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

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Abstract

Public in-kind provision of education, healthcare, or cultural amenities accounts for a large share of government spending, even though redistribution can be achieved with cash transfers and externalities addressed with subsidies. We propose a new efficiency-based rationale for in-kind provision of goods, grounded in two empirically relevant features: (i) these goods are luxuries, with consumption rising more than proportionally with income; and (ii) they generate externalities that depend not only on the total level of consumption but also on its distribution across households. In a tractable heterogeneous-agent model, we show that when these two conditions hold, direct in-kind provision is welfare-improving, even when cash transfers and subsidies are available. Using household- and country-level data, we document that most publicly provided goods exhibit both features. Embedding these insights into a calibrated model for France, we find that optimal fiscal consolidation should reduce subsidies rather than direct provision, and that income-targeted in-kind benefits can generate substantial fiscal savings. Finally, we develop a welfare-based imputation method for in-kind benefits, yielding a more accurate assessment of the distributive impact of government spending.

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1 Introduction

Governments devote a substantial share of GDP to the direct provision of goods and services – such as healthcare, education, housing, and cultural amenities – rather than relying on cash transfers or subsidies. Standard economic theory struggles to rationalize this pattern: redistribution is usually most efficient through cash transfers, while externalities are best addressed through Pigouvian subsidies. Why, then, do governments directly provide such a wide range of goods, and what is the optimal mix between cash transfers, subsidies, and in-kind provision? These questions are increasingly urgent as public debt and distortionary taxation reach historic highs, and fiscal consolidation appears on the policy agenda in many countries.

In this paper, we develop a new theory of in-kind benefits based on two key features of many publicly provided goods. First, they are luxuries: their consumption share rises with income, and low-income households consume little or none. Examples include education, healthcare or cultural goods. Second, they generate externalities that increase with broad and equitable participation. For instance, early childhood education yields large social returns in productivity, crime reduction, and civic engagement when coverage is widespread, and vaccination reduces disease transmission only if broadly adopted. In this sense, externalities are "pro-equality": they are larger when two individuals each have one unit of vaccine than when one has two units and the other has none.

We incorporate these two features into a tractable heterogeneous-agent model, where the government chooses the optimal mix of in-kind benefits, subsidies, and cash transfers. We then use household- and country-level data to show that these conditions hold empirically for most publicly provided goods. Finally, we embed our insights into a calibrated quantitative model of France to study optimal fiscal consolidation.

Our main findings are the following. First, both luxury good and "pro-equality" externalities are necessary to justify positive public provision. Second, two-thirds of in-kind spending is on luxury goods, and there is ample evidence that these goods yield external returns beyond private ones, which increase with equal consumption. Third, our approach to valuing public spending sheds new light on optimal fiscal consolidation. The planner should reduce the provision of pure public goods that are not privately consumed, such as defense, more than the provision of goods with private counterparts, such as education and health. Moreover, income-targeted provision of in-kind benefits can deliver substantial fiscal savings – around 0.7% of GDP. Fourth, accounting for how households value luxury goods substantially reduces the measured redistributive impact of in-kind transfers, implying that existing methods overstate the progressivity of tax-and-transfer systems.

The paper is organized as follows. In the first part, we develop an analytically tractable heterogeneous-agent model in which private and public consumption of a luxury good generates "pro-equality" externalities, that do not only depend on the total consumption, but also on its distribution across households. The government chooses the optimal mix of in-kind benefits, subsidies, and cash transfers, financed by a distortionary linear labor tax. We show that Pigouvian subsidies raise aggregate consumption but also increase dispersion in individual consumption, as they do not affect poor people with zero consumption of the luxury good, which is detrimental when externalities are stronger under more equal consumption. By contrast, cash transfers reduce inequality but lower aggregate consumption of the luxury good, as they redistribute from high-consuming rich households to lower-consuming poorer households. The interaction of luxury goods and pro-equality externalities therefore makes direct in-kind provision strictly welfare-improving, even when governments already have access to cash transfers and subsidies. Without luxury demand, cash transfers and in-kind benefits are perfect substitutes; without pro-equality externalities, subsidies dominate direct provision, as they raise consumption without under- or over-providing goods across households. Importantly, our theory does not rely on missing markets, informational frictions, or paternalistic preferences: even when households can purchase these goods privately and redistribution could in principle be achieved more efficiently through cash transfers, direct public provision can still be welfare-maximizing. Using country-level panel data for education and health, we confirm the model's prediction that both the size of government and the level of in-kind provision increase with inequality. Finally, we discuss how our theory relates to existing explanations for in-kind provision and how it is modified under alternative modeling assumptions.

In the second part, we show that our two assumptions – luxury goods and pro-equality externalities – hold for most publicly provided goods. Using both country-level and household-level panel data, we compute income elasticities and estimate non-homothetic preferences for health, education, culture, and transportation. All these goods exhibit high-income elasticities and therefore qualify as luxuries. Household surveys and transaction-level bank account data further reveal that a substantial share of households does not consume these goods privately, and that this share declines with income. A detailed classification of French public spending shows that at least 65% of in-kind benefits fall into this category of publicly provided luxury goods. We then review empirical estimates of externalities for health and education and find support for our distribution-sensitive externality. Straightforward examples include vaccines against infectious diseases and broad education coverage, which increases productivity and political participation while reducing involvement in criminal activities. Moreover, using country-level data, we find that inequalities in educational and health outcomes are negatively correlated with GDP per capita, even after controlling for country fixed effects and income or wealth inequalities.

Our theory of in-kind benefits, supported by empirical evidence, allows us to properly value these benefits and thus assess the cost of reducing them during fiscal consolidation. To do so, we extend the analytical model along several dimensions: realistic income tax elasticities, multiple sectors with varying degrees of luxury and private consumption, and a dynamic structure to capture debt accumulation and welfare effects. We then build a state-of-the-art dynamic heterogeneous-agent model calibrated to France. The model features eight goods: a normal good consumed only by households (e.g., food), a pure public good provided only by the government (e.g., defense), and six sectoral goods (health, education, culture, transportation, security, and housing) that differ in their luxury nature for households and are subject to public provision or subsidies. The government has multiple instruments for debt reduction: lowering in-kind benefits or subsidies in the six private sectors, cutting provision of the pure public good, or raising taxes. Because household heterogeneity is crucial for assessing the costs of these adjustments, we carefully calibrate income and wealth distributions as well as consumption baskets across households. Specifically, we combine administrative data to estimate idiosyncratic productivity shocks in France, consumption surveys and bank data to match sectoral consumption across income deciles, and tax data to capture the progressivity of the tax-and-transfer system. Finally, sector-specific externality parameters are inferred from observed policies and validated against empirical estimates. In this rich framework, we reproduce households' sectoral consumption patterns, their tax payments on labor, capital, and goods, their income and wealth distributions, and the government's expenditure profile. This allows us to evaluate the effects of fiscal consolidation through changes in public debt.

Our main quantitative exercise is to determine the best transitional scenario to reduce debt-to-GDP ratio from 100% to 90%. This poses numerical and theoretical challenges to compute the optimal dynamics for heterogeneous-agent models; we develop an approach to approximate the Ramsey solution. Following a 10% debt reduction, the optimal adjustment relies more on cutting publicly provided goods without a direct private counterpart – such as defense or justice – and on reducing subsidies, rather than lowering the public provision of goods with private substitutes – such as health and education. The intuition is twofold. First, fiscal consolidation leads to a larger reduction in the consumption of luxury goods that generate externalities than in the consumption of normal goods; further cuts in public provision would therefore excessively restrict these goods. Second, if inequality rises during consolidation – as in our quantitative exercise, where labor income taxes, the main source of revenue for poorer households, adjust – the dispersion of consumption increases, which undermines the pro-equality externality. This finding highlights the importance of our theory, as standard approaches that scale public provision proportionally with private consumption fail to account for these effects. We then relax the assumption of uniform in-kind provision and examine whether income-targeted in-kind benefits could generate substantial fiscal savings. Our estimates show that, holding aggregate welfare constant, optimal targeting could save €21 billion – about half of the fiscal adjustment planned by the French government for 2025.

Lastly, we contribute to the measurement of in-kind transfer progressivity. Existing studies often assume that households value in-kind benefits equally, which tends to overstate their redistributive impact. However, if publicly provided goods are luxuries, they are valued less by poorer households that do not consume them privately. Building on this idea and using our analytical model, we propose a simple imputation formula that accounts for the declining marginal valuation of luxury goods among poorer households. Our formula generates a household-specific weight using only three sufficient statistics: the share of households with zero consumption, the income distribution, and each household's relative position within that distribution. Applying this weight to in-kind benefits measured in the Distributional National Accounts, our method reduces the estimated redistributive effects of in-kind benefits in France by one-third compared to standard approaches.

1.1 Literature review

This paper contributes to three literatures: optimal public spending, optimal progressive taxation, and the distributional incidence of public spending.

Optimal public spending. The modern literature on the optimal level of public expenditures originates with Samuelson (1954)'s seminal contribution, and his formula relating the marginal utility of private and public consumption. Subsequent work extended this framework to account for production inefficiencies (P. Diamond and Mirrlees (1971)), tax distortions (Stiglitz and Dasgupta (1971), Atkinson and Stern (1974)), labor market frictions (Michaillat and Saez (2019)), and externalities (Sandmo (1975)). We contribute to this literature by providing a unified framework that provides a rationale for the optimal mix of cash transfers, subsidies, and in-kind provision. In contrast to much of the prior work, we relax the "missing-market" assumption and allow for positive private demand for publicly provided goods. A related strand of research focuses more specifically on the motivations for in-kind transfers, with explanations including paternalistic or interdependent preferences (Currie and Gahvari (2008); J. Cunha

(2014)), superior screening or targeting properties (Nichols and Zeckhauser (1982); Besley and Coate (1991); Lieber and Lockwood (2019)), solutions to the Samaritan's dilemma (Coate (1995)), political economy considerations (Meltzer and Richard (1981); Epple and Romano (1996); Bearse, Glomm and Janeba (2000)), positive pecuniary externalities (J. Cunha, De Giorgi and Jayachandran (2019); R. Diamond and McQuade (2019)), and insurance against commodity price risk (Gadenne et al. (2024)). We propose a distinct rationale based on non-homothetic preferences and externalities that increase with the equal distribution of consumption. These features generate interior solutions for direct in-kind provision, even when cash transfers and subsidies are available.

Optimal taxation 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 taxation part of fiscal policy, we address the substantial remaining part: in-kind benefits and subsidies. 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, providing 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 its 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 individuals' characteristics (age, income, location, etc.). These papers usually impute public spending to households based on observable characteristics such as age, income, or location, valuing it at their monetary cost.[1] This approach ignores heterogeneity in preferences and willingness to pay for public services. We address this concern by proposing a welfare-based imputation formula that converts in-kind benefits into a "cash transfer equivalent" measure, as some goods are more "luxury" than others and therefore less valued by poor households. We find that previous methods overestimate the redistributive effects of French in-kind transfers by 50%. 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 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. Moreover, we are not limited to evaluating existing policies; the structural model enables counterfactual analysis of hypothetical interventions, and the 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 2 presents our analytical model and key results on the optimal provision of goods. Section 3 provides empirical evidence to justify our modeling assumptions. Section 4 presents our quantitative model, and Section 5 describes the calibration. Section 6 discusses the properties of our model, before turning to our optimal fiscal consolidation exercise in Section 7. Finally, Section 8 proposes an imputation method to assess the distributive effects of in-kind benefits.

2 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] One exception is Gethin (2023) who estimate the welfare value of public education and healthcare using discounted returns to schooling and gains in life expectancy

2.1 The model

We first assume that households are heterogeneous in terms of their productivity z_i, such that $z_i \sim$ log-Normal $\left(-\frac{\nu}{2}, \nu\right)$.[2] 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.[3] Finally, there is an externality related to the individual consumptions of the good g, that households do not internalize. Each household i solves the following problem:

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

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

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

The term g_i+G implies that public and private consumption of g are perfect substitutes, which is the most unfavorable case for justifying the intervention of the government.[4] The Stone-Geary preferences, with the luxury parameter $\bar{g}$, imply that for households with a productivity lower than a threshold $\zeta = \frac{\phi}{\omega}\frac{1-s}{1-\tau}(G+\bar{g})$, the constraint $g_i \geq 0$ binds, meaning that they do not privately consume education or health. Note that $\bar{g}$ enters the externality to obtain closed-form solution, which will not be the case in the quantitative model. The last externality term is a concave combination of individual contributions. The parameter χ determines the strength of the externality, and equals the derivative of welfare with respect to average contribution.[5] Finally, the parameter α determines the concavity of the combination, or with a CES interpretation, the elasticity of substitution between individual contributions.[6] When $\alpha = 1$, households' contributions are perfect substitutes, so what matters is the total consumption and not its distribution; when $\alpha > 1$, inequality increases the externality; when $\alpha < 1$, inequality

[2]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.

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

[4]Assuming imperfect substitution is similar to the missing market argument.

[5]Suppose every individual contribution is multiplied by $1+dx$: the externality term 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 $\frac{dX}{dx} = \chi$.

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

reduces the externality, with the extreme case of a Leontief function $\chi \min_i(g_i + G + \bar{g})$ when $\alpha \to -\infty$.

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.

2.2 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 $g_i = 0$: households cannot privately consume g, and $\bar{g} = 0$. The planner problem becomes:*

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

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

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

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

In this model, $g_i = 0$ for all households: they cannot consume education or health, but still value these goods privately and through the externality they generate, giving the government a unique ability to increase welfare.[7] The interpretation of welfare is as follows. The first term, $\ln(1-\tau)$, represents the crowding-out of private consumption by

[7] 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.

public consumption. The second term, $e^{\nu}(\tau - \phi G)$, 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, $(\chi + \omega)\ln(G)$, reflects the private valuation and 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 (and there is no s because there is no private consumption). 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.*
a) 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:

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

b) 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, G and T are equivalent: their sum is determinate, but not each component separately. The sum-to-GDP ratio increases with ν, as the redistribution motive becomes stronger when inequality rises.

On the other hand, the subsidy s is determined and independent of inequality. This implies that, in the absence of luxury goods, the externality and associated under-consumption relative to the social optimum can be addressed through subsidies, independently of the household distribution. The optimal subsidy decreases with ω, since households already devote a large share of their consumption to g, and increases with

χ, as the externality motive becomes stronger. Once again, we obtain a dichotomy: transfers (whether cash or in-kind, which are equivalent here) address inequality, while subsidies address the externality.

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. Assuming luxury goods breaks this equivalence.

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 in-kind benefit is equal to

$$G^\star = \frac{\omega + \chi}{\phi e^\nu \left(1 + \mathbb{P}(z \geq \zeta^*) \frac{\mathbb{E}[z|z \geq \zeta^*] - \zeta^*}{\zeta^*}\right)} - \bar{g} \quad \text{and} \quad \frac{\partial G^\star(\nu)}{\partial \nu} > 0$$

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

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

c) The optimal size of the government is equal to

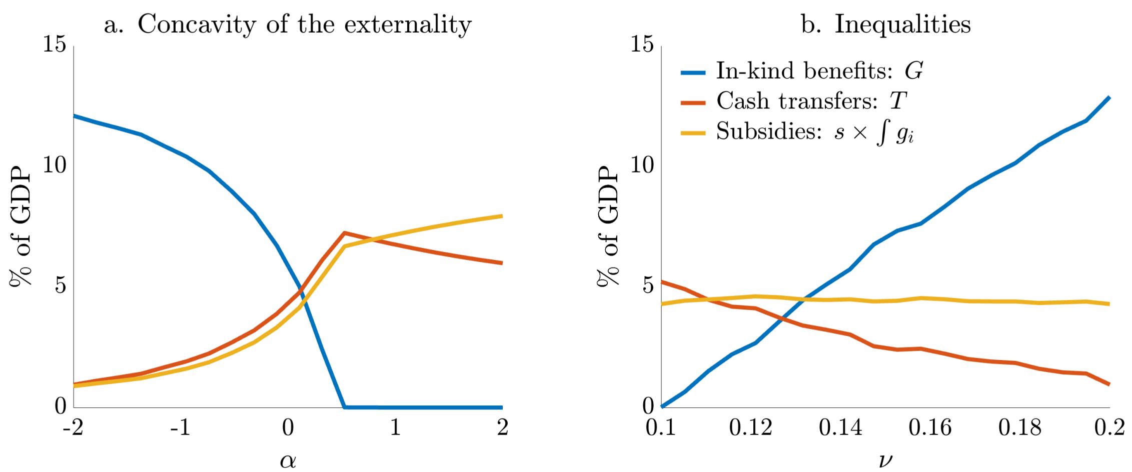
$$\tau^\star = 1 - e^{-\nu}$$

The first result (Proposition 3.a) 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, which is represented by the term e^ν. 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 second result (Proposition 3.b) 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 mechanism: when substitutability between individual contributions is low (high), the planner should rely on direct provision (subsidies) to address externalities.

The third result (Proposition 3.c) 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.

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.

Taking stock. We show that two conditions are necessary for a positive level of optimal in-kind benefits: the luxury nature of the goods provided by the government and the presence of concave externalities associated with these goods. Without luxury demand, cash transfers and in-kind benefits are perfect substitutes; without pro-equality externalities, subsidies dominate direct provision, since they raise consumption without misallocating goods across households.

The rationale for in-kind provision is thus the following. If a good generates a positive externality, the government should aim to increase its consumption. But 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, rather than just the aggregate level, direct provision through in-kind transfers becomes necessary.

It is therefore crucial to identify the luxury dimension of government-provided goods and to validate the model with data. We provide empirical evidence on these dimensions in Section 3.

3 Empirical evidence

Our theory of public spending predicts that the government provides certain goods because i) they are luxury goods, and ii) they generate concave externalities, and that this provision is positively correlated with inequalities. In this section, we first test these predictions, and show that there exists a significant positive correlation between public spending and inequality. 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.

3.1 Empirical validation: 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.c), and second, the size of in-kind benefits is a function of inequality (Proposition 3.a). These two predictions are different from the usual Samuelson rule, where $G^\star$ is independent from inequality. The aim of this section is to assess whether the key implications of our baseline model find some empirical support in a cross-country panel data set.

Cross-country data. Total government spending over GDP comes from the IMF Public Finances in Modern History Database, covering 151 countries over the period 1800–2022. We recover health spending as a share of total government spending from the World Health Organization – Global Health Observatory that covers 192 countries between 2000 and 2022. For public education spending, we use total general government spending on all levels of education as a share of GDP from the UNESCO Institute for Statistics (2025). For our inequality measure, we choose the top 10% wealth share from the World Inequality database. This choice is motivated by the large sample (199 countries since as early as 1807), and because the wealth inequality is less independent from government taxation, more "exogenous" and uninsurable, and therefore closer to our exogenous productivity component z.

Controls and weights are drawn from the following sources: (i) GDP per capita estimates, regional dummies and dummies for the country's level of development are based on the World Bank classification, (ii) population data come from the UN World Population Prospects (2024), (iii) the democracy index is based on V-Dem (2025) estimates. We keep countries for which we have at least 10 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 of 3,925 and 2,366 observations, respectively, for our two validation exercises.

3.1.1 Validation 1: government size and inequalities

Proposition *3.c* states that the total size of the government should increase with inequality: $\tau^\star = 1 - e^{-\nu}$. We test this proposition in cross-country panel dataset with the following regression:

$$\frac{\text{Gov}_{i,t}}{\text{Y}_{i,t}} = \alpha + \beta \text{ Inequality}_{i,t} + \theta X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

With $\frac{\text{Gov}_{i,t}}{Y_{i,t}}$ the total size of government over GDP (including in-kind benefits and transfers) for country i at period t, Inequality measured as the share of wealth held by the top 10% of the wealth distribution, X our vector of controls (log GDP per capita, regional and development dummies, democracy index), μ and λ respectively the country and time fixed effects, and ϵ the residual. Our dataset covers 137 countries from 1990 to 2023.

Table 1: Total public spending and inequalities

	Total public spending G/Y					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	9.67			-2.28		
	(14.2)			(13.3)		
Top 10% wealth share	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		✓	✓		✓	✓
Country FE			✓			✓
Additional Controls				✓	✓	✓
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

Observations weighted by population. Standard errors clustered at the country level.
Signif. levels: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

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. This results hold with and without country fixed effects and is in line with the predictions of the model.

3.1.2 Validation 2: in-kind benefits and inequalities

Proposition *3.a.* states that in-kind benefits should increase with inequality: $\frac{\partial G^{\star}}{\partial v} > 0$. We test this result with the following regression:

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

With $\frac{\text{Public Health and Educ}_{i,t}}{Y_{i,t}}$ the sum of public health and public education spending over GDP, Inequality measured as the share of wealth held by the top 10% of the wealth distribution, X our vector of controls (log of GDP per capita, total size of government, regional and development dummies, democracy index), μ and λ the country and time fixed effects, and ϵ 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. Other type of public spending like culture, transportation or security are not included, as similar series are not available for these sectors. Our current dataset covers 127 countries from 2000 to 2023.

Table 2: In-kind benefits and inequalities

	Public spending in health and education (% GDP)					
	(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		✓	✓		✓	✓
Country FE			✓			✓
Additional Controls				✓	✓	✓
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

Observations are weighted by population. Standard errors are clustered at the country level.
Signif. levels: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

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, the expenditures over GDP is 0.07% bigger. This is in line with Proposition 3.a and Figure 1.b, where G is an increasing function of inequality.

3.2 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 income elasticities and nonhomothetic CES preferences. We conclude that health, education, transportation, and culture, four important government expenditures in many countries, can be considered as luxury goods.

3.2.1 Cross-country analysis

Aggregate data. In this section, we build upon the broadest datasets available on sectoral expenditures (health, education, culture, and transportation) at the country-level. For health, we use health expenditure in US$ PPP per capita from the OECD System of

Health Accounts (SHA). For education expenditure, we use total general government spending on all levels of education as a share of GDP from the UNESCO (2025) as in Section 3.1. To impute culture and transportation consumption per capita, we use sectoral employment data from Groningen's 10-Sector Database,[8] 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.[9] 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.[10] The coefficient θ can be interpreted as the income elasticity 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 3 reports our results with and without country fixed effects. Additional regressions without controls or fixed effects can

[8]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.

[9]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.

[10]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.

be found in Appendix C.2.1. For regressions with only time fixed effects, the estimated income elasticity θ exceeds one, a result that is statistically significant at the 1% level. Therefore, richer countries spend a higher share in health, education, culture and transportation than poorer countries. Adding the country fixed effect, we find that the result hold. This means that on average, when countries get richer, they tend to increase the share of the economy devoted to these sectors. This indicates that the share of these goods in total expenditures rises with income, classifying them as luxury goods.

Table 3: Income elasticity

$\log(c)$	*Health*		*Education*		*Culture*		*Transportation*	
	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)
θ	1.25**	1.15**	1.31**	1.38**	1.55**	2.17**	1.29**	1.32**
	(0.060)	(0.051)	(0.055)	(0.127)	(0.106)	(0.411)	(0.181)	(0.087)
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Country FE		✓		✓		✓		✓
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. Controls are described in Appendix C.2.1.
Signif. levels against $\theta = 1$: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Robustness: private expenditures. The education data we use covers only government spending and excludes private expenditures (e.g., private schools, private teachers). In Appendix C.2.2, we replicate the analysis using OECD data that include private expenditures. Moreover, for culture and transportation, relative sectoral consumption expenditures may not be proportional to relative sectoral employment or value-added shares: we replace them by annual household final consumption expenditure by purpose (COICOP 2018) in constant 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.

Estimating non-homothetic CES preferences. In Table 3, we estimate average income elasticity. However, this elasticity can be non-linear: the consumption share increases with income until a certain level, then decreases, and another "more luxurious" good replaces it. To quantify this, we estimate a non-homothetic CES (nhCES) 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 of goods.[11] The dataset, methodology and

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

results are detailed in Appendix C.2.3. We can conclude that all our sectors are relative luxuries with respect to manufacturing. This stays true when we restrict the sample to OECD and non-OECD countries, except for cultural expenditures in OECD countries.

3.2.2 Household-level analysis

Household-level data. We focus on U.S. household-level data as there is no comparable dataset available for France. We follow Comin, Lashkari and Mestieri (2021) and use 1999-2010 U.S. Consumption Expenditure Survey (CEX) at the quarterly frequency. As common in this literature (see Aguiar and Bils (2015); Heathcote, Perri and Violante (2010); D. Krueger and Perri (2006)), we focus on a sample of urban households with a present household head aged between 25 and 64, and our controls are dummies for age range of household head, household size and number of household earners. Compared with cited papers, we construct 7 consumption categories: agriculture, manufacturing (industry), health, education, culture, transportation and other services. Price series data come from the BLS's urban CPI (CPI-U).

Simple OLS regression. We first estimate the income elasticity θ of each good with the following regression:

$$\log(c_i) = \theta \log(y_i) + \gamma X_i + \epsilon_i \tag{2}$$

where c_i denotes expenditures on a given good (health, education, culture, or transportation) for household i, y_i is total expenditures, controlling by age groups, household size and number of earners. Our results are showed in Table 4. We find that for all categories, $\theta > 1$. Since we construct a quantitative model calibrated on French data, we reproduce these regressions with 2 cross-sectional datasets from France in Appendix C.2.4.

Table 4: Income elasticity, US CEX 2010 cross-section

	Health		Education		Culture		Transportation	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
θ	1.40	1.39	1.70	1.59	1.27	1.28	1.27	1.25
	(0.036)	(0.011)	(0.057)	(0.163)	(0.025)	(0.006)	(0.019)	(0.016)
Controls		✓		✓		✓		✓
Observations	3,099	3,099	3,099	3,099	3,099	3,099	3,099	3,099
Adj R^2	0.32	0.31	0.22	0.26	0.44	0.45	0.58	0.59

Observations are weighted by survey weights.

Since we construct a quantitative model calibrated on French data, we reproduce these regressions with 2 cross-sectional datasets from France. Our results still hold in the French context: all sectors have income-elasticities above 1, except for education.

We discuss these results in Appendix C.2.4.

Estimating nhCES preferences. As in the previous subsection, we now estimate the current state-of-the-art nhCES demand system from Comin, Lashkari and Mestieri (2021) on our 7 sectors, using GMM estimation. Details about the estimation procedure and additional results are presented in Appendix C.2.5. Table 5 line (i) presents our main result with 7 sectors. We find that health, culture and transportation are relative luxuries compared to manufacturing. In this estimation, education is a relative necessity to manufacturing, but a relative luxury compared to agriculture. Since education has a lot of observations equal to 0, the number of observations is very low: 4,152 compared to over 60,000 initially, implying large standard deviations. Therefore, we estimate the same demand system by aggregating 6 sectors, putting education in the other services category. These results are presented in line (ii). Again, we conclude that health, culture and transportation are relative luxuries compared to manufacturing. Computing expenditure elasticities, we quantify that from the perspective of the U.S. average household, health and culture are luxuries, while transportation is a necessity.[12]

Table 5: nhCES demand system estimation

	Elasticity of substitution: σ	*Non-homothetic parameter:* ϵ_s *Health*	*Education*	*Culture*	*Transportation*	*Observations*
	(a)	(b)	(c)	(d)	(e)	
(i) 7 sectors	0.24	2.64	0.65	3.60	2.34	4,152
	(0.07)	(0.77)	(0.26)	(1.00)	(0.62)	
(ii) 6 sectors	0.25	1.56	–	2.26	1.36	36,083
	(0.07)	(0.18)	–	(0.20)	(0.13)	

Observations are weighted by survey weights. Standard errors clustered at the household level. All regressions include region and year × quarter fixed effects.

3.3 Literature review on externalities and stylized facts

In this section, we review empirical estimates of externalities found in the literature, especially for education and health. We also provide empirical evidence that inequality in education and health attainment reduces GDP per capita, beyond the effect of income inequality, which supports our hypothesis of "pro-equality" externality.

[12]We cannot estimate this system of preference for France, as equivalent datasets do not exist. Budget de Famille (household budget survey) is done at most every five years, and our transaction-level bank data is only available for 2023-2024.

3.3.1 Education

There exists a large literature on the idea that education generates externalities, in the sense that the social return to schooling exceeds its private return. Beyond the academic notion of "externality", this idea is likely to be shared by governments, and explains the prominence of education policies. For instance, U.S. Presidents Lyndon B. Johnson ("Every child must be encouraged to get as much education as he has the ability to take, not only for his sake, but for the nation's sake; for we cannot sustain growth without trained manpower, and freedom is fragile if citizens are ignorant"[13]), Barack Obama ("every dollar we invest in high-quality early education can save more than seven dollars later on, by boosting graduation rates, reducing teen pregnancy, even reducing violent crime"[14]), and, much earlier, Representative Horace Mann ("consider how a virtuous or a vicious education tends to fit or to unfit him for them all"[15]).

As highlighted in Blundell et al. (1999), "While the existence of these positive economy-wide educational spillovers is an important economic justification for the public support of education, the difficulties of actually verifying their size and thus calculating true social returns are formidable". Still, there are attempts to identify specific externality channels; see Moretti (2004). The first and main one is productivity spillovers and technological changes: when the presence of educated workers can make other workers more productive, and higher aggregate education levels can increase overall productivity. Lucas (1988) and many others have proposed models of endogenous growth driven by human capital. Attempts to measure these externalities often involve estimating the total social return to education using macro data and subtracting the private return, typically estimated with micro data and Mincer equations. Moretti (2004) estimates that a 1 percentage point increase in the college share of a city raises average wages by 0.6–1.2%, above and beyond the private return. Rauch (1993) suggests externalities of around 3–5%, while Acemoglu and Angrist (2000) finds modest external returns of 1–3%. Using a different approach and assuming that highly educated and less-educated workers are imperfect substitutes, Ciccone and Peri (2006) finds little evidence for average-schooling externalities. Finally, an important externality arises through the transmission of education to children, as individuals do not internalize the fact that part of their education will also be passed on to their offspring. F. Cunha and Heckman (2007) propose a skill production function in which parental education is an

[13] January 12, 1965, "Special Message to the Congress: Toward Full Educational Opportunity".

[14] February 12, 2013, "State of the Union Address".

[15] Fall 1839, "The Necessity of Education in a Republican Government": "Take any individual you please; look at him as a citizen in a free government, throwing his influence and his vote into one or the other of the scales where peace and war, glory and infamy are weighed; look at him in these relations, and consider how a virtuous or a vicious education tends to fit or to unfit him for them all."

input.

Other externality channels for education include reduced participation in criminal activities and increased participation in civic processes. Lochner and Moretti (2004) estimate that the social savings from crime reduction associated with education amount to about 14–26 percent of the private return, a substantial share of the overall social return. Friedman (1962) argues that "A stable and democratic society is impossible without a minimum degree of literacy and knowledge on the part of most citizens and without widespread acceptance of some common set of values." In line with this, Milligan, Moretti and Oreopoulos (2004) find that increased education raises voter turnout rates by 10.4–12.3 percentage points and improves political knowledge about candidates and parties.

Even if education externalities exist and, in some cases, can be quantified, the shape of the externality function remains unclear. In this paper, we argue that externalities are "pro-equality," in the sense that the distribution of individual contributions matters beyond the average, with inequality being penalized when individuals are imperfect substitutes. Related papers include A. Krueger and Lindahl (2001), which shows that the assumption of a linear relationship between growth and education is rejected by the data, and that the relationship is more likely inversely U-shaped, with the largest marginal gains in growth occurring at intermediate levels of education. In Bénabou (1996), total human capital is modeled as a CES combination of individuals' human capital, as in our externality function. Castelló-Climent (2008) also finds that the most important determinant for democracy is not average education, but the median, consistent with our hypothesis.

For the crime-reduction channel, one can also conjecture that an additional year of education has a greater effect on reducing crime when an individual starts from no education than when they already hold a PhD. For productivity spillovers, the picture is less clear: while the best ideas are often generated by the most talented individuals, see Murphy, Shleifer and Vishny (1991), these individuals still require a sufficiently educated workforce to implement their ideas effectively.

Empirical evidence. In addition to these indications of a "pro-equality" externality, we also present cross-country correlations between GDP per capita and both the average level of education and education inequality. We find a clear negative correlation between GDP per capita and education inequality, even after controlling for income inequality. These stylized facts do not constitute proof of the imperfect substitutability assumed in our externality function, but they do suggest that high prosperity may be difficult to achieve if educational attainments are too unequal. For the data, we use the dataset from Barro and Lee (2013) on average years of schooling across countries, extended by Ziesemer (2022) to compute the Gini index of education. We complement this with the Gini index of income distribution from the World Bank data and GDP per capita from the Maddison project. The resulting database covers 147 countries i, between 1950 and 2015, with one observation per country every five years. We then run the following regression:

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

Our results are showed in Table 6.

Table 6: Education and inequality on GDP per capita

	log(GDP per capita)				
	(1)	(2)	(3)	(4)	(5)
Constant (α)	8.404***				
	(0.7313)				
log(Average education) (β_1)	0.5739**	0.6848**	-0.5497**	-0.6200	-0.1877
	(0.2547)	(0.2887)	(0.2134)	(0.3737)	(0.2329)
Gini Education (β_2)	−2.341***	−2.082***	−2.123***	−2.588**	−1.343*
	(0.7051)	(0.6910)	(0.5911)	(1.067)	(0.7706)
Gini Income (β_3)				1.527*	
				(0.0041)	
Top 10% wealth share (β_3)					0.0167***
					(0.7767)
Time FE (λ_t)		✓	✓	✓	✓
Country FE (μ_i)			✓	✓	✓
Observations	1,836	1,836	1,836	846	696
R^2	0.63	0.64	0.95	0.97	0.99

Observations weighted by population. Standard errors clustered at the country level.
Signif. levels: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

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. The coefficient β_2 stays significant and around -2 by adding fixed effects in column (2) and (3). Importantly, as illustrated by column (4), this effect is not due to the general income inequality, and is specific to education inequality, suggesting that GDP increases if education attainments are similar in the population. We verify that the result hold measuring inequality with the top 10% wealth share from the World Inequality Database instead of the Gini in column (5).

3.3.2 Health

The literature on health externalities is less delineated than that on education, partly because health is not traditionally modeled as an input in the production function. Nonetheless, there is substantial evidence suggesting that health generates social returns beyond the private return: my health status may benefit others. The most common example of health externalities is infectious disease. Vaccination reduces not only my own risk of infection but also the prevalence of the disease in the community. Miguel and Kremer (2004) show that deworming treatment in Kenya increased school participation among untreated children in both treated and neighboring schools. Gersovitz and Hammer (2003) distinguish between the "infection externality" (treating infected individuals reduces the risk for others) and the "prevention externality" (effort to avoid infection also benefits others). To monetize such externalities, a common approach is to multiply the change in the probability of infecting others by the cost of the disease, which often requires valuing life using the wage premium individuals demand for risky jobs. These papers also highlight that subsidies may not suffice to reach efficiency, as the externality may imply an optimal subsidy exceeding 100%.

Bloom, Canning and Sevilla (2004) incorporate health into the productivity function and find a strong positive effect of life expectancy on output. The reverse link is also documented: Cutler and Lleras-Muney (2006) show that an additional year of education increases life expectancy by 0.6 years, with a present value of about $44,000, implying that "the health returns to education increase the total returns to education by 55 percent." Moreover, better health not only increases one's own productivity but also that of relatives: Pearlin et al. (1990) show that caring for a sick family member raises stress levels and the likelihood of illness, thereby reducing productivity.

Other health-related externalities arise from insurance costs and moral hazard: when risks are pooled and treatments are publicly or collectively financed, individual health-risk behaviors impose costs on others. Chaloupka and Warner (2000) estimate that smoking generates over $100 billion annually in the U.S. through direct medical costs and indirect morbidity costs associated with lost earnings. They also review policies to reduce smoking: tobacco taxes are the most common, but restrictions on smoking in public places also play a key role, and may correspond to a negative G in our framework. For alcohol, Cook and Moore (2002) review evidence of external costs from motor vehicle accidents, violent crime, risky sexual behavior, and lower productivity, highlighting the significant burden imposed by drinkers on bystanders. For obesity, Bhattacharya and Sood (2011) find that implicit transfers from thinner to obese individuals exist, but are unlikely to generate large social losses. Even when the cost of insurance is not socialized, transfers within families may exist, which constitutes an externality if we assume utility functions are individualized and not at the extended-family level. Colombo et al. (2011) estimate that the cost of family caregiving could double by 2050.

As with education, the shape of the health externality function is not straightforward. For pollution and passive smoking, contributions are likely perfect substitutes: one car emitting two units of CO_2 or one smoker consuming two cigarettes creates the same externality as two cars emitting one unit each, or two smokers smoking one cigarette each. By contrast, for diseases linked to alcohol and smoking, contributions may be imperfect substitutes: the costs arise primarily from the heavy consumption of a few individuals rather than the light consumption of many. For infectious diseases and vaccination, our externality function clearly applies: two individuals each receiving one vaccine reduce transmