As the main cost of school are the tuition fees, and as public school in France is free, we define households with zero expenditure as the share of student in public school. As shown in Figure 2, 15% of kids are enrolled in private schools in kindergarten, 18% in elementary school, and 20% in middle school, a share that increases steeply with parental income. Moreover, using the panel dataset *Conditions de vie des étudiants (CdV) – 2016* with 46,340 students in higher education, we find that 23.2% of them pay more than €500 of fees, where in France public university costs around €400 to register. Therefore, we choose a share of 80% for households with zero consumption of education. This number is consistent with the fact that 88% of households in the household survey BdF 2017, and 85% of households in bank data 2023, spend less than €10 in education every year, a pattern that again decreases a lot with income (see Table 30).

Figure 2: Share of kids enrolled in private schools, by income decile



Sources: *Panel d'élèves du premier degré: 2011-2016* and *Panel d'élèves du second degré: 2007-2017*.

Transportation: for *average consumption*, we use government report, consumption survey and bank data. In Chiffres clés des transports - Édition 2025, households' transportation expenditures represents 14% of households' expenditures. In households budget survey, it is 16.6%, and in bank data, it is 17.4% (see Table 29). Then, we choose 16%, a middle point between report, survey and banking data.

For the *share of households with zero consumption*, we use the 2007–2008 survey *Enquête Nationale Transport et Déplacements* (ENTD). As transportation enters utility, not as a constraint but as a consumption good, we assume households value mobility, and find in data the share of mobility-constrained households. We document in Table 8 that mobility, both in daily life (commuting and leisure during the work year) and for vacations, increases with income. Specifically, both the average number of trips on weekdays and weekends, as well as the average number of annual journeys, rise with income. Furthermore, we find that the share of households in the bottom income quintile (Q1) who took a trip of over 100 km in the past 13 weeks is approximately 34%, compared to 75% in the top quintile (Q5). Similarly, 29% of households in Q1 took one or fewer long-distance trips last year, compared to only 11% in Q5. Based on these observations, we target a share of people with zero consumption corresponding to the proportion of households who took one or fewer long-distance trips last year, which is 20.5%.

Table 8: Transports data

	Q1	Q2	Q3	Q4	Q5
Distance home-work-school-daycare, km	7.44	10.38	10.79	11.77	23.69
Average number of annual travels	4.98	5.47	5.64	5.90	7.32
% went on vacation last weekend	8.11	7.23	8.39	10.90	12.85
% went on a +100km travel, last 13 weeks	34.89	43.47	51.86	61.68	75.21
% with less than one annual travel	28.96	25.61	21.40	15.88	10.89

Sources: 2007–2008 survey *Enquête Nationale Transport et Déplacements.*

Housing: for *average consumption*, we use Rapport du compte du logement 2023. Equivalent rents from owners represent 209 billion euros, actual rents of tenants represent 91 billion, summing to 290 billion or 15% of households' expenditures.

For the *share of households with zero consumption*, we use the share of homeless people in 2022 estimated by the DIHAL[12] report, equal to 0.49%. Homelessness definition includes individuals who either spent the previous night in a place not intended for habitation (street, tent, car, car park, park or forest, public transport facility, slum) or in temporary accommodation (emergency shelters).

Security: Consumption surveys do not identify security equipment expenditures. Hence we use the 2019 *enquête Cadre de Vie et Sécurité* with 12,397 households, and show in Table 9 the share of households that own security equipments by income quintiles. This share increases with income or equivalently, the share of households with no security equipment decreases with income. On average, we find that 89.5% of households live with no alarm, 90% with no camera and 45% with no armored door. Overall, 75% of them have at least 1 security equipment. Hence, we target a share of households with zero consumption of 25%. For average consumption, we assume security share in total households expenditures is small and equal to 0.5%.

[12] *Délégation interministérielle à l'hébergement et à l'accès au logement.*

Table 9: Share with security equipments by income quintiles

Category	Mean	Q1	Q2	Q3	Q4	Q5
Alarm	10.5	3.1	5.2	8.6	12.9	21.9
Camera	10.0	8.5	7.1	8.0	10.4	15.4
Armored door	54.7	44.4	49.4	54.6	58.3	65.9
Digital keypad (intercom)	46.5	52.6	43.1	42.6	43.2	51.0
At least 1 equipment	74.9	70.5	69.4	73.0	76.9	84.2
At least 2	36.4	33.0	29.7	32.6	36.6	49.5
At least 3	8.9	4.8	5.3	7.1	9.9	16.6
Building caretaker	10.3	14.5	10.0	9.0	7.8	10.2
Dog for security	5.8	5.8	6.2	6.5	5.9	4.6

Sources: 2019 *Enquête Cadre de Vie et Sécurité*.

Culture: for *average consumption*, we use 3 sources: government report, consumption survey and bank data. In 2023 National Accounts, Cultural, sports and leisure expenditures are 108 billion euros, representing 5.5% of households expenditures. In households budget survey, it is 9.46% of households' expenditures; in bank data, it is 13.45% (see Table), with definition of "culture expenditures" varying across sources. Then, we choose an average consumption of 8%, an average value between these numbers.

For the *share of households with zero consumption*, we use culture survey, consumption survey and bank data. The *Enquête sur les pratiques culturelles des Français*, with 9,234 households, gives us the share of households with no participation to some cultural activities in the last 12 months, that we present in Table 10. 71% of households did not go to the museum in the last 12 months, 57% to a concert and 36% to the theater, a share decreasing with income. In households consumption survey, we find that 79% of households have spend less than €10 in sports equipments or facilities, and 86% for museums and theaters (Table 30). In the bank data, we cannot identify these type of spending since we only have access to the first digit of the COICOP classification, and virtually every households have non-zero spending in the general recreation category. Therefore, we set the share households with zero consumption to 60% in the culture sector.

Table 10: Share with no participation to the activity in the last 12 months (%)

	Mean	Q1	Q2	Q3	Q4	Q5
Concert	56.6	66.1	59.9	58.4	55.8	42.0
Theater or show	36.1	46.9	41.8	34.1	28.7	23.0
Museum	71.2	82.6	79.2	73.3	67.7	48.3
Historic monument	27.2	42.7	33.1	26.6	17.1	8.2

Sources: *Enquête sur les pratiques culturelles des Français.*

3.5.2 Households heterogeneity

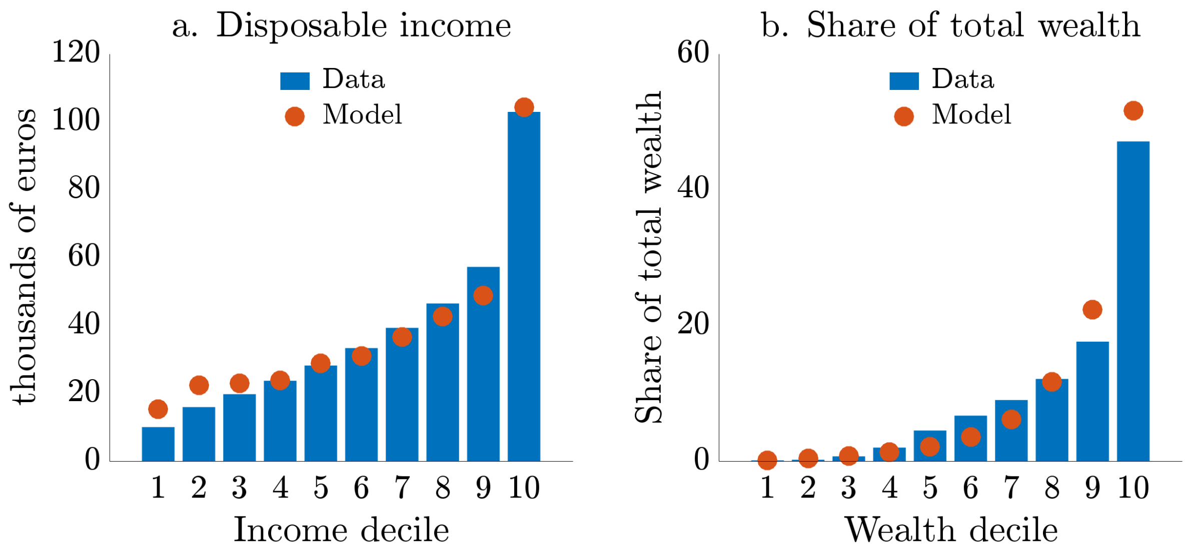
Our strategy to calibrate households heterogeneity is the following. We assume idiosyncratic productivity shock z follows a Markov chain, and we directly compute this Markov chain using fiscal data with 40 million individuals between 2000 and 2023. First, we compute for each households the hourly net wage, by dividing the net wage by hours worked. Second, we divide by the average hourly net wage for each year, to neutralize growth, inflation and business cycle. Third, we subtract to each individual the average increase in wage over life-cycle, to neutralize the salary increase over time for each individual. Fourth, we compute hourly net wage percentiles 16, 32, 48, 64, 80 and 96. This creates 7 productivity categories, to which we associate the average hourly net wage. Finally, we compute the one-year transition matrix between these categories, *i.e.* the probability to have a productivity z' next year when having a productivity z today. The resulting Markov probabilities, values of the grid and invariant probabilities of the matrix, are shown in Table 11 below:

Table 11: Markov probabilities for productivity process z

	z'_1	z'_2	z'_3	z'_4	z'_5	z'_6	z'_7	Sum	Value	Invariant probability
z_1	0.669	0.215	0.093	0.016	0.004	0.003	0.001	1	0.1570	0.0132
z_2	0.018	0.572	0.37	0.028	0.007	0.005	0.001	1	0.4102	0.1173
z_3	0.004	0.109	0.769	0.098	0.011	0.006	0.001	1	0.6633	0.3739
z_4	0.001	0.019	0.161	0.684	0.108	0.025	0.002	1	0.9165	0.1993
z_5	0.001	0.011	0.043	0.154	0.629	0.156	0.006	1	1.1696	0.1123
z_6	0.001	0.009	0.026	0.034	0.104	0.768	0.058	1	1.4228	0.1374
z_7	0.002	0.009	0.023	0.015	0.015	0.138	0.798	1	4.1194	0.0467

We also choose $x = 1$, the curvature of dividend rule with respect to productivity, so that dividends are proportional to productivity. Then, we do not target income and wealth distribution in our model. However, as shown in Figure 3, the resulting level of inequality is close to data. We even slightly over-estimate the share of total wealth held by the top 20%, a feature usually hard to obtain in heterogeneous-agent models.

Figure 3: Untargeted income and wealth distributions, data and model



Source: Insee *Enquête Revenus fiscaux et sociaux* and *Life History and Wealth Survey*.

3.5.3 Government expenditures

As explained in Section 2, we use Eurostat decomposition of government total expenditures into 80 items. We classify these expenditures into in-kind benefits, transfers and debt repayment. We then allocate in-kind benefits into direct provision (G) and subsidies (s) for each good. The resulting policies and model fit, expressed in percent of GDP, are shown in Table 12. As we do not have retired households in our model, the only item we do not match is pensions, hence the difference in the sum of government expenditures between model and data. Other transfers T (sickness and disability, survivors, family and children, social exclusion, and unemployment benefits) are set to be equal to 9.6% of GDP. Finally, debt is set at 100% of GDP. As the debt repayment rd for France in 1.8% of GDP, the implied borrowing rate for France is 1.8%. We calibrate the model to have $r = 3.5\%$, so we slightly over-estimate debt repayment in government budget (since the average rate on French debt is about 2%).

Table 12: Decomposition of government expenditures (% GDP): data and model

	Sector	Data	Model
Direct provision G	Health	4%	4%
	Education	4%	4%
	Transportation	0.6%	0.6%
	Housing	0.7%	0.7%
	Security	1.5%	1.5%
	Culture	1%	1%
	Pure public good	11.5%	11.5%
Subsidies s	Health	5.2%	5.2%
	Education	1.1%	1.1%
	Transportation	1.8%	1.8%
	Housing	1.2%	1.2%
	Security	0.2%	0.2%
	Culture	0.5%	0.5%
Transfer T	Pension	13.1%	0%
	Other	9.6%	9.6%
Debt repayment rd		1.8%	2.8%
Sum government expenditures		57%	44.9%

3.5.4 Other parameters

Government: The standard *consumption tax rate* in France is 20%; for some goods, this rate is reduced to 10% or even lower. To obtain an average value, we use Insee data: adding VAT (176.9), energy taxes (17.6) and other consumption taxes (39.6), we obtain a total of €234.1 billion. As households' total expenditures amount to €2,052 billion, this implies an effective consumption tax rate of 12.9%[13]. Hence, we set $\tau^c = 0.129$.

For the *tax on capital income* τ^k, we sum the six main asset taxes in France: corporate tax (€57.4 billion in 2024), property tax (€55.3 billion in 2024), inheritance tax (€16.6 billion in 2024), transfer rights (€13.0 billion in 2023), flat-rate on capital gains (€6.8 billion in 2023), and real estate wealth tax (€2.2 billion in 2024). Total capital income taxes add up to €151.3 billion. As we target an interest rate of 3.5%, and since the net wealth-to-GDP ratio in France is 5.6, the effective capital income tax is $\tau^k = 0.274$.[14]

To compute the *progressivity of labor tax* τ^l, we use the French Distributional National Account 2023, which distributes the Net National Income by income ventiles.

[13] If $\tau^c c = 234.1$ and $(1+\tau^c) * c = 2,052$, then $\tau^c = 0.129$.

[14] If $\tau^k * ra = 151.3$, $\frac{a}{Y} = 5.6$, $r = 0.035$ and $Y = 2,822$ in 2023, we get $\tau^k = \frac{151.3}{0.035*5.6*2,822} = 0.274$.

We aggregate these to obtain deciles[15] and report the results in Table 13, in thousand euros per year per consumption unit. Then we proceed as follows. First, we compute incomes. National income is divided into 5 categories: gross wages, mixed income of the self-employed, property income, undistributed profits, and income of non-profit institutions. We sum the first two categories to obtain "labor income" and the next two to obtain "capital income". Second, we compute labor taxes. Taxes are divided into 5 categories: consumption, production, labor and property, social contributions for pensions, and other contributions. We sum production taxes, labor and property taxes, and other contributions, and then subtract τ^k (computed above) times "capital income", to avoid double-counting of capital taxes (since we assume a flat tax rate). This gives us "labor taxes". Finally, we compute net labor income with and without pension, subtracting labor taxes (and pension contributions in the first case) from labor income. We obtain the ratio between net labor income and original labor income. This ratio decreases with income, and is equal to 51% with pensions and 71% without pensions, on average, as pensions represent about 20% of labor income.

Table 13: Income and taxes by income decile (thousands euros per year)

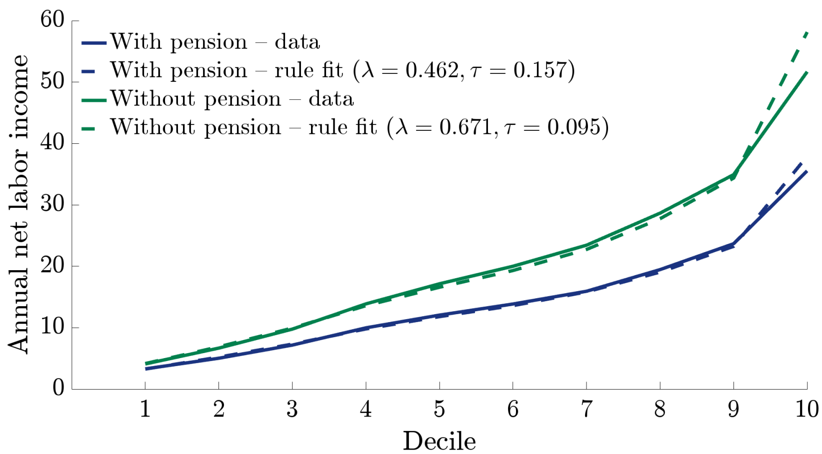
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Labor income	5.1	8.9	13.3	18.9	23.5	27.8	33.3	41.5	52.5	93.9
Capital income	2.0	2.0	2.7	3.3	3.8	4.4	5.3	5.8	8.45	39.7
Labor taxes	1.0	2.2	3.6	5.0	6.4	7.8	9.9	12.8	17.6	42.3
Pension contributions	0.8	1.7	2.6	3.9	5.1	6.15	7.5	9.2	11.2	16.1
With pensions										
Net labor income	3.3	5.0	7.2	10.0	12.0	13.9	15.9	19.5	23.7	35.5
$\frac{\text{Net labor income}}{\text{Labor income}}$ (%)	64.5	56.6	53.7	52.9	51.3	49.8	47.9	46.9	45.1	39.1
Without pensions										
Net labor income	4.1	6.7	9.8	13.9	17.1	20	23.4	28.7	34.9	51.7
$\frac{\text{Net labor income}}{\text{Labor income}}$ (%)	80.2	75.0	73.2	73.6	73	72	70.4	69	66.6	56.9

Using this last ratio, we can estimate our net labor income function $\Gamma^l(y) = \lambda y^{1-\tau^l}$. We rescale the labor income of Table 13 by the GDP per capita to obtain the model counterpart y_i for each decile i. We create the net-to-gross ratio function $R_i(\lambda, \tau^l) = \frac{\Gamma^l(y_i)}{y_i} = \lambda(y_i)^{-\tau^l}$. Finally, we find λ and τ^l in order to minimize the distance between the model ratio and the data ratio computed above: $\min_{\lambda,\tau^l} \left\{ \sum_{i=1}^{10} \left(R_i(\lambda, \tau^l) - \frac{\text{Net labor income}_i}{\text{Labor income}_i} \right)^2 \right\}$. For the data with pension, we find values $\lambda^\star = 0.462$ and $\tau^{l\star} = 0.157$. For the data without pension, we find $\lambda^\star = 0.671$ and $\tau^\star = 0.095$. Therefore, in our model without

[15] The first ventile shows disproportionate values, for example a total income of €5,300 per year, but total taxes of €6,400. To compute progressivity, we exclude this ventile and treat the first decile as corresponding to the second ventile only.

pension, we choose the progressivity tax rate $\tau^l = 0.095$, and we let λ adjust to clear the government budget constraint (0.68 in the model). In Figure 4 below, we show the fit of our function with data (with and without pensions); the fit is good, except that we slightly underestimate taxes on rich households.

Figure 4: Annual labor income by income decile, data and rule $\lambda(y)^{1-\tau^l}$



Sources: Distributional National Accounts.

Household: we set the labor disutility ν such that Y is equal to 1 in our initial steady state. The Frisch elasticity is set to 0.4 such that $\psi = 1/0.4$. β is set to match a steady state interest rate of 3.5%.

Firms: we choose a markup equal to 14% so that $\mu = 1 - 0.14$. To calibrate the total wealth, we use Banque de France report. Households net wealth-to-GDP ratio is 5.6, and 56% of these assets is housing. Non-financial corporations net wealth-to-GDP ratio is 1.5, and 34% of these assets is housing. Therefore, the sum of non-housing wealth-to-GDP ratio for households and firms is 3.5.[16] As debt-to-GDP ratio is 1, this leaves us with a financial wealth-to-GDP of 2.5. We choose α, the capital share, such that $\frac{K}{Y} = 2$, and γ, the share of profit distributed in dividend, such that $\frac{q}{Y} = 0.5$.

[16] $5.6(1 - 0.56) + 1.5(1 - 0.34) = 3.5$.

Table 14: Table of parameters

Parameter	Description	Value	Notes and targets
Households			
β	Discount factor	0.977	$r = 3.5\%$
ω_k	Weight of good k	[0.079 0.108 0.355 0.083 0.023 0.220], see text	
$\bar{g}_k$	Luxury parameter k	[0.5 0.76 1.06 0.15 0.06 0.71], see text	
ν	Labor disutility	0.3	$Y = 1$
ψ	Inverse Frisch	2.5	Frisch = 0.4
$\underline{a}$	Borrowing constraint	0	Choice
Government			
$G_p, \{G_k\}, \{s_k\}$	In-kind and subsidy	see text	
T	Transfers	0.096	Share of T in GDP
$\bar{d}$	Initial debt	1	Debt/GDP=100%
τ^l	Labor tax progressivity	0.095	Estimated, see text
τ^k	Asset income tax rate	0.275	Estimated, see text
τ^c	VAT tax rate	0.129	Estimated, see text
Firms			
μ	Markup	1.1	$\Pi/Y = 14\%$
γ	Share of dividend	0.875	$q/Y = 0.5$
α	Capital share	0.2	$K/Y = 2$
x	Dividend distribution rule	1	Share of dividend for Q10

4 Revealed externalities and planner preferences

Our theory of public spending is grounded on two features: the luxury nature of the goods provided by the government, and the concave externalities associated to these goods. The first feature is justified by our empirical evidence in Section 2. The second is not easily identifiable. In this section, we use our quantitative model to retrieve the parameter of the externality functions that are consistent with observed policies, for different welfare functions. We then discuss the plausibility of our externality estimates. We provide some cross-country correlations between GDP per capita and unequal education and health levels, and compare our estimates with existing literature.

4.1 Observed policies and revealed preferences

We observe a given level of direction provision G_k, subsidies s_k and pure public good G_p. Assuming these policies are set at their optimal, welfare-maximizing levels, we reverse-engineer what is the welfare function consistent with the observed levels in France. For K = {health, education, transportation, security, culture, housing}, we assume the externality function is the following:

$$\mathbf{X} = \sum_{k \in K} \left[\chi_k \frac{\epsilon_k}{\epsilon_k - 1} \ln \left(\int_j (g_{i,k} + G_k)^{\frac{\epsilon_k - 1}{\epsilon_k}} \right) \right] + \chi_p \ln(G_p)$$

Parameters χ_k control the level of the externality associated to the good k, and parameters ϵ_k control the curvature. As the pure public good G_p is not privately consumed by households, there is no associated curvature parameter.

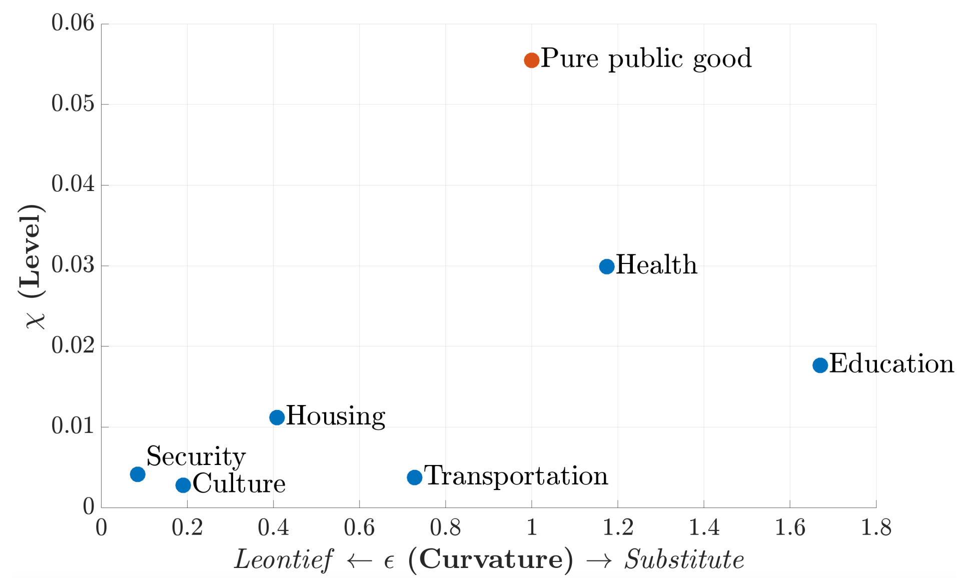
We assume a utilitarian planner (and consider other welfare function in Appendix E.1) who maximizes the sum of steady state individual value functions:

$$\mathbb{W} = \int V(a, z) d\mu(a, z)$$

with V the value function of households with asset a and productivity z, and μ the stationary measure over the asset×productivity state space. Then we have 13 parameters to find: the externality levels χ_k, the externality curvatures ϵ_k, and the externality level of pure public good χ_p, and 13 associated policies that must be at their optimal levels: in-kind benefits G_k, subsidies s_k, and pure public good G_p. We jointly compute the 13 parameters $(\{\chi_k\}, \{\alpha_k\}, \chi_p,)$ to solve the following 13-equation system:

$$\forall k \in K, \ \frac{d\mathbb{W}}{G_k} = \frac{d\mathbb{W}}{s_k} = \frac{d\mathbb{W}}{G_p} = 0$$

We obtain the following results:



with the pure public good aligned on $\epsilon = 1$ in the x-axis. The explanation for these results is the following. First, the higher the total expenditures in a sector (in-kind and subsidies), the higher the level of χ. Second, the higher the subsidy, the higher the substitutability ϵ. If the government relies mostly on in-kind benefits, it means that the substitutability between individual contributions must be low, otherwise the government would have preferred subsidies (education is a special case, because even if direct provision is the most part of education policy, the subsidy rate is still very high). Figure 12 in Appendix clearly shows this relationship. This means that the relative substitutability is low for security, culture, housing and transportation, medium for health, and high for education (perfect substitutability means $\epsilon = \infty$, hence the term "relative").

Of course, these results depend heavily on the assumptions that the government is running optimal policy. In the rest of the Section, we discuss our results, compare them with existing estimates for externalities, and provide some evidence for the concavity of the externality function.

4.2 Relation to literature

As the empirical estimation of externalities is difficult, especially because our theory necessitates both a level and a curvature for the externality function, we have chosen to reverse-engineer the model. By assuming the government' policies (G_k, s_k) are optimal, we obtain the (ϵ_k, χ_k) consistent with observed policies, for each luxury good k.

This choice does not prevent us to compare our results with the empirical estimates of externalities found in the literature, especially for education and health. In this section, we relate existing estimate, enriched by our own results, to our model, to calibrate our externality function, and we compare the empirical results with the results above. [Work in progress].

4.3 Distribution versus average: stylized facts for education and health

We present some correlations between GDP per capita and the average levels and inequality in education and health. We show that there is a clear negative correlation between GDP per capita and inequality in education and health, even after controlling for income inequality. These stylized facts are not proof of the imperfect substitutability of our externality function, but they still suggest that high prosperity may not be achievable if health and education attainments are too unequal.

4.3.1 Education

We use country-level panel data to estimate the effect of average education and education inequality on GDP per capita. We use Barro and Lee (2013) dataset for the average years of schooling across countries, extended by Ziesemer (2022) to compute the Gini index on education. We use the World Bank database for the Gini index for income distribution and the GDP per capita. We obtain a database with 147 countries i, between 1950 and 2015, with one observation per country every five years. We run the following regression:

$$\ln(\text{gdp per capita}_{i,t}) = \alpha + \beta_1 \,\text{average education}_{i,t} + \beta_2 \,\text{gini education}_{i,t} + \beta_3 \,\text{gini income}_{i,t} + \gamma_t + \mu_i + \epsilon_{i,t}$$

Our results are showed in Table 15.

Table 15: Education and inequality on GDP per capita

Dependent Variable:	log(GDP per capita)			
Model:	(1)	(2)	(3)	(4)
Constant (α)	8.286***			
	(0.6561)			
log(Average education) (β_1)	0.5625**	0.6255**	-0.3468**	-0.4226***
	(0.2406)	(0.3138)	(0.1365)	(0.1611)
Gini Education (β_2)	-1.308*	-1.190	-0.9020**	-1.290**
	(0.7667)	(0.8956)	(0.4372)	(0.5690)
Gini Income (β_3)				1.117**
				(0.4588)
Time fixed-effect (γ_t)		Yes	Yes	Yes
Country fixed-effect (μ_i)			Yes	Yes
Observations	1,836	1,836	1,836	846
R^2	0.49	0.50	0.92	0.96

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.*
Standard errors are clustered at the country-level.

Column (1), without fixed effects and income inequality, shows a clear negative correlation between GDP per capita and the Gini index for education, meaning that a higher education equality is associated with more income. As illustrated by column (2), this effect is not due to the general income inequality, and is specific to education inequality. Moreover, the coefficient β_2 stays significant and around -1 by adding fixed effects in column (3) and (4).

4.3.2 Health

We use country-level panel data to estimate the effect of health expenditures and health inequality on GDP per capita. We use Aburto et al. (2020) dataset that compute a Gini coefficient in women's life expectancy, using the Human Mortality Database. We use the World Bank database for the Gini index for income distribution and the GDP per capita. As a control, we add the average life expectancy from the UN, World Population Prospects (2024). We obtain a database with 183 countries i, between 2000 and 2022, with one observation per country every year. We run the following regression:

$$\ln(\text{gdp per capita}_{i,t}) = \alpha + \beta_1 \ln(\text{health exp. per capita}_{i,t}) + \beta_2 \,\text{lifespan inequality}_{i,t} + \beta_3 \,\text{gini income}_{i,t} + \beta_4 \,\text{mean life expectancy}_{i,t} + \gamma_t + \mu_i + \epsilon_{i,t}$$

Our results are showed in Table 16.

Table 16: Health expenditures and inequalities in life expectancy on GDP per capita

Dependent Variable:	log(GDP per capita)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant (α)	5.187***	7.264***				
	(0.2534)	(1.889)				
$\log(\frac{\text{health exp.}}{\text{capita}})$ (β_1)	0.7222***	0.6516***	0.7464***	0.7002***	0.3660***	0.4082***
	(0.0284)	(0.0552)	(0.0290)	(0.0525)	(0.0328)	(0.0512)
Lifespan inequality (β_2)	-2.230***	-10.53**	-2.225***	-10.68**	-1.074**	-6.409***
	(0.6312)	(5.070)	(0.6290)	(4.534)	(0.4502)	(2.373)
Gini Income (β_3)		0.3487		0.6130*		-0.3845*
		(0.3093)		(0.3144)		(0.2145)
Mean life expectancy		-0.0123		-0.0152		-0.0129
		(0.0204)		(0.0188)		(0.0111)
Time fixed-effect (γ_t)			Yes	Yes	Yes	Yes
Country fixed-effect (μ_i)					Yes	Yes
Observations	3,996	1,587	3,996	1,587	3,996	1,587
R^2	0.89	0.88	0.91	0.90	0.99	0.99

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1. Standard errors are clustered at the country-level.*

Column (1), without fixed effects and income inequality, shows a clear negative correlation between GDP per capita and lifespan inequality. As illustrated by column (2), this effect increases when controlling for income inequality. Moreover, the coefficient β_2 stays significantly below 0 by adding fixed effects in column (3) to (6). Adding mean life expectancy as a control does not change the results and its coefficient is not significant.

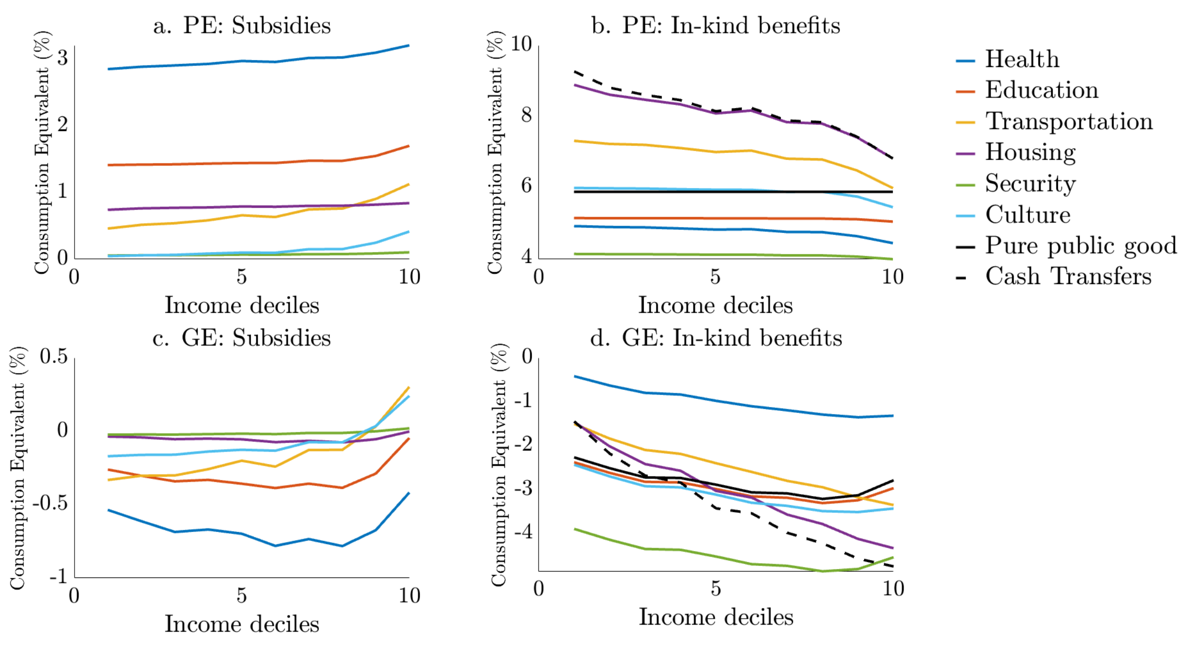
5 Public spending and inequalities

Before turning to the fiscal consolidation exercise, we analyze the key properties of our model. First, we examine who benefits from in-kind provision and subsidies. Second, we assess how the introduction of in-kind benefits alters the optimal degree of redistribution. Third, we investigate how the optimal levels of in-kind provision and subsidies respond to rising inequality.

5.1 The distributive effects of public spending

We now compute the distributive impact of each type of government purchase separately. Specifically, we simulate a 1% of GDP increase in cash transfers, in-kind public provision, and subsidies. We then estimate the distributive effects both in partial equilibrium (holding the income distribution, prices and taxes fixed) and in general equilibrium. Figure 5 reports the welfare effects, expressed in consumption-equivalent terms, by income deciles.

Figure 5: Distributive effects of subsidies and in-kind provision



Partial equilibrium. In partial equilibrium, any expansion of public policy raises household welfare, since policies enter utility positively, either directly or through externalities, and taxes do not adjust. However, their distributive profiles differ. Subsidies are regressive, as poor people do not consume the luxury goods that are subsidized. In-kind benefits are progressive: even if the goods provided are less valuable than transfer for poor household, it still represents a significant increase in their consumption. Cash transfers are more progressive than both subsidies and in-kind benefits, while the pure public good delivers a flat welfare effect across the distribution.

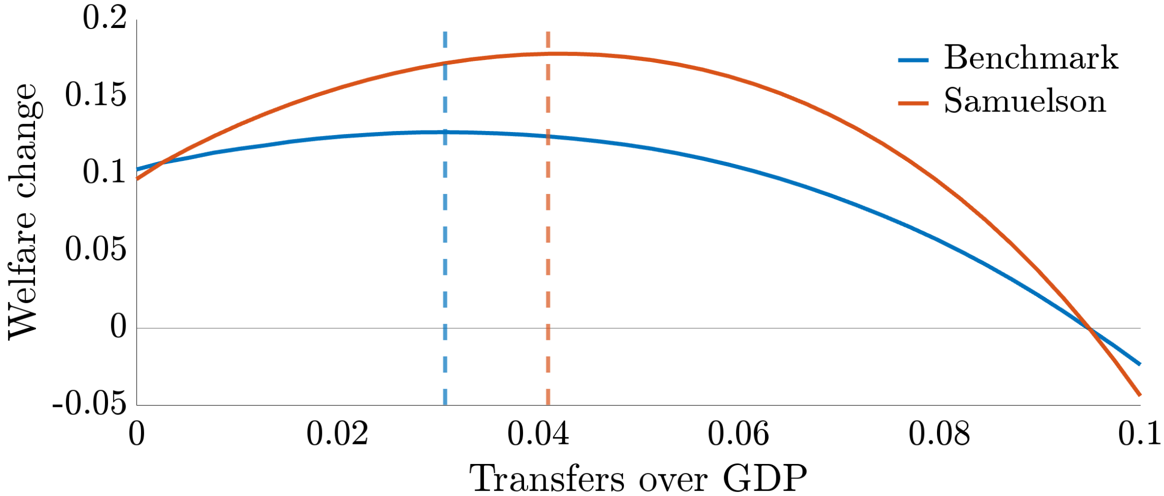
General equilibrium. In general equilibrium, because the model is calibrated such that existing policies are optimal, any deviation from steady-state values reduces aggregate welfare. Yet the incidence of these welfare losses varies across households. For instance, subsidies to culture and transportation lower overall welfare but disproportionately benefit higher-income households, confirming that subsidies are regressive. By contrast, in-kind benefits remain progressive in general equilibrium. This is because they are financed by higher labor income taxes, which are effectively progressive since poorer households rely more on transfers than on labor earnings. Finally, cash transfers remain the most progressive policy instrument.

5.2 Optimal tax progressivity and public spending

We now quantify how our way of modeling public expenditures modifies the optimal degree of tax progressivity. In many models, public spending G does not interact with redistribution, except indirectly through the taxes required to finance it. In our framework, however, because households can privately consume publicly provided goods, G itself becomes a source of redistribution and directly interacts with optimal transfers and progressivity.

We first compute the optimal level of cash transfers, reported in Figure 6. In our benchmark model, we obtain $T^{\star} = 3\%$ of GDP. We then consider a modified version of the model in which all in-kind transfers and subsidies (57.2% of total public spending) are treated as a pure public good G_p, entering separably in household utility, as is standard in most macroeconomic models. After recalibrating the model for comparability, we compute the optimal $T^{\star}$ and find that it rises to about 4% of GDP. This implies that neglecting the distributive role of public spending leads to an overestimation of the optimal level of redistribution through lump-sum transfers. Put differently, recognizing that in-kind transfers already serve as a redistributive tool reduces the need for additional redistribution via cash transfers, even if the latter remain the more efficient instrument for redistribution.

Figure 6: Optimal transfers: benchmark model versus “Samuelson”



Another channel of redistribution is labor tax progressivity, τ^l. In Heathcote, Storesletten and Violante (2017), the optimal value is 0.084, below the empirical estimate, implying that the U.S. tax system is “too redistributive.” In our framework, we similarly find that the optimal τ^l in the French system is below the observed level, and in fact $\tau^{l\star}$ is negative. Importantly, however, the optimal progressivity depends crucially on how workers respond to labor taxation, and therefore on how labor supply is modeled. In our benchmark specification, households choose labor supply along the intensive margin, subject to a utility cost $-\nu\frac{h^{1+\psi}}{1+\psi}$. In this setup, an increase in labor tax progressivity induces large reductions in labor supply among high-income households. As a result, the efficiency cost of progressive taxation is high: the planner avoids taxing rich households too heavily, since they would sharply reduce their hours worked.

Although not the main focus of the paper, we compare this intensive-margin approach to an extensive margin specification, as in Ferriere and Navarro (2025). Here, households face a discrete choice: $h \in 0, \bar{h}$, subject to a linear utility cost $-Bh$. We introduce a Gumbel shock on the choice of hours (see Appendix D for details), and compute labor participation elasticities in both models: that is, the percent change in labor supply by income quintile when the labor tax rate increases by 1%. Results are reported in Table 17.

Table 17: Labor participation elasticities

	Q1	Q2	Q3	Q4	Q5
Intensive margin (Frisch elasticity)	0.31	0.31	0.45	0.59	0.73
Extensive margin (discrete labor choice)	0.75	0.65	0.56	0.43	0.21

With the extensive-margin model, elasticities are essentially reversed: increases in labor tax progressivity raise participation among low-income households and barely reduce labor supply among the rich. In this case, we find a much higher optimal value for tax progressivity, $\tau^{l\star} = 2.2$, compared to the observed one. This implies that under the extensive-margin implementation, the current French system is not redistributive enough, since taxing rich households entails very limited efficiency losses.

Finally, even under the extensive-margin specification, the optimal tax progressivity remains higher in the "Samuelson scenario." Overall, our implementation of in-kind benefits lowers the optimal degree of redistribution relative to previous models, both in terms of cash transfers and labor tax progressivity.

5.3 Optimal in-kind benefits and changing inequalities

Finally, we study how optimal in-kind benefits and subsidies respond to an increase in inequality. In Proposition 1 of Section 1, we show that if there is no private consumption of the publicly provided good, the optimal level of in-kind benefits is independent of inequality. By contrast, Proposition 3 demonstrates that when agents can privately consume the publicly provided good, optimal provision depends on inequality, consistent with the common view that public services disproportionately benefit poorer households. Numerical simulations in Figure **??** confirm that $G^\star$ increases with inequality.

We then perform the same experiment in our quantitative model, for each good. To facilitate comparison with standard heterogeneous-agent frameworks, we construct an alternative version of our model where the idiosyncratic income process z follows an AR(1) with persistence 0.93 and innovation standard deviation $\sigma = 0.20$. We calibrate the optimal externality parameters $\chi_k, \epsilon_k, \chi_p$ as described in Section **??**, ensuring that the observed policies G_k, s_k, G_p are optimal in this benchmark.

Next, we keep these externality parameters fixed but raise inequality by increasing the income shock standard deviation to $\sigma = 0.21$. Prior to any policy adjustment, this raises the Gini coefficient of labor income from 0.472 to 0.483 and the Gini coefficient of wealth from 0.670 to 0.673. We then compute the new optimal policies by solving for the vector $\mathbf{x} = G_k, s_k, G_p$ such that $\frac{d \int_i V_i}{d\mathbf{x}} = 0$. Table 18 reports the results, expressed as percent changes relative to GDP, $\Delta(x) = 100 \times (x^{\sigma=0.21} - x^{\sigma=0.20})$.

Table 18: Policy change after an increase in inequality (%)

	Health	Education	Transportation	Housing	Security	Culture	Pure
$\Delta(G_k^\star/Y)$	1.51	0.10	0.09	0.02	0.05	0.04	0.11
$\Delta(s_k^\star g_k/Y)$	-1.33	-0.07	-0.09	-0.04	-0.03	-0.13	/

As shown, optimal in-kind benefits rise with inequality, in line with our analytical results. Higher inequality reduces the externalities, pushing the government to expand direct provision in order to offset disparities in individual contributions, while simultaneously lowering subsidies that mainly increase consumption among richer households. Overall, the size of government rises by 0.23% of GDP, again consistent with the analytical predictions. With these distributional dynamics clarified, we now turn to our main quantitative exercise.

6 On the optimal design of fiscal consolidation

The main contribution of this paper is to propose a new theory of in-kind benefits, grounded in non-homothetic preferences and externalities. We estimated the externality parameters that render government policies optimal: a natural application of our theory is now to use these parameters to determine the optimal strategy for fiscal consolidation. In this section, we assume the objective is to transition towards a new steady-state with a lower level of government debt, and we compute the optimal mix between increasing taxes and reducing in-kind benefits and subsidies. We first analyze the optimal final steady state, and then the optimal transition.

6.1 A new world with less debt

We suppose the government wants to reduce the public debt-to-GDP ratio from 100% to 90%. It is out of the scope of this paper to know if this is optimal or not. In many models, including ours, the static optimal level of debt is low, or even 0, as debt repayment induces distortionary taxation. However, dynamically, the optimal level of debt can be much larger, as increasing debt creates benefits today, while the future cost is discounted. Therefore, we take as given the trajectory of public debt.

At the new steady state, with a lower level of debt, the government has more money, and can reduce distortionary taxes or increase public spending. Therefore, we need to re-optimize over our 13 interest policies: $\{G_k, s_k, G_p\}$, with λ that implicitly adjusts to maintain the government budget constraint. These policies were optimal at the initial steady state, because the externality parameters $\{\epsilon_k, \chi_k, \chi_p\}$ were calibrated to make them optimal. Now, we do the opposite: taking as given the externality parameters, we find the best policies to maximize welfare. Formally, we find the new vector $\mathbf{x} = \{G_k, s_k, G_p\}$ such that $\frac{d\mathbb{W}}{d\mathbf{x}} = 0$, with $\mathbb{W} = \int_i V_i$ the integral of individuals' value functions. Denoting x_0 and x_{new} the values of variable x at the initial and new steady states, respectively, and $\Delta x = 100 \times (\frac{x_{new}}{Y_{new}} - \frac{x_0}{Y_0})$ the absolute percent change with respect to GDP, we obtain the following optimal policies at the new steady state:

Table 19: Policy change at the new steady state with less public debt (%)

	Health	Education	Transport	Housing	Security	Culture	Pure
$\Delta G_k^\star$	0.19	0.06	−0.01	0.01	0.01	0.01	0.02
$\Delta s_k^\star g_k$	−0.33	−0.10	−0.08	−0.15	−0.02	−0.05	/

The story behind these results is the following. With less debt repayment, the government has more money, either to increase externality with in-kind benefits and subsidies, or to decrease distortionary taxation. Absent any general equilibrium change, the optimal response would probably be to increase a bit each policy. However, the reduction by 10% of debt available to households has distributive consequences. Even if the decrease in debt (−10% GDP) is slightly compensated by the increase in capital (+0.5%) and equity (+0.3%) due to the decrease in interest rate, the sum of wealth decreases (−9.2%). With less assets available, more people are at the borrowing constraints, and the asset distribution is more unequal: the top 10% of the wealth distribution holds 52% of total wealth at the new steady state, against 51% at the initial one. This increases the share of households with zero consumption of g_k, by 1% on average. The distribution of individual consumption of externality goods is more unequal, which penalizes the externality function. Then, the government increases the direct provision G_k to maintain enough equality, and decreases subsidies s_k that are biased towards rich households. Finally, the pure public good increases with less debt: as the new steady state is more efficient, with less debt repayment and then less taxes (λ goes from 0.57 to 0.56), private consumption increases, and through the Samuelson rule, public consumption G_p also increases.

6.2 Comparing fiscal consolidations

General experiment. We computed the optimal policies $\mathbf{x} = \{G_k, s_k, G_p\}$ for our initial and final steady states, with a debt-to-GDP ratio of 100% and 90%, respectively. We then compute the transition between these two steady states under different consolidation scenarios. In every experiment, we assume a debt shock equal to $\epsilon_1 = -0.01$ at $t = 1$, and $\epsilon_{t+1} = 0.9 \cdot \epsilon_t$ for $t \geq 2$, so that the total shock is $\sum_{t=1}^{\infty} \epsilon_t = 0.1$, *i.e.*, 10% of initial GDP. Therefore, the exogenous debt path is given by $d_{t+1} = d_t + \epsilon_t$. Finally, to link our optimal policies $\mathbf{x}$ between the initial and final steady states, we assume the policy path is given by $\mathbf{x}_t = \mathbf{x}_{t-1} + \frac{\mathbf{x}_{new} - \mathbf{x}_0}{d_{new} - d_0} \epsilon_t$.

To finance this reduction in public debt, we allow the government to change the policies included in the vector $\mathbf{k}$ (in-kind benefits or subsidies), while keeping the other policies constant, except for the labor tax rate λ, which always balances the government budget constraint.[17] We restrict the policy path by assuming it must be proportional to the change in debt, so that $\mathrm{d}\mathbf{k}_t = \boldsymbol{\alpha} \cdot \epsilon_t$, with $\boldsymbol{\alpha}$ the vector of coefficients. The planner chooses the coefficients in $\boldsymbol{\alpha}$, and implicitly the policies in $\mathbf{k}$, in order to maximize the welfare along the transition:

$$\max_{\boldsymbol{\alpha}} \mathbb{W}^d(\mathbf{k}) = \int V(a_1, z_1) \mathrm{d}\mu(a_1, z_1)$$

$$\text{such that} \qquad d_{t+1} = d_t + \epsilon_t$$

$$\text{and} \qquad \mathrm{d}\mathbf{k}_t = \boldsymbol{\alpha} \cdot \epsilon_t$$

with $\mathbb{W}^d(\mathbf{k})$ the welfare during the transition between $t = 1$ and ∞, $V_1(a_1, z_1)$ the value function[18] at the first period of the transition of households with asset a_1 and productivity z_1, and μ the measure over the state space at period 1.

Note on the method: non-linear transitions and Ramsey steady state. Optimizing welfare during transition is challenging for two reasons. First, the transition is non-linear: we move from one steady state to another, and therefore cannot rely on linearization techniques. More importantly, linearization implies that welfare changes linearly with respect to policies: if changing policy x by 1 increases welfare by y, then changing x by 10^{10} would increase welfare by $10^{10}y$, preventing us from finding an interior solution for the path of public spending and taxes. For this reason, we cannot use the sequence-space Jacobian method of Auclert, Bardóczy, et al. (2021), widely applied in heterogeneous-agent models. Instead, we develop from scratch our own non-linear transition codes in Matlab. Our codes, available online, solve the non-linear transition in one second, using techniques described in Appendix D. We still rely on the fake-news tricks of Auclert, Bardóczy, et al. (2021) to speed up the computation of the Jacobian around the final steady state, which we use in our quasi-Newton algorithm to update guesses.

[17] This change in $\mathbf{k}$ adds to the "normal" change in policies required to connect the two steady states.

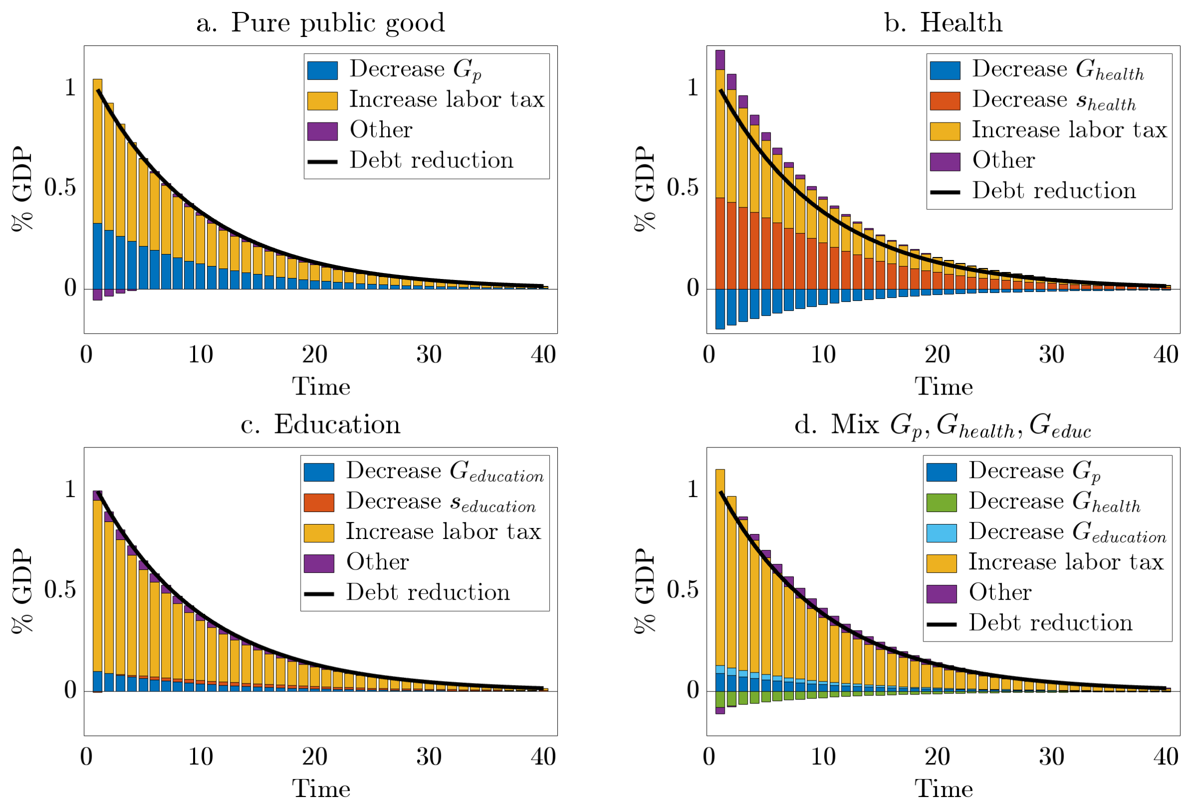
[18] $V_1(a_1, z_1) = \max \{u_1 + \beta \mathbb{E}_{z'} [V(a_2, z_2) | z_1]\}$.

The second obstacle is more fundamental, and relates to the notion of the "Ramsey steady state." In our model, steady-state policies are optimal in the sense that they maximize welfare, defined as the integral of individuals' value functions. However, they may not be dynamically optimal, in the sense that the planner may want to deviate from these policies during the transition, and converge towards different values. In this sense, we are not at the "Ramsey steady state," and it would be numerically difficult to find it, if it even exists (see Auclert, Cai, et al. (2024)). This raises a major concern for our experiment: if a given policy path maximizes welfare, how can we know that it results from the debt-reduction shock, rather than simply from the planner exploiting the transition to get closer to the Ramsey steady state? Indeed, not starting at the Ramsey steady state means that, even absent shocks, the planner may want to deviate from "optimal" steady-state policies. For instance, if $G^{\star}$ maximizes welfare at the steady state, a temporary deviation to $G \neq G^{\star}$ may still be welfare-improving. Therefore, solving the problem above is not sufficient to compute the optimal fiscal consolidation, since the results may be contaminated by the Ramsey steady state problem.

To address this issue, we propose a simple and, in our view, reasonable way to isolate the true consolidation response. We first compute the transition without any shock ($d_{t+1} = d_t = 90\%$ GDP, with other policies constant), at the final steady state, and solve the problem above. This yields the vector $\boldsymbol{\alpha}^{\text{no shock}}$, which determines the change in policies $\mathbf{k}^{\text{no shock}}$. In other words, we allow the planner to use the transition to temporarily re-optimize policies and move closer to the Ramsey steady state. Second, we compute the transition with the debt shock and associated policy changes between the initial and final steady states, obtaining the vector $\boldsymbol{\alpha}^{\text{shock}}$ and the policies $\mathbf{k}^{\text{shock}}$. These policies combine both the debt-reduction response and the Ramsey deviation. Third, we isolate the debt-reduction component by taking the difference: $\mathbf{k} = \mathbf{k}^{\text{shock}} - \mathbf{k}^{\text{no shock}}$. This "double-difference" method allows us to identify the planner's preferred policy response to reduce public debt, net of Ramsey-driven deviations.

Policy scenarios. Within the general debt-reduction experiment, and using our "double-difference" method described above, we consider four scenarios: three focusing on our largest policies separately, and one combining them. In the first scenario, the planner can adjust $\mathbf{k} = G_p$, the pure public good, and implicitly the labor tax rate λ. This corresponds to the standard view of fiscal consolidation, where in-kind benefits enter utility in a separable way and do not interact with agents' decisions, except through tax changes. A concrete example would be a planner reducing public debt by cutting military spending. In the second and third scenarios, the planner can adjust $\mathbf{k} = G_k, s_k$, *i.e.*, the direct provision and subsidies in sector $k = \{\text{Health, Education}\}$. Scenario 2 thus corresponds to debt reduction through cuts in public hospitals and medicine reimbursements, while Scenario 3 reflects cuts in public schools and subsidies to private schools. In the fourth scenario, the planner has access to $\mathbf{k} = G_p, G_{\text{health}}, G_{\text{education}}$, *i.e.*, the direct provision of the pure public good, health, and education. Figure 7 shows the optimal policy deviations in each scenario relative to the final steady state.

Figure 7: Fiscal consolidation with different scenarios



In Figure 7, positive values represent gains for the government (which help reduce public debt), while negative values represent losses (which hinder debt reduction). The black line, common to all scenarios, represents the reduction in debt, equal to $-\epsilon_t$. The bars must add up to the black line: gains minus losses equal the total effort required to reduce public debt. The blue bars represent changes in direct provision: a positive value indicates a decrease in G. The red bars represent changes in subsidy costs $s_k g_k$: a positive value indicates a reduction in subsidy costs. The yellow bars represent changes in labor tax revenues, $zwn - \lambda(zwn)^{1-\tau^l}$: a positive value indicates an increase in labor taxation, *i.e.*, a decrease in λ. Finally, the violet bars capture the general equilibrium effects in the government budget constraint, arising from changes in other revenues (capital and consumption taxes) or expenditures (subsidies and debt repayment). A negative value indicates a reduction in net revenues (*i.e.*, lower revenues or higher expenditures).

The main result is the following: **the higher the share of households that**

consume a good privately, the less the planner should reduce its public provision when lowering public debt. In other words, since fiscal consolidation already reduces individual consumption of health and education, the planner should avoid further cutting the direct public provision of these goods. If fiscal consolidation reduces private consumption of a good that generates externalities too strongly, the planner may even increase its provision to compensate—illustrated in panel b for health. In the first period, for a 1% debt reduction, the optimal reductions in G are 0.33% for the pure public good, 0.1% for education, and −0.2% (*i.e.*, an increase) for health.[19] The shares of households consuming these goods privately are, respectively, 0% for the pure public good, 20% for education, and 85% for health. In panel d, where we jointly optimize the three provisions, we also find that the pure public good should decrease (−0.9%) more than education (−0.04%), while health should increase slightly (+0.08%).

This mechanism is closely tied to inequality. Cutting the public provision of a good that is not privately consumed reduces only the average level of consumption, without increasing its dispersion, and therefore has a limited impact on the externality. By contrast, cutting the provision of a good that is widely consumed privately raises dispersion: some households maintain high consumption, while others fall to zero. The planner thus avoids increasing dispersion for goods with strong externalities and low substitutability, such as health and transportation. The reverse holds for subsidies: for education, where private consumption is limited, raising subsidies cannot compensate for lower public provision. For health, the planner reduces subsidies, since they amplify inequality in consumption precisely when inequality is already rising.

Policy implication and discussion. We find that the planner should reduce spending more strongly on goods that are not privately consumed (for example military spending, roads, justice) than on goods with substantial private consumption (for example health, transportation, culture). The reasoning is twofold. First, fiscal consolidation already reduces private consumption of the latter goods, so additional cuts in public provision would compound this effect. Second, fiscal consolidation increases inequality, and reducing direct provision of widely consumed goods further amplifies inequality, worsening the externality that values equal consumption. We now discuss several remarks related to our results and policy experiments.

First, the quantitative results for each good depend on our calibration to France, where public provision accounts for a very large share of total consumption in some sec-

[19] As explained above, these values are computed as the difference between $\boldsymbol{\alpha}^{\text{shock}}$ and $\boldsymbol{\alpha}^{\text{no shock}}$, the optimal planner policies with and without the debt shock. For example, in the first scenario, $\boldsymbol{\alpha}^{\text{shock}} G_p = 0.41$ and $\boldsymbol{\alpha}^{\text{no shock}} G_p = 0.08$, yielding 0.33.

tors, especially education. In countries with less government intervention and greater reliance on private provision, education could resemble health in the French case, which would strengthen our argument against reducing in-kind benefits during fiscal consolidation.

Second, part of our findings hinge on how the government budget constraint is closed. We assume that debt reduction is financed by adjusting λ, the labor tax rate, since labor is the government's primary tax base. This choice is not neutral for inequality. Raising labor taxes does not significantly harm the poor, whose consumption is largely financed by transfers, nor the rich, whose income comes mainly from capital. Instead, the middle of the distribution bears most of the burden, which increases dispersion in the consumption of goods with externalities: poor households already consume little, rich households continue to consume, and middle-income households reduce their consumption. This explains why optimal policy calls for higher direct provision G_k during consolidation. If fiscal consolidation were instead achieved through higher capital taxes τ^k or greater progressivity in labor taxation τ^l, we would likely find reduced inequality during the transition, thereby weakening the inequality-driven motive for higher in-kind benefits.

Third, our result is not the exact Ramsey policy. While our "double difference" method provides a useful approximation, the true Ramsey solution may differ, notably because the initial and final steady states would themselves be different. In addition, for computational reasons, we do not jointly optimize over all 13 policy instruments. Our results should therefore be interpreted as providing intuition for the planner's optimal policy—consistent with the analytical model in Section 1, while a full quantitative Ramsey solution remains a task for future research.

7 Distributional National Accounts revisited

7.1 A new imputation formula for in-kind benefits

As inequality has become a major research topic, a large body of literature has emerged to estimate the progressivity of the tax and transfer system (see Heathcote, Storesletten and Violante (2017) and Ferriere and Navarro (2025), among others). However, this approach typically ignores the distributional effects of public spending. If the government provides schools and hospitals for everyone, this should reduce overall consumption inequality. Piketty, Saez and Zucman (2018) addresses this issue through the concept of Distributional National Accounts, allocating in-kind benefits to households.[20] Subsequent research has refined this methodology by imputing in-kind benefits at a much finer level of detail.

This method of converting in-kind benefits into monetary terms implicitly assumes that one euro of disposable income or cash transfer provides the same utility as one euro of in-kind benefits. Our analytical model shows that this is not the case. Goods such as education and health are luxury goods: poorer households consume little of them privately, because the marginal utility they derive is lower than that of normal consumption goods. This implies that for households at the bottom of the distribution, one euro of disposable income yields more utility than one euro of publicly provided goods.

Building on a simplified version of our analytical model (see Appendix F for details), we propose a new rule for converting in-kind benefits into monetary equivalents, applying an individual-specific weight to direct provision. Let disposable income y_i follow a distribution F with mean $\bar{y}$ normalized to 1, and let S denote the share of households with zero private consumption of the publicly provided good under consideration. Then the individual-specific weight is given by

$$\omega_i = \frac{\partial u_i/\partial G}{\partial u_i/\partial y_i} = \min\left\{\frac{y_i/\bar{y}}{F^{-1}(S)}, 1\right\} \tag{2}$$

This formulation shows that, with only three statistics – the relative income of household i, the income distribution F, and the share of households with zero private consumption of the luxury good – we can allocate any publicly provided good by multiplying its monetary value by the individual-specific weight ω_i.

To illustrate, assume income follows a Pareto distribution with tail index $\alpha = 2.2$, and that average net disposable income in France is $\bar{y} = 26,000$. For education, suppose the share of households with zero private spending is $S = 0.8$. The monetary equivalent of one euro of public education provided to household i is then $\omega_i = \min\left(\frac{y_i}{29{,}474}, 1\right)$. For households in the first income decile ($y_i = 12,000$), one euro of public schooling is equivalent to a cash transfer of €0.40; for median households ($y_i = 23000$), the equivalent is€0.80, and for households above average income, it is €1.

7.2 Application

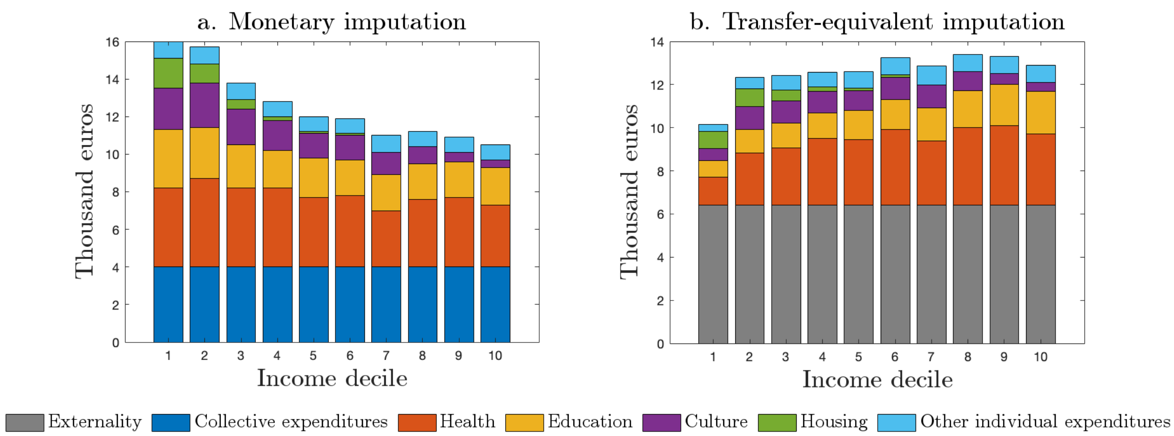
With only three statistics and rule 2, we can impute the monetary value of all publicly provided goods and assess the redistributive impact of the French tax–transfer–spending

[20]For example, public education, defense, justice, and infrastructure are distributed proportionally to disposable income, while health expenditures are imputed based on age and income.

system. An Insee study on France (Germain, André and Blanchet (2021)) provides a highly detailed distributional national account, including a precise breakdown of in-kind benefits across the income distribution. In the left panel of Figure 8, we reproduce their imputation across six categories: collective expenditures (such as police and justice, allocated uniformly), health, education and culture (based on survey data incorporating income, age, and geography), housing (imputed using administrative records), and other categories that can be individualized.

In the right panel of Figure 8, we present our "monetary-equivalent" imputation, based on the methodology described above. We assume a Pareto income distribution with $\alpha = 2.2$. For the share of households with zero private expenditures, we set: $S = 100\%$ for collective expenditures (defense and police), 70% for health (households that do not purchase unreimbursed health services), 80% for education (students in public schools), 75% for culture (a midpoint between health and education), 0% for housing, and 50% for other categories. Finally, since our imputation assigns weights between 0 and 1, some euros are "lost" relative to the direct imputation. We assume these lost euros can be recovered through the externality parameter, which is constant across households.

Figure 8: Distribution of in-kind benefits

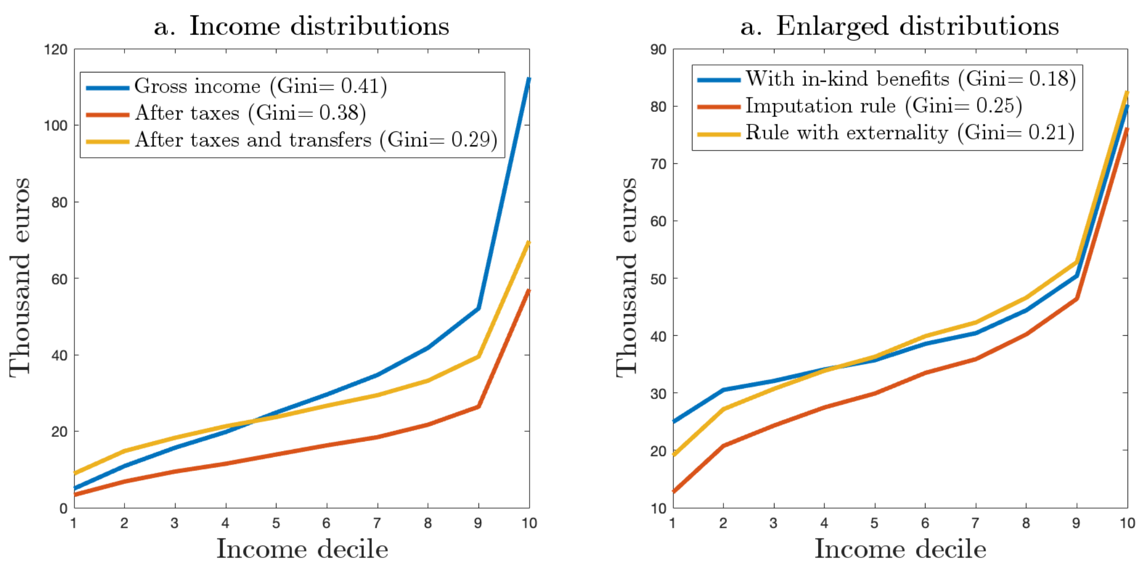


As explained above, our imputation rule provides a different perspective on the redistributive effects of in-kind benefits. Whereas the standard imputation method is progressive and biased toward poorer households, our corrected monetary-equivalent imputation is regressive, since lower-income households do not value education, health, and other in-kind benefits as highly as they value monetary transfers.

Because the purpose of distributional national accounts is not only to describe the positive distribution of GDP but also to address its normative implications for inequality, we use our imputed in-kind benefits to analyze their impact on inequality patterns. In the left panel of Figure 9, we show the distribution of gross income, net income (gross income minus taxes and social contributions), and disposable income (net income plus monetary transfers). This corresponds to the standard approach to assessing the redistributive effect of the fiscal system. In France, this reduces the Gini coefficient from 0.41 to 0.29.

In the right panel of Figure 9, we add the distribution of in-kind benefits discussed above to disposable income. The blue line represents the "usual" imputation method, corresponding to Figure 8a. Because this method is progressive, it further reduces the Gini coefficient from 0.29 to 0.18. The red line shows the distribution using our corrected rule without externalities. In this case, the Gini falls only slightly, from 0.29 to 0.25, since our imputation is regressive and excludes collective expenditures that households do not privately value. Finally, when accounting for externalities (yellow line), the Gini decreases to 0.21, still above the 0.18 obtained under the standard monetary imputation.

Figure 9: Distribution with and without in-kind benefits



Therefore, we build on the intuition from our analytical model to propose a new methodology for allocating in-kind benefits to households. We argue that the standard approach does not provide an accurate picture of household inequality, and we show that the inequality-reducing effect of public spending is smaller under our imputation method.

8 Targeted in-kind benefits

In the analytical and quantitative models, we have assumed a uniform in-kind benefit G_k for each sector k, implying that the government provides an identical level of these goods to all households. While this assumption captures a significant part of government intervention, it excludes the possibility of targeting in-kind benefits to specific households. In practice, some degree of targeting does occur: for example, more public teachers or schools in low-income areas, greater spending on rural roads, higher security expenditures in disadvantaged neighborhoods, housing or energy discounts, and subsidized public transportation or cultural activities for low-income households.

To account for this, we now introduce a more general rule for in-kind benefit provision that allows allocation to vary with household income. Specifically, each household i receives an in-kind benefit in sector k given by:

$$G_{i,k} = \mu_k (y_i)^{-\gamma_k}$$

with γ_k the progressivity of in-kind transfers and $\mu_k = \frac{G_k}{\int_i (y_i)^{-\gamma_k}}$ a scaling parameter such that $\int_i G_{i,k} = G_k$.[21] In this section, we first provide empirical estimates of our function across seven sectors of government intervention in France, using Distributional National Account data. Our benchmark resembles the Heathcote, Storesletten and Violante (2017)[22] tax rule, applied to in-kind benefits. We then compute the optimal progressivity of individual in-kind benefits across sectors and assess the welfare implications of this targeted approach compared to the uniform, "one size fits all" approach. Table 20 presents our results.

Table 20: In-kind benefit rule, power law

	Observed (France)		Optimal	
	μ_k	γ_k	μ_k	γ_k
Health	0.04	0.16	0.03	0.23
Education	0.04	0.30	0.04	0.10
Transportation	0.003	0.89	0.001	0.59
Security	0.01	0.25	0.01	0.10
Culture	0.01	0.68	0.002	0.99
Housing	0.005	1.97	0.01	0.15

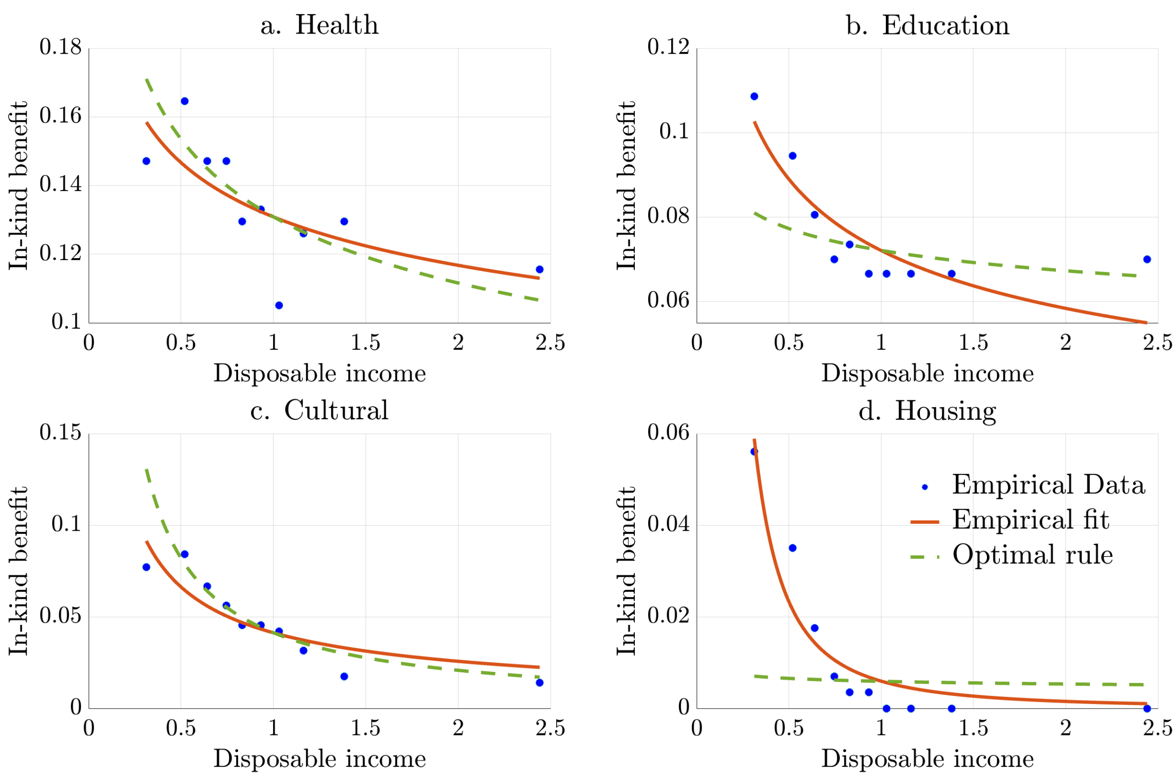
As expected, we find that $\gamma_k > 0$ for all sectors, indicating a progressive pattern of both observed and optimal in-kind benefits. A simple power law provides a good approximation of the empirical French Distributional National Accounts, as shown in Figure 10. When aggregating across all sectors, we obtain an overall in-kind benefit

[21] In Appendix G, we describe our formula and alternative rules. We choose the power law as our benchmark because it is the more parsimonious formula, with only two parameters.

[22] Other contributions include Feldstein (1973), Persson (1983) or Benabou (2000).

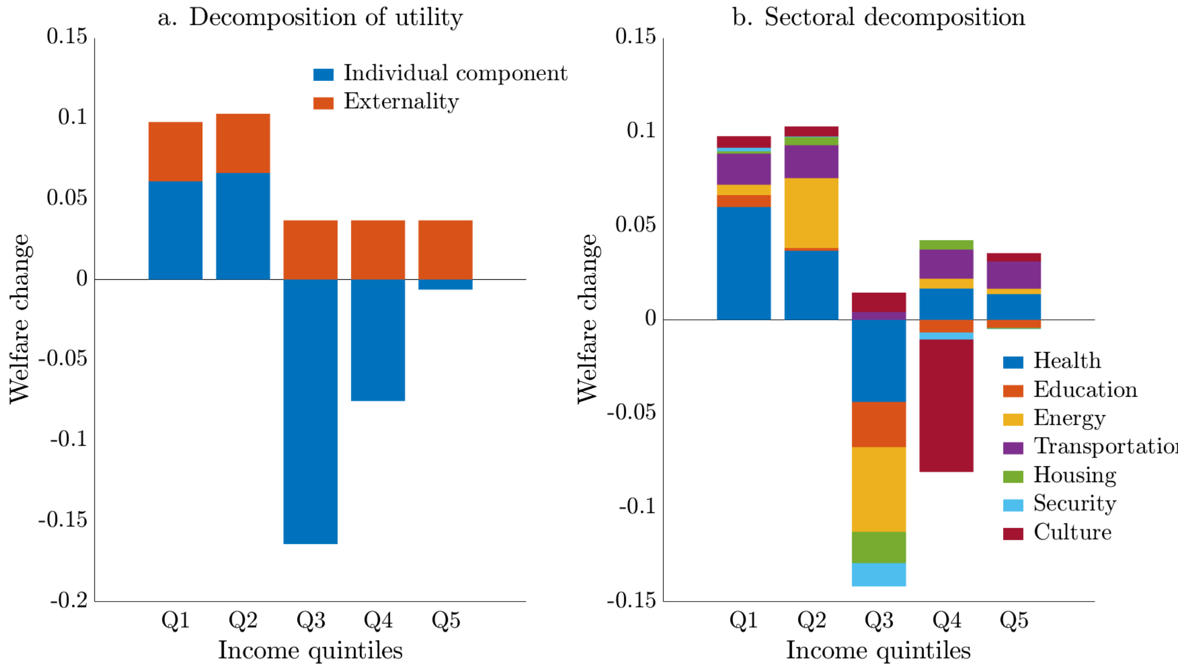
function with estimated parameters $\mu = 0.397$ and $\gamma = 0.27$. The optimal progressivity relative to observed progressivity varies by sector. For Health and Culture, the optimal progressivity should be higher than the current level, as consumption is too unequal due to the high value of subsidies in these sectors. For Education, Housing, Transportation and Security, the current system is overly progressive, largely because of the high value of direct provision in these sectors.

Figure 10: Empirical fit, power law



We now assess how replacing the uniform distribution of in-kind benefits in our benchmark model with these targeted rules affects welfare, and present our results in Figure 11. Implementing progressive rules, while keeping aggregate spending in each sector constant, increases overall welfare by 0.34%. This gain primarily stems from an increase in the externality component, whereas the direct effect on individual utility is unevenly distributed, as illustrated in Panel *a*. Specifically, individual utility for middle-income households declines due to higher labor income taxation. In contrast, low-income households experience an increase in utility thanks to greater public good provision. Higher-income households are less affected by income taxation because of asset accumulation. A sectoral decomposition of welfare effects shows that more progressive in-kind transfers in health, energy, and transportation benefit low-income households, but come at the expense of middle-income households.

Figure 11: Welfare change, implementing French rules



These results illustrate that our theory can be used to compute the optimal distribution of in-kind benefits. Since inequality interacts with public provision through luxury goods and pro-equality externalities, an interior solution exists for the progressivity of direct provision: because rich households already consume the luxury good, it may be inefficient to provide it to them for free.

9 Conclusion

In this paper, we develop a new theory of in-kind benefits. In many models, public expenditures are introduced as an exogenous parameter G in the government budget constraint. When forced to assign them utility, G typically enters separably, implicitly assuming that households cannot privately consume the good. This missing-market assumption is plausible for some goods, such as defense, but not for others, such as education or health, where private substitutes exist. If agents are allowed to consume these goods privately, government intervention becomes redundant. To justify a role for government provision, one must introduce an externality: individual consumption falls short of the social optimum. Yet, externalities typically call for subsidies rather than direct provision, which makes the prevalence of large in-kind benefits puzzling.

Our theory resolves this puzzle by assuming that publicly provided goods are (i) luxury goods and (ii) generate externalities that rise with equality. These two conditions are necessary and sufficient for positive optimal direct provision. Without the luxury good property, everyone consumes the good and cash transfers are equivalent to in-kind transfers; without the pro-equality externality, the planner cares only about aggregate consumption, in which case subsidies are more efficient. Using empirical evidence, we show that both conditions hold for most publicly provided goods, especially health and education, and that our model delivers realistic predictions: the size of government rises with inequality, particularly through direct provision.

We embed these insights into a quantitative heterogeneous-agent model with multiple goods consumed both privately and publicly. We carefully calibrate household consumption baskets using survey and bank data, classify government expenditures into transfers, in-kind benefits, and subsidies, and use administrative data to capture household heterogeneity. We first assume that observed policies are optimal to back out the parameters of the externality function. We then use these parameters in two applications. The first is fiscal consolidation. We show that optimal debt reduction should rely more on cutting subsidies than on reducing direct provision, especially for goods with private substitutes. Cutting direct provision would exacerbate consumption inequality, which is already heightened by higher taxes and lower aggregate consumption, thereby lowering the pro-equality externality.

Second, we assess the distributive properties of in-kind benefits. We propose a corrected imputation of public consumption in Distributional National Accounts, weighting absolute contributions to account for the lower marginal valuation of luxury goods by poorer households. Our corrected inequality measure suggests that the fiscal system is less redistributive than commonly thought. Finally, we depart from uniform provision and allow targeting based on income. We estimate the empirical distribution of in-kind benefits and compute the optimal progressivity, showing that targeted rules can substantially improve welfare.

Our theory is a first step toward shedding light on a significant but under-studied component of government expenditures. Several limitations remain. First, our results hinge on the shape of the externality function. We show that pro-equality externalities are a necessary condition for positive provision, and provide supporting evidence and stylized facts, but direct empirical estimates of this curvature remain elusive. Second, we simplify household consumption choices by assuming "top-up" behavior. Extensions could model discrete choices between public and private alternatives (e.g., "opt-out" for schools) or allow for quality differences and imperfect substitutability. Third, we abstract from production, assuming identical technologies across goods. In reality, sectoral heterogeneity in production and price rigidities may create additional channels for public provision. Moreover, we do not model public production explicitly, such as the role of public servants, a dimension we would like to investigate in further research. Finally, most of our results remain approximations of the Ramsey solution: while we provide a tractable method to approach it, the exact Ramsey allocation in heterogeneous-agent models remains a frontier topic for future research.

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Appendix

Table of contents

A Analytical results

In this section, we provide proofs of analytical results in the paper, and discuss alternative models.

A.1 Proofs of Section 1

Our analytical model is the following. We have heterogeneous households with productivity $z_i \sim$ log-Normal $\left(-\frac{\nu}{2}, \nu\right)$. They solve the following problem:

$$\max_{c_i, g_i, n_i} u_i = (1-\omega)\ln(c_i) + \omega \ln(g_i + G + \bar{g}) - \psi n_i + \frac{\chi}{\alpha} \ln\left(\int_j (g_j + G + \bar{g})^\alpha\right)$$

$$\text{such that } c_i + (1-s) g_i = (1-\tau) z_i n_i + T$$

and $g_i, c_i, n_i \geq 0$. The first-order conditions for c_i and n_i give the demand for c_i:

$$c_i = \frac{1-\omega}{\psi}(1-\tau) z_i$$

The first-order conditions for c_i and g_i, with the constraint $g_i \geq 0$, give the demand for g_i:

$$g_i = \max\left\{\frac{\omega}{\psi}\frac{1-\tau}{1-s} z_i - G - \bar{g}, 0\right\}$$

This implies the threshold ζ below which g_i is equal to 0:

$$g_i \geq 0 \iff z_i \geq \frac{\psi}{\omega}\frac{1-s}{1-\tau}(G + \bar{g}) = \zeta$$

The budget constraint, associated with the demand for c_i, gives the labor supply:

$$n_i = \frac{1-\omega}{\psi} + \frac{(1-s) g_i - T}{(1-\tau) z_i}$$

Finally, the externality term X is the following:

$$X = \frac{\chi}{\alpha}\ln\left(\int_j (g_j + G + \bar{g})^\alpha\right) = \frac{\chi}{\alpha}\ln\left(\int_{z<\zeta} (G + \bar{g})^\alpha + \int_{z \geq \zeta}\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s} z_i\right)^\alpha\right)$$

Denoting $t.i.p.$ the terms independent from policies (τ, s, T, G),[23] the individual utility function is given by

$$\begin{aligned} u_i = {} & (1-\omega)\ln(1-\tau) + \psi\frac{T}{(1-\tau) z_i} + t.i.p. \\ & + \frac{\chi}{\alpha}\ln\left((G+\bar{g})^\alpha \mathbb{P}(z<\zeta) + \left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}\right)^\alpha \mathbb{P}(z \geq \zeta)\mathbb{E}(z^\alpha | z \geq \zeta)\right) \\ & + \begin{cases} \omega \ln\left(\frac{1-\tau}{1-s}\right) + \psi\frac{(1-s)(G+\bar{g})}{(1-\tau) z_i} + a_1 & \text{if } z_i \geq \zeta \\ \omega \ln(G + \bar{g}) & \text{if } z_i < \zeta \end{cases} \end{aligned}$$

[23] For example, $\ln(c_i) = \ln\left(\frac{1-\omega}{\psi}(1-\tau) z_i\right) = \ln(1-\tau) + t.i.p.$, with $t.i.p. = \ln\left(\frac{1-\omega}{\psi} z_i\right)$.

with $a_1 = \omega \ln\left(\frac{\omega z_i}{\psi}\right) - \omega$ a scalar. The first line is the common utility term, the second is the externality, and the third is the different utility for the two types of households. The budget constraint of the government is the following:

$$G + T + s\int g_i = \tau \int z_i n_i$$

Using the fact that $\int_i z_i = 1$ and the good market clearing, we compute the output as

$$\int z_i n_i = Y = G + \int c_i + \int g_i = G + \frac{1-\omega}{\psi}(1-\tau) + \int g_i$$

which, associated with the government budget constraint, gives

$$T = \tau(1-\tau)\frac{1-\omega}{\psi} + (\tau - s)\int g_i - (1-\tau)G$$

Finally, we assume a utilitarian planner with the welfare $\mathbb{W} = \int_i u_i$. Using the fact that $\mathbb{E}[1/z] = e^{v}$[24] and $\int g_i = \int_{z\geq\zeta}(\frac{\omega}{\psi}\frac{1-\tau}{1-s}z_i - G - \bar{g})$, the planner problem is the following:

$$\begin{aligned}
\max_{T,\tau,G,s} \mathbb{W} = & (1-\omega)\ln(1-\tau) + \psi e^{\nu}\frac{T}{(1-\tau)} + t.i.p. \\
& + \frac{\chi}{\alpha}\ln\left((G+\bar{g})^{\alpha}\mathbb{P}(z<\zeta) + \left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}\right)^{\alpha}\mathbb{P}(z\geq\zeta)\mathbb{E}(z^{\alpha}|z\geq\zeta)\right) \\
& + \mathbb{P}(z<\zeta)\omega\ln(G+\bar{g}) \\
& + \mathbb{P}(z\geq\zeta)\left(\omega\ln\left(\frac{1-\tau}{1-s}\right) + a_1 + \psi\frac{(1-s)(G+\bar{g})}{(1-\tau)}\mathbb{E}(1/z|z\geq\zeta)\right)
\end{aligned}$$

such that

$$T = \tau(1-\tau)\frac{1-\omega}{\psi} + (\tau-s)\mathbb{P}(z\geq\zeta)\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}\mathbb{E}(z|z\geq\zeta) - G - \bar{g}\right) - (1-\tau)G$$

A.1.1 Theorem 1: missing market and Samuelson rule

In this first theorem, we assume households cannot privately consume g, so that $\omega = \bar{g} = 0$ and $\mathbb{P}(z\geq\zeta) = 0$. As there is not private consumption of g, there is no subsidy s. The planner problem above becomes:

$$\max_{T,\tau,G} \mathbb{W} = \ln(1-\tau) + \psi e^{\nu}\frac{T}{(1-\tau)} + \frac{\chi}{\alpha}\ln(G^{\alpha}) + t.i.p.$$

such that

$$T = \tau(1-\tau)\frac{1}{\psi} - (1-\tau)G$$

[24] $z \sim \text{log-Normal}(\mu,\sigma^2) \iff \alpha = \ln(z) \sim \mathcal{N}(\mu,\sigma^2)$, then $\int z^k = \int (e^{\alpha})^k = \exp\left(\mu k + \frac{\sigma^2 k^2}{2}\right)$, and here we have $\mu = -\frac{\nu}{2}$ and $\sigma^2 = \nu$ so that $\int z^k = \exp\left(\frac{\nu}{2}k(k-1)\right)$, and if $k=-1$ we have $\int \frac{1}{z} = \exp(\nu)$.

or equivalently by replacing T in the objective:

$$\max_{\tau,G} \mathbb{W} = \ln(1-\tau) + e^{\nu}\tau - \psi e^{\nu} G + \chi \ln(G) + t.i.p.$$

We have the first-order conditions:

$$\frac{d\mathbb{W}}{dG} = -\psi e^{\nu} + \chi \frac{1}{G} = 0 \iff G^{\star} = \frac{\chi}{\psi} e^{-\nu}$$

$$\frac{d\mathbb{W}}{d\tau} = \frac{-1}{1-\tau} + e^{\nu} = 0 \iff t^{\star} = 1 - e^{-\nu}$$

Plugging these solutions into the transfer and output:

$$T^{\star} = \tau^{\star}(1-\tau^{\star})\frac{1}{\psi} - (1-\tau^{\star})G^{\star} = \frac{e^{-\nu}}{\psi}[1 - e^{-\nu}(1+\chi)]$$

$$Y^{\star} = G^{\star} + \frac{1}{\psi}(1-\tau^{\star}) = \frac{1+\chi}{\psi} e^{-\nu}$$

Finally, we obtain:

$$\boxed{\begin{aligned} \frac{G^{\star}}{Y^{\star}} &= \frac{\chi}{1+\chi} \\ \frac{T^{\star}}{Y^{\star}} &= \frac{1}{1+\chi} - e^{-\nu} \end{aligned}}$$

A.1.2 Theorem 2: undetermined T and G

In this second theorem, we allow households to privately consume g, and we assume $\bar{g} = 0$. We also assume that $z_i \geq \frac{\psi G}{\omega} \frac{1-s}{1-\tau}$ for everyone, so that each household consumes a bit of g_i. In this case, we have $\mathbb{P}(z < \zeta) = 0$, and the planner problem becomes:

$$\begin{aligned} \max_{T,\tau,G,s} \mathbb{W} = &(1-\omega)\ln(1-\tau) + \psi e^{\nu} \frac{T}{(1-\tau)} + t.i.p. \\ &+ \frac{\chi}{\alpha} \ln\left(\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}\right)^{\alpha} \mathbb{E}(z^{\alpha})\right) \\ &+ \left(\omega \ln\left(\frac{1-\tau}{1-s}\right) + a_1 + \psi e^{\nu} \frac{(1-s)G}{(1-\tau)}\right) \end{aligned}$$

such that

$$T = \tau(1-\tau)\frac{1-\omega}{\psi} + (\tau - s)\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s} - G\right) - (1-\tau)G$$

or equivalently,

$$\max_{T,\tau,G,s} \mathbb{W} = (1+\chi)\ln(1-\tau) + \psi e^{\nu} \frac{T + (1-s)G}{(1-\tau)} - (\chi+\omega)\ln(1-s) + t.i.p.$$

such that

$$T+(1-s)G=\tau(1-\tau)\frac{1-\omega}{\psi}+(\tau-s)\frac{\omega}{\psi}\frac{1-\tau}{1-s}$$

As we see, the term $T+(1-s)G$ is present one time in the welfare, and one time in the constraint, **meaning T and G are undetermined**: the sum is defined, not its component, while s appears several time and is determined. Plugging $T+(1-s)G$ in the welfare, the planner problem becomes:

$$\max_{\tau,s}\mathbb{W}=(1+\chi)\ln(1-\tau)+e^{\nu}\left(\tau(1-\omega)+\omega\frac{\tau-s}{1-s}\right)-(\chi+\omega)\ln(1-s)+t.i.p.$$

The first-order solutions are the following:

$$\frac{d\mathbb{W}}{ds}=-e^{\nu}\omega\frac{1-\tau}{(1-s)^2}+(\chi+\omega)\frac{1}{1-s}=0\iff e^{\nu}\frac{1-\tau}{1-s}=\frac{\chi+\omega}{\omega}$$

$$\frac{d\mathbb{W}}{d\tau}=\frac{-(1+\chi)}{1-\tau}+e^{\nu}\left(1-\omega+\omega\frac{1}{1-s}\right)=0\iff e^{\nu}\frac{1-\tau}{1-s}=\frac{1+\chi}{1-s+s\omega}$$

Equalizing the two conditions:

$$\frac{\chi+\omega}{\omega}=\frac{1+\chi}{1-s+s\omega}\iff\boxed{s^{\star}=\frac{\chi}{\chi+\omega}}$$

The first FOC gives us:

$$\boxed{t^{\star}=1-e^{-\nu}}$$

Finally, plugging $s^{\star}$ and $t^{\star}$ in the constraint $T+(1-s)G=...$, we obtain the following relation between T and G:

$$\boxed{T^{\star}+a_1G^{\star}=a_2(\nu)}$$

with a_1,a_2 scalar, and a_2 increasing with ν.

A.1.3 Theorem 3: luxury good and concave externality

Our theorem 2 shows that $\bar{g}>0$ is necessary to obtain the determination of G and T. We now assume $\bar{g}>0$, and obtain a threshold $z_i\geq\zeta=\frac{\psi}{\omega}\frac{1-s}{1-\tau}(G+\bar{g})$ above which $g_i\geq 0$. First, we show how T and G are valued by the households below and above this threshold. Abstracting from the externality function, the utility for households is given by

$$u_i=\begin{cases}\ln(1-\tau)-\omega\ln(1-s)+\psi\frac{T+(1-s)(G+\bar{g})}{(1-\tau)z_i}+t.i.p. & \text{if } z_i\geq\zeta\\(1-\omega)\ln(1-\tau)+\omega\ln(G+\bar{g})+\psi\frac{T}{(1-\tau)z_i}+t.i.p. & \text{if } z_i<\zeta\end{cases}$$

Then, for households above the threshold, the derivatives with respect to transfer and direct provision are proportional. For households below the threshold, there exists a difference between G and T. As $u_g < u_c = u_n$, households are in a corner solution, meaning that T provides more utility than G:

$$\begin{cases} \frac{du_i}{dT} = \frac{du_i}{dG}\frac{1}{1-s} & \text{if } z_i \geq \zeta \\ \frac{du_i}{dT} > \frac{du_i}{dG} & \text{if } z_i < \zeta \end{cases}$$

Second, we provide analytical results on the optimal policies. We plug the constraint for T in the welfare, and regroup terms multiplied by $\mathbb{P}(z \geq \zeta)$. For brevity, we denote $Z_x = \mathbb{E}(z^x | z \geq \zeta)$ for $x = \{1, -1, \alpha\}$, and $Z_l = \mathbb{E}(\ln z | z \geq \zeta)$. We obtain the following planner problem:

$$\begin{aligned}
\max_{\tau,G,s} \mathbb{W} = &(1-\omega)\ln(1-\tau) - \psi e^{\nu} G + \tau e^{\nu}(1-\omega) + t.i.p. \\
&+ \mathbb{P}(z < \zeta)\omega \ln\left(G + \bar{g}\right) \\
&+ \mathbb{P}(z \geq \zeta)\left(\omega \ln\left(\frac{1-\tau}{1-s}\frac{\omega}{\psi}\right) + \omega e^{\nu} Z_1 \frac{\tau - s}{1-s} + \omega Z_l - \omega + \psi\frac{G+\bar{g}}{1-\tau}\left[(1-s)Z_{-1} - e^{\nu}(\tau - s)\right]\right) \\
&+ \frac{\chi}{\alpha}\ln\left(\mathbb{P}(z<\zeta)(G+\bar{g})^{\alpha} + \mathbb{P}(z \geq \zeta)\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}\right)^{\alpha} Z_{\alpha}\right)
\end{aligned}$$

The trick to simplify computation is to replace s by the threshold $\zeta = \frac{\psi}{\omega}\frac{1-s}{1-\tau}(G+\bar{g})$. Moreover, we also denote $M = (G + \bar{g})$. Then, instead of optimizing on (τ, G, s), we optimize on (τ, M, ζ). The planner problem becomes:

$$\begin{aligned}
\max_{\tau,M,\zeta} \mathbb{W} = &(1-\omega)[\ln(1-\tau) + \tau e^{\nu}] + (\omega + \chi)\ln(M) - \psi e^{\nu} M + t.i.p. \\
&+ \mathbb{P}(z \geq \zeta)\omega\left(Z_{-1}\zeta - \ln(\zeta) + (Z_l - 1) + e^{\nu}\left(1 - \frac{\psi M}{\zeta\omega}\right)(Z_1 - \zeta)\right) \\
&+ \frac{\chi}{\alpha}\ln\left(\mathbb{P}(z<\zeta) + \mathbb{P}(z \geq \zeta)Z_{\alpha}\zeta^{-\alpha}\right)
\end{aligned}$$

We immediately obtain the optimal tax rate $\tau^{\star}$:

$$\frac{d\mathbb{W}}{d\tau} = 0 \iff \boxed{\tau^{\star} = 1 - e^{-\nu}}$$

The derivative with respect to M is:

$$\frac{d\mathbb{W}}{dM} = \frac{\omega+\chi}{M} - \psi e^{\nu} + \mathbb{P}(z \geq \zeta)\omega e^{\nu}\left(-\frac{\psi}{\zeta\omega}\right)(Z_1 - \zeta) = 0$$

$$\iff \boxed{M^{\star} = \frac{\omega + \chi}{\psi e^{\nu}\left(1 + \mathbb{P}(z \geq \zeta)\frac{Z_1 - \zeta}{\zeta}\right)}}$$

Moreover, we have

$$\int g_i = \int_{z \geq \zeta}\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}z_i - G - \bar{g}\right) = \mathbb{P}(z \geq \zeta)\left(\frac{\omega}{\psi}\frac{1-\tau}{1-s}Z_1 - M\right)$$

$$= \mathbb{P}(z \geq \zeta) M \left(\frac{\omega}{\psi} \frac{1-\tau}{1-s} \frac{1}{M} Z_1 - 1 \right) = \mathbb{P}(z \geq \zeta) M \left(\frac{1}{\zeta} Z_1 - 1 \right) = \mathbb{P}(z \geq \zeta) M \frac{Z_1 - \zeta}{\zeta}$$

and we have $\int c_i = \frac{1-\omega}{\psi}(1-\tau)$, so that the good market clearing condition is

$$Y = \int c_i + \int g_i + G = \left[\frac{1-\omega}{\psi}(1-\tau) \right] + \left[\mathbb{P}(z \geq \zeta) M \frac{Z_1 - \zeta}{\zeta} \right] + [G]$$

Replacing $(1-\tau)$ by its expression from the FOC:

$$= \left[\frac{1-\omega}{\psi} e^{-\nu} \right] + \left[\mathbb{P}(z \geq \zeta) M \frac{Z_1 - \zeta}{\zeta} \right] + [M - \bar{g}]$$

$$= \left[\frac{1-\omega}{\psi e^{\nu}} \right] + M \left[\mathbb{P}(z \geq \zeta) \frac{Z_1 - \zeta}{\zeta} + 1 \right] + [-\bar{g}]$$

Replacing M by its expression for the FOC:

$$= \left[\frac{1-\omega}{\psi e^{\nu}} \right] + \frac{\omega + \chi}{\psi e^{\nu} \left(1 + \mathbb{P}(z \geq \zeta) \frac{Z_1 - \zeta}{\zeta} \right)} \left[\mathbb{P}(z \geq \zeta) \frac{Z_1 - \zeta}{\zeta} + 1 \right] + [-\bar{g}]$$

$$= \left[\frac{1-\omega}{\psi e^{\nu}} \right] + \frac{\omega + \chi}{\psi e^{\nu}} - \bar{g} \iff \boxed{Y^{\star} = \frac{1+\chi}{\psi e^{\nu}} - \bar{g}}$$

Note that this implies that

$$\frac{M}{Y + \bar{g}} = \frac{\frac{\omega+\chi}{\psi e^{\nu} \left(1 + \mathbb{P}(z \geq \zeta) \frac{Z_1 - \zeta}{\zeta} \right)}}{\frac{1+\chi}{\psi e^{\nu}}} = \frac{\omega + \chi}{1 + \chi} \frac{1}{1 + \mathbb{P}(z \geq \zeta) \frac{Z_1 - \zeta}{\zeta}}$$

B Empirical evidence

B.1 Decomposition of French Public Spending

In this section, we describe how we decompose French public spending among cash transfers, direct provision and subsidies. We use Eurostat data, administrative datasets and budgetary bills in order to make our imputation. The general idea goes as follows: (i) all cash transfers, conditional or not, are considered as transfers T, (ii) we consider collective goods, public goods or goods offered for free as direct provision G, (iii) we consider all policies that reduce the price for households as subsidies s. Table 21 provides examples of each category.

Table 21: In-kind and subsidies decomposition

	In-kind benefits (G)	**Subsidies (s)**
Health	public hospital operations and infrastructures, public health clinics and centers, healthcare worker salaries in public facilities, public health campaigns and preventive care programs, emergency medical services and direct provision of medical equipment and supplies.	partial reimbursements through the mandatory health insurance system, subsidies for complementary health insurance, pharmaceutical reimbursements, provider payments for private practices, medical transport subsidies, long-term car subsidies, VAT exemptions for medical devices and medications, and income tax rebates for health related spending and investments.
Education	teacher and staff salaries in public schools, operation of public schools and universities, educational materials and equipment, school infrastructure and maintenance, research funding for public universities.	student financial aid (grants), housing subsidies for students, tax credits for education expenses, subsidies to private schools, voucher programs, VAT exemptions for education-related goods, and income tax rebates for education related spending and investments.
Transportation	public infrastructure development and operating costs: roads, railways.	public transport services, incentives for purchasing electric vehicles, subsidies for installing EV chargers, and reduced taxes on certain fuels.
Housing	construction and maintenance of public housing units and renovation of public buildings for energy efficiency.	personal housing assistance programs and tax reductions for energy improvement works in private residences.
Security	police services, fire protection services, law courts and prisons operating costs, R&D Public order and safety, public order and safety.	VAT exemptions for security-related goods, and income tax rebates for security related spending and investments.
Culture	operation of public museums, theaters, cultural institutions, and organization of cultural events.	grants to support artistic creation, cultural projects, and tax incentives for cultural donations and sponsorships.

B.2 In-kind benefits and luxury goods

B.2.1 Cross-country analysis: additional tables

Table 22: Fixed effects panel regression, health

Dependent Variable:	log(Health expenditures per capita)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant (α)	-6.72***	-7.87***				
	(0.364)	(0.497)				
log(GDP per capita) (θ)	1.39***	1.28***	1.37***	1.25***	1.32***	1.15***
	(0.044)	(0.057)	(0.041)	(0.060)	(0.024)	(0.051)
Age dependency ratio (%)		0.012***		0.012***		0.010***
		(0.002)		(0.002)		(0.001)
Life expectancy at 80		0.205***		0.221***		0.257***
		(0.046)		(0.048)		(0.040)
Year fixed-effects			Yes	Yes	Yes	Yes
Code fixed-effects					Yes	Yes
Observations	4,058	4,058	4,058	4,058	4,058	4,058
R^2	0.94417	0.96121	0.94817	0.96553	0.98588	0.99192
Within R^2			0.94355	0.96246	0.96133	0.97789

Clustered (country-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 23: Fixed effects panel regression, education

Dependent Variable:	log(Education expenditures per capita)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant (α)	-5.50***	-6.57***				
	(0.518)	(0.943)				
log(GDP per capita) (θ)	1.24***	1.32***	1.20***	1.31***	1.34***	1.38***
	(0.052)	(0.086)	(0.035)	(0.055)	(0.106)	(0.127)
Young-age dependency ratio (%)		0.006*		0.007**		0.003
		(0.003)		(0.003)		(0.003)
Year fixed-effects			Yes	Yes	Yes	Yes
Code fixed-effects					Yes	Yes
Observations	4,424	4,424	4,424	4,424	4,424	4,424
R^2	0.93177	0.93447	0.93873	0.94227	0.97603	0.97610
Within R^2			0.92294	0.92740	0.69811	0.69894

Clustered (country-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 24: Fixed effects panel regression, culture

Dependent Variable:	log(Culture expenditures per capita)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant (α)	-6.53***	-8.09***				
	(1.10)	(1.23)				
log(GDP per capita) (θ)	1.40***	1.67***	1.31***	1.55***	2.18***	2.17***
	(0.137)	(0.174)	(0.075)	(0.106)	(0.410)	(0.411)
Old-age dependency ratio (%)		-0.071***		-0.060***		0.013
		(0.024)		(0.019)		(0.018)
Year fixed-effects			Yes	Yes	Yes	Yes
Code fixed-effects					Yes	Yes
Observations	2,062	2,062	2,062	2,062	2,062	2,062
R^2	0.86865	0.88834	0.89833	0.91191	0.96891	0.96911
Within R^2			0.86497	0.88301	0.70059	0.70254

Clustered (country-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 25: Fixed effects panel regression, transportation

Dependent Variable:	log(Transportation expenditures per capita)					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Constant (α)	-6.54***	-6.30***				
	(0.557)	(1.07)				
log(GDP per capita) (θ)	1.37***	1.34***	1.36***	1.29***	1.37***	1.32***
	(0.064)	(0.159)	(0.072)	(0.181)	(0.102)	(0.087)
Old-age dependency ratio (%)		-0.012		-0.010		-0.026***
		(0.013)		(0.014)		(0.009)
Share of urban (%)		0.004		0.005		0.006
		(0.005)		(0.005)		(0.007)
Year fixed-effects			Yes	Yes	Yes	Yes
Code fixed-effects					Yes	Yes
Observations	1,864	1,864	1,864	1,864	1,864	1,864
R^2	0.95398	0.95548	0.95547	0.95707	0.99035	0.99137
Within R^2			0.94792	0.94979	0.76930	0.79370

Clustered (country-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

B.2.2 Cross-country: OECD data

Table 26: Income elasticity, OECD data

	Dependent variable: log(expenditures per capita)							
y	*Health*		*Education*		*Culture*		*Transportation*	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
θ	1.05	1.15	1.26**	1.26**	1.39*	1.36.	1.30***	1.28***
	(0.138)	(0.100)	(0.101)	(0.098)	(0.197)	(0.194)	(0.080)	(0.073)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,529	1,529	444	444	500	500	528	528
# countries	38	38	31	31	16	16	17	17
# years	54	54	17	17	53	53	53	53

*Observations are weighted by population. Standard errors are clustered at the country level. Signif. levels against $\theta = 1$: .p<0.1; *p<0.05; **p<0.01; ***p< 0.001*

B.2.3 Cross-country: Demand system

Empirical strategy. We follow Comin, Lashkari and Mestieri (2021) and estimate $\{\sigma, \epsilon_i, \zeta_i^n\}_{i \in \mathcal{I}_{-m}}$ via GMM:

$$\log\left(\frac{\omega_{it}^n}{\omega_{mt}^n}\right) = (1-\sigma)\log\left(\frac{p_{it}^n}{p_{mt}^n}\right) + (1-\sigma)(\epsilon_i - 1)\log\left(\frac{E_t^n}{p_{mt}^n}\right) + (\epsilon_i - 1)\log\left(\omega_{mt}^n\right) + \zeta_i^n + \upsilon_{it}^n$$

Aggregate data.

	Health & Education	Culture	Transportation
nonhomotheticity: ϵ_i	1.339	2.232	1.017
	(0.162)	(0.115)	(0.179)
$\bar{\eta_i} = \sigma + (1-\sigma)\frac{\epsilon_i}{\bar{\epsilon}}$	0.90	1.36	0.80
$\mathrm{S}_i^p = \int(\eta_i > 1)d\mu$	0.52	1.00	0.18

Results. [Work in progress].

Table 27: Estimates, 10-Sector regression, $\epsilon_m = 1$

	(1)	(2)	(3)
σ	0.10	0.13	0.07
	(0.03)	(0.05)	(0.04)
$\epsilon_{\text{agriculture}}$	0.32	0.34	0.38
	(0.05)	(0.05)	(0.06)
$\epsilon_{\text{other services}}$	1.90	1.97	1.81
	(0.157)	(0.179)	(0.304)
$\epsilon_{\text{health, education, defense}}$	1.59	1.32	1.61
	(0.03)	(0.04)	(0.03)
$\epsilon_{\text{transportation}}$	1.44	1.36	1.41
	(0.03)	(0.04)	(0.03)
$\epsilon_{\text{culture}}$	1.18	0.85	1.21
	(0.03)	(0.05)	(0.03)
Country × Sector FE	Yes	Yes	Yes
Observations	1,596	492	1,104

B.2.4 Household-level analysis

Table 28: Estimates, CEX final-good expenditures, $\epsilon_m = 1$

	(1)	(2)	(3)
σ	0.346	0.377	0.283
	(0.024)	(0.024)	(0.032)
$\epsilon_{\text{agriculture}} - 1$	-0.629	-0.580	-0.594
	(0.076)	(0.103)	(0.087)
$\epsilon_{\text{other services}} - 1$	0.888	1.917	1.733
	(0.157)	(0.304)	(0.264)
$\epsilon_{\text{health \& education}} - 1$	0.227	0.775	0.487
	(0.162)	(0.240)	(0.179)
$\epsilon_{\text{transportation}} - 1$	0.01	0.319	0.370
	(0.115)	(0.167)	(0.139)
$\epsilon_{\text{culture}} - 1$	1.232	1.557	1.335
	(0.179)	(0.259)	(0.215)
Region FE	No	Yes	Yes
Year × Quarter FE	No	No	Yes
Observations	36,281	36,281	36,281
# parameters	36	51	216
# moments	80	135	260

C Calibration

C.1 Households budget survey and bank data

Description BDF: We keep households who declare more than 1,000 euros in annual disposable income and total consumption, and age between 25 and 85, this gives 15,412 observations.

Description Bank data: [Work in progress].

For share in total consumption expenditures, we get:

Table 29: Share in total consumption, budget survey and bank data

	Mean	Q1	Q2	Q3	Q4	Q5
Budget de familles 2017						
Health	1.83	1.87	1.74	1.94	1.88	1.76
Transport	16.59	11.42	13.97	15.15	17.45	18.53
Culture, recreation, entertainment	9.46	7.27	7.63	9.10	9.33	10.72
Education	0.73	0.60	0.47	0.42	0.56	1.09
Bank data						
Health	4.41	3.89	4.01	4.29	4.60	4.68
Transport	17.39	14.12	16.32	17.42	18.01	18.48
Culture, recreation, entertainment	13.45	12.44	12.67	13.07	13.36	14.31
Education	0.46	0.45	0.33	0.35	0.39	0.59

For share of households with less than 10 euros in each sector every year, we get:

Table 30: Share of households spending less than 10 euros, budget survey and bank data

	Mean	Q1	Q2	Q3	Q4	Q5
Budget de familles 2017						
Health	20.14	34.94	27.36	20.15	14.81	11.12
Culture, recreation, entertainment	2.02	9.75	2.37	0.89	0.15	0.28
Museums & theaters	85.78	93.99	89.47	88.01	85.91	76.11
Sports	79.00	90.66	85.91	82.72	77.83	64.71
Education	88.13	95.87	94.10	92.13	86.94	76.53
Bank data						
Health	7.79	13.23	10.42	7.81	5.24	2.00
Culture, recreation, entertainment	0.10	0.16	0.11	0.12	0.07	0.03
Education	85.34	89.71	90.03	88.11	85.10	73.40

D Algorithm

The main challenges of this paper are the heterogeneous-agent structure, the discrete labor choice and the high number of guesses. In this section, we detail the algorithms used at the steady state, for the calibration and during the transition. Each steady state takes 0.5 seconds to compute on a personal computer, and 3 seconds for a non-linear transition between two distinct steady states. The entire code has been written from scratch on Matlab.

Heterogeneous-agent structure. Our state-space for asset and income is $\mathbb{S} = \mathbb{A} \times \mathbb{Z}$. We discretize $\mathbb{A}$ over an exponential grid of 100 points between 0 and 40, and $\mathbb{Z}$ over 5 points using Tauchen (1986) method, which gives us 500 grid points. We solve the household decision using value function iteration (VFI). The key variable of choice for the household is the consumption of the private good $c(a, z)$: given c, h and the first-order conditions, the households can choose its consumption g_k, and the budget constraint gives the saving choice a' as a residual. To solve the VFI, the follow these steps:

1. for each choice $h \in \{0, \bar{h}\}$, use a golden-section algorithm to find the consumption $c^h(a, z)$ such that $a' = 0$, to obtain a lower bound for the maximization of the utility.
2. guess the expected value function $f(a, z) = \mathbb{E}[V(a, z)]$.
3. for each choice $h \in \{0, \bar{h}\}$, use a golden-section algorithm to find the consumption $c^h(a, z)$ that maximizes the value function $U^h(a, z) + \beta f(a', z')$.
4. using Gumbel trick described below, find the new value function $V(a, z)$.
5. using spline interpolation over $V(a, z)$, compute the new guess for the value function $f(a, z)$.
6. use the Howard's improvement: for 30 iterations, iterate the f guess without optimizing, taking $f^{new}(a, z) = u^h(a, z) + \beta f(a, z)$.
7. compare the new value function f^{new} with the guess $f(a, z)$: if the Euclidian norm of the difference is above 10^{-8}, replace f by f^{new} and go back to step 3.

Once we have the decision rule, we compute the transition matrix M between (a, z) and (a', z'). If $d(a, z)$ is our column measure of density over the state space, we compute $d' = Md$. This means that the row i of d is associated with the column i of M. Therefore, for each initial point i of the state space, we fill the column i of M with $2 * n_z * n_h = 2 * 5 * 2$ values, that represent the different probabilities to go in a new point of the state space. These probabilities are the products of:

- **a**: for the household's decision $a'(a, z)$, we put a' on our grid $\mathbb{A}$, by computing weights ω^- and ω^+ depending on the distance between a' and the inferior (a^-) and superior (a^+) points of the grid. Therefore, each choice a' leads to two possible future grid points a^- and a^+, with probability ω^- and ω^+.

- **z**: using the Markov process probability, we put the probability $\mathbb{P}(z \to z')$ at every rows z'. Therefore, each initial z leads to n_z future grid points z', with probabilities $\mathbb{P}(z \to z')$.
- **h**: each point of the state space is associated with a probability $\mathbb{P}^h(a, z)$ of working h hours (see below for the computation). Therefore, each initial (a, z) leads to n_h decision rules $a'^h(a, z)$.

Note that we use a sparse matrix M, as each column contains only 10 values over 500 lines. Finally, we compute $d' = Md$ until every row of $|d' - d|$ is lower than 10^{-8}, *i.e.* when we obtain the stationary density given the decision matrix M.

Discrete labor choice. We follow Ferriere and Navarro (2025) for the implementation of discrete choice with preference shocks drawn from an extreme-value distribution. Denote $V_t^h(a, z)$ the value function for the household at the grid point (a, z) choosing the labor supply h. Let ϵ_h the preference shock for each choice h, and assume the vector $\overrightarrow{\epsilon} = \{\epsilon_1, \epsilon_2\}$. Then the complete value function is the expectation of all h-value function, taken over $\overrightarrow{\epsilon}$:

$$V_t(a, z) = \mathbb{E}_{\overrightarrow{\epsilon}}\left[\max_h \left\{V_t^h(a, z)\right\}\right] = \varrho \ln\left(\sum_h \exp\left(\frac{V_t^h(a, z)}{\varrho}\right)\right)$$

where the last equality derives from assuming that ϵ_h follows a Gumbel distribution with variance ϱ. The probability of choosing hours h is given by:

$$\mathbb{P}_t^h(a, z) = \frac{\exp\left(\frac{V_t^h(a,z)}{\varrho}\right)}{\sum_h \exp\left(\frac{V_t^h(a,z)}{\varrho}\right)} = \exp\left(\frac{V_t^h(a, z) - V_t(a, z)}{\varrho}\right)$$

High number of guesses. We need n_g guesses to solve our model, at the steady state and during the transition. For the calibration procedure, we use more than 30 guesses, as we add parameters as guesses and calibration targets as clearing conditions.

To find the equilibrium values for our guesses at the steady state, we use a quasi-Newton algorithm, improved with the Broyden method. Denote $\mathbf{x}$ the column vector of our guess variables, and f the function that associates the vector of guesses to the column vector of errors $\mathbf{e}$ in each clearing conditions, so that $f(\mathbf{x}) = \mathbf{e}$. f is the central function, that computes the optimality conditions for firms, governments, households and the measure. We use the following steps:

1. guess an initial vector $\mathbf{x}_0$, and compute the error $\mathbf{e}_0 = f(\mathbf{x}_0)$.
2. for each guess i, create the vector $\mathbf{x}_0^i$ with $\mathbf{x}_0^i(i) = \mathbf{x}_0(i) + \epsilon$ (with $\epsilon = 10^{-4}$) and $\mathbf{x}_0^i(\bar{i}) = \mathbf{x}_0(\bar{i})$, and compute the error $\mathbf{e}_0^i = f(\mathbf{x}_0^i)$.
3. create the Jacobian matrix M of size n_g^2 that relates a change of each guess to a change in each clearing condition. The column i is the vector $\mathbf{e}_0^i - \mathbf{e}_0$.
4. iterate the guess using $\mathbf{x}^{new} = \mathbf{x} + \alpha$, with $\alpha = -M^{-1} * \mathbf{e} * d$, with d a dampening factor (usually equal to 1, can be lower if the initial guess is far for the equilibrium). Denote $\mathbf{e}^{last} = \mathbf{e}$ the error.
5. compute $e^{new} = f(\mathbf{x}^{new})$.
6. modify the Jacobian matrix using the Broyden algorithm: $(M^{-1})^{new} = M^{-1} + \frac{(\alpha-\theta)(\alpha' M^{-1})}{\alpha'\theta}$, with $\theta = M^{-1}(\mathbf{e} - \mathbf{e}^{last})$. If the code does not converge, it is also possible to recompute, every t iterations, the "true" Jacobian of step 3.
7. if $\max|\mathbf{e}| > 10^{-5}$, go back to step 4.

For the non-linear transition, we use the same method of guessing a path for our variables and iterating it using a quasi-Newton algorithm. First, we compute the initial and final steady state, as we consider a permanent increase in carbon tax.

Second, we compute the Jacobian of our system around the final steady state. This means that we compute the effect of a shock at any time period t^{schock} of the transition (100-1 in our experiment), of any variable i (n_g), on any clearing condition j (n_g), at any time $t^{clearing}$ (99), leading to a matrix $J = (99 * n_g) \times (99 * n_g)$. To compute this object efficiently, we use parallel computation (as any variable can be shocked independently), sparse vectors, and the fake-news algorithm developed by Auclert, Bardóczy, et al. (2021). While formally dependent on the final steady state considered, the matrix J can be used to compute transitions towards other steady states (possibly with a dampening factor), as it only provides a new guess for the non-linear transition, and not the real path.

Third, we use the following algorithm to compute the non-linear transition:

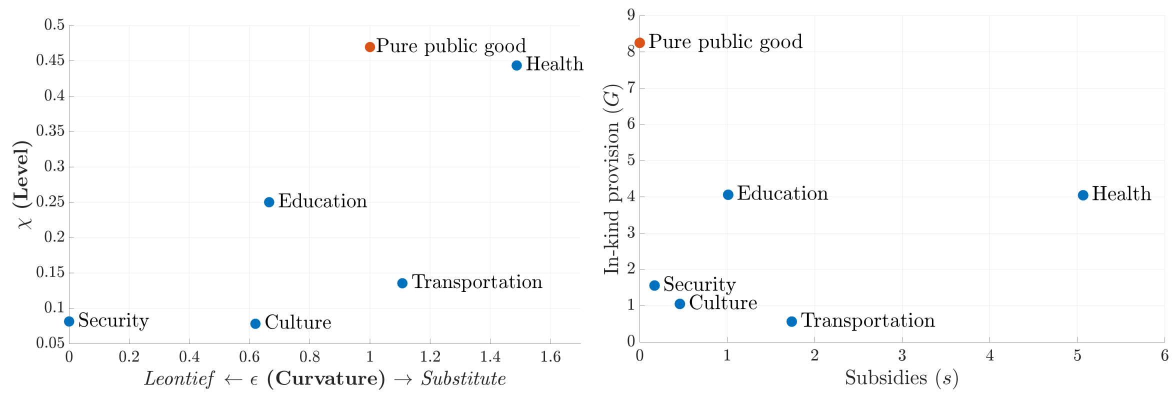
1. guess an initial path $\mathbf{X}$ of size $n_g \times (T-1)$ for our guess variables.
2. starting from period $T-1$, compute the optimal backward decision for households, and the firms' and government optimality conditions.
3. create the transition matrix as explained above for each period, and iterate forward from 1 to $T-1$ to obtain the measure and the aggregate variables.
4. compute the path of errors $\mathbf{E}$ of size $n_g \times (T-1)$ for the market clearing condition.
5. iterate the guess path using $\mathbf{X}^{new} = \mathbf{X} - J^{-1}\mathbf{E}$.
6. if $\max|\mathbf{E}| > 10^{-3}$, go back to step 2.

E Quantitative model – additional results

E.1 Externality function

On the left, we have our implied externality parameters (ϵ_k, χ_k). On the right, we have the observed policies (s_k, G_k), in % of GDP. The higher the subsidy, the higher the implied curvature ϵ_k. The higher the use of in-kind benefits, the lower the elasticity of substitution.

Figure 12: Link between observed policies and implied externality parameters



a. Parameters ϵ_k and χ_k

b. $s_k g_k$ and G_k (% GDP)

Robustness: with non-utilitarian planner.

E.2 Earning risks in the public and private sectors

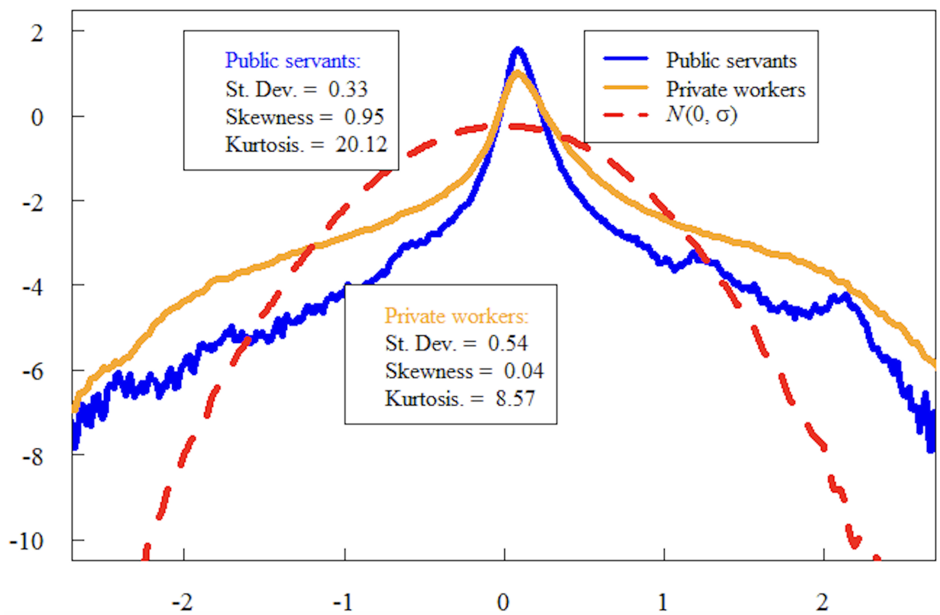
In this section, we extend our quantitative model to integrate a public sector. We estimate that this sector is characterized by a lower earning risk, and that this creates a stabilization channel for the public policies.

Data. We use administrative matched employer-employee data from France known as DADS[25], which has two advantages. First, it is highly representative, containing more than 3 million individuals in each cross-section. Second, it is a panel dataset that covers the entire work history of individuals, providing rich demographic, geographic, and firm-level information. The large sample size enables us to estimate idiosyncratic earning risks for several income level types and several occupation types.

Empirical results. To compute idiosyncratic earning risks we follow the methodology described in Guvenen et al. (2021). Our novelty is that we compute idiosyncratic risks for both private workers and public servants, that we are able to identify in our dataset

[25]DADS: *Déclarations Annuelles de Données Sociales.*

Figure 13: Log-density of 5-year earnings risks: public servants vs private workers



Sources: DADS.

We use this fact in an extension of our quantitative model and show that it increases the optimal level of public spending, as more public spending means more public servant and then more stabilization. [Work in progress].

E.3 Keynesian multipliers

Our model allows us to revisit the Keynesian multipliers literature: as we have an interaction between private consumption, public consumption and inequality, the effect of an increase in G are different from traditional results. To compute Keynesian multipliers, we use the quantitative model described in Section 3, adding a New Keynesian block and a Taylor rule. Specifically, we assume intermediate producers face a Rotemberg price adjustment cost $\Theta_t = \frac{\theta}{2}\left(\frac{p_{j,t}}{p_{j,t-1}} - 1\right)^2 Y_t$, giving rise to the New-Keynesian Phillips curve:

$$\frac{\epsilon}{\theta}\left(\mu_t - \frac{\epsilon - 1}{\epsilon}\right) + \mathbb{E}_0\left[\frac{1}{r_{t+1}}\frac{Y_{t+1}}{Y_t}\pi_{t+1}(\pi_{t+1} - 1)\right] = \pi_t(\pi_t - 1)$$

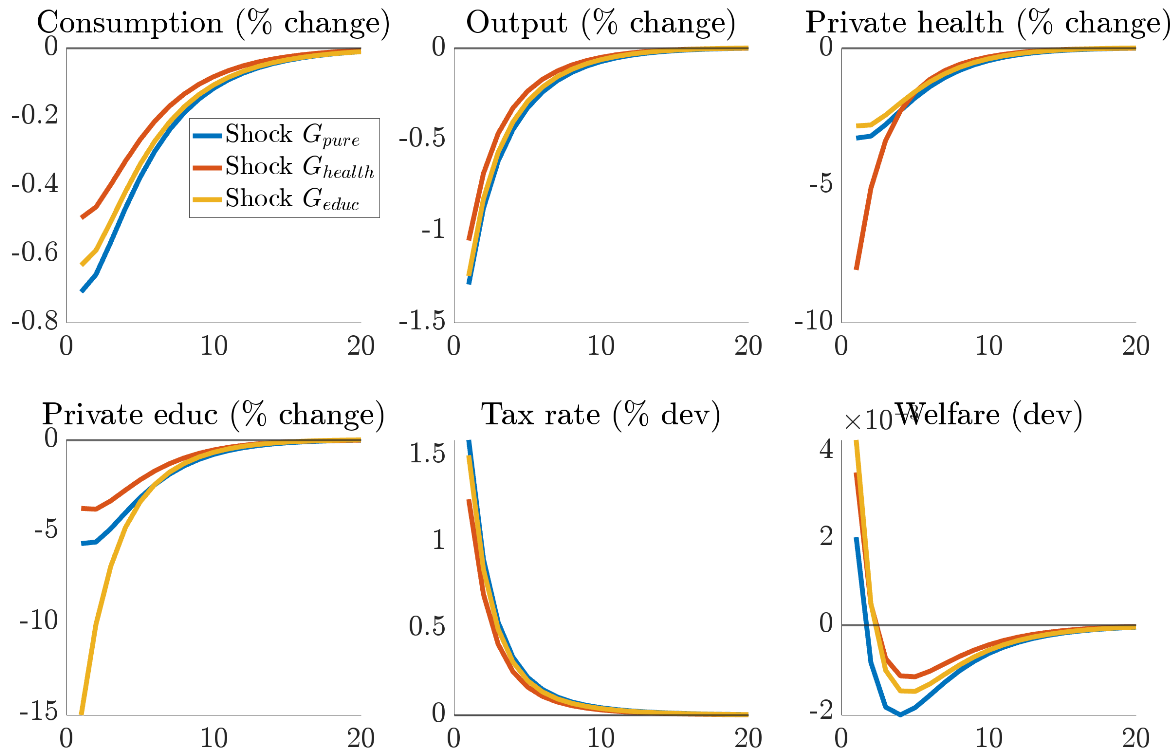
We assume central bank controls the nominal interest rate according to a Taylor rule:

$$i_t = \bar{i} + \varphi(\pi_t - \bar{\pi})$$

with $\varphi > 1$. Within this HANK version of our model, we assume a temporary increase[26] in the in-kind benefit G_k for $k = \{\text{pure public good, health, education}\}$. We obtain the following impulse response functions:

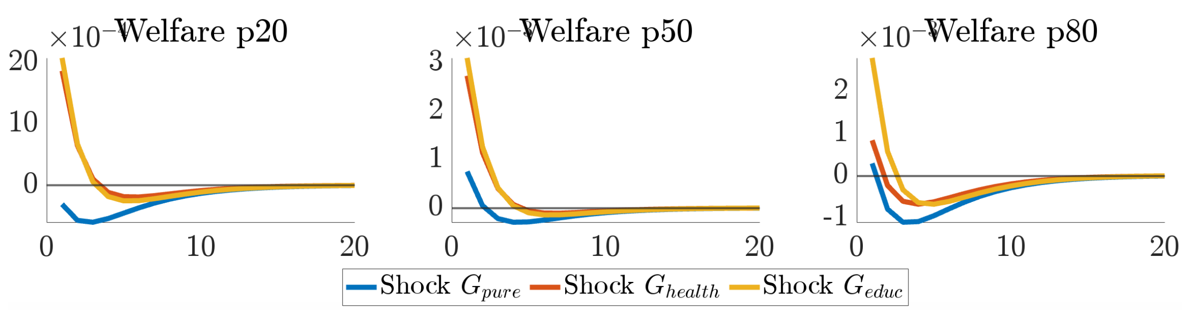
[26]following a AR(1) process $G_{k,t} = \bar{G_k} + e_{k,t}$ and $e_{k,t} = 0.5e_{k,t-1}$, with $e_{k,1} = 0.01$.

Figure 14: IRF following a temporary increase in G_k



We can also compute the welfare for the 20$^{\text{th}}$, 50$^{\text{th}}$ and 80$^{\text{th}}$ percentile of the income distribution. As illustrated by the figure below, education being more a luxury good than health (in the sense that less people consume private education), the

Figure 15: IRF following a temporary increase in G_k



F Distributional National Accounts – Section 7

In this part, we compute how much households value in-kind benefits G with respect to cash transfers T or disposable income, in a reduced version of our analytical model of Section 1. We suppose households are heterogenous with respect to their disposable income y_i drawn from a distribution probability F. They can consume good c and luxury good g, also publicly provided. They face the following problem:

$$\max_{c_i,g_i} u_i = (1-\omega)\ln(c_i) + \omega \ln(g_i + G + \bar{g})$$

$$\text{s.t. } c_i + g_i = y_i$$

The first-order condition implies that there is a threshold $\zeta = \frac{1-\omega}{\omega}(G+\bar{g})$ under with households do not consume the luxury good. Then we have the following demands for c and g:

$$c_i = \begin{cases} (1-\omega)(y_i + G + \bar{g}) & \text{if } y_i \geq \zeta \\ y_i & \text{if } z_i < \zeta \end{cases}$$

$$g_i = \begin{cases} \omega y_i + (1-\omega)(G+\bar{g}) & \text{if } y_i \geq \zeta \\ 0 & \text{if } z_i < \zeta \end{cases}$$

Then the utility for both types is:

$$g_i = \begin{cases} \ln(y_i + G + \bar{g}) + t.i.p. & \text{if } y_i \geq \zeta \\ (1-\omega)\ln(y_i) + \omega \ln(G+\bar{g}) & \text{if } z_i < \zeta \end{cases}$$

Then, the marginal utility of G with respect to the marginal utility of disposable income y is

$$\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \begin{cases} 1 & \text{if } y_i \geq \zeta \\ \frac{\omega}{1-\omega}\frac{y_i}{G+\bar{g}} = \frac{y_i}{\zeta} & \text{if } z_i < \zeta \end{cases}$$

or equivalently,

$$\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \min\left(\frac{y_i}{\zeta}, 1\right)$$

Now, suppose we now the share S of households with zero consumption, and with F the distribution followed by y: $S = \mathbb{P}(y < \zeta) = F(\zeta) \iff \zeta = F^{-1}(S)$ Finally, suppose the distribution is normalized such that $\mathbb{E}[y] = \bar{y} = 1$ so that $y_i = y_i/\bar{y}$. Then, our formula above comes:

$$\boxed{\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \min\left(\frac{y_i/\bar{y}}{F^{-1}(S)}, 1\right)}$$

Example: Pareto distribution and education. Suppose disposable income y follows a Pareto distribution of density

$$f(y) = \frac{\alpha(\alpha-1)^{\alpha}}{\alpha^{\alpha} y^{\alpha+1}}$$

with the shape parameter $\alpha > 1$, known as the tail index. In this case, we have that $\mathbb{E}[y] = 1$, and the share of zero-consumption households is

$$S = F(\zeta) = 1 - \left(\frac{\alpha - 1}{\alpha\zeta}\right)^{\alpha} \iff \zeta = \frac{\alpha - 1}{\alpha(1-S)^{\frac{1}{\alpha}}}$$

Then, our rule becomes

$$\boxed{\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \min\left(\frac{y_i}{\bar{y}}\frac{\alpha}{\alpha - 1}(1-S)^{\frac{1}{\alpha}}, 1\right)}$$

Suppose we want to compute the monetary equivalent of one euro of public education provided to household i in a given country. In this case, we just need to need two parameters: the tail index α of the income distribution, and the share S of households with zero private consumption of education. We suppose $\alpha = 2.2$ in France, a value in the range of empirical estimates, and $S = 0.8$ as explained in our calibration part. Then, assuming a net disposable income $\bar{y} = 26000$ in France, we obtain

$$\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \min\left(\frac{y_i}{29474}, 1\right)$$

G Targeted in-kind benefits: robustness

Herein, we detail our empirical procedure and propose additional functional forms for targeted in-kind transfers. We compare their relative performances in Table 31.

Simple power rule. Our benchmark formula from Section 8 is equivalent to a pure power function:

$$g_{i,k}^{\text{in-kind}} = \mu_k y_i^{\gamma_k}$$

This is the simpler formula and only needs 2 parameters: γ_k a non-linear parameter, and μ_k a scaling parameter. When $\gamma_k < 0$, this means that targeted transfers favor low-income households. To estimate jointly both parameters, we use data from French Distributional National Accounts and run the following regression:

$$\log(g_{i,k}^{\text{in-kind}}) = \beta_0 + \beta_1 \log(y_i) + \epsilon_i$$

where y_i denote normalized disposable income. One can interpret estimators as $\beta_0 = \log(\mu_k)$ and $\beta_1 = \log(\gamma_k)$.

Logistic Drop-off. Then, we propose another formula using a logistic function:

$$g_{i,k}^{\text{in-kind}} = \frac{\mu_k}{1 + (y_i/(\zeta_k \bar{y}))^{\gamma_k}}$$

This function provides a smoother decay than the simpler power law, at the cost of adding one parameter: ζ_k.

Softer Cutoff. Finally, our most complex formula uses the tanh functional form:

$$g_{i,k}^{\text{in-kind}} = \frac{\mu_k y_i^{\gamma_k}}{2} \left(1 - \tanh\left[\xi_k(y_i - \zeta_k \bar{y})\right]\right)$$

This functional form gives the best empirical fit but has 4 parameters: μ_k, γ_k, ζ_k and ξ_k.

Table 31: MSEs relative to power law by sector

	Health	Education	Culture	Housing
Logistic Drop-off	0.98	1.02	0.27	0.01
Softer Cutoff	0.90	0.23	0.27	0.01

Note: The first line presents the MSE of the logistic function divided by the MSE of the power law. If the ratio is close to 1, then it means that the fits are close to identical.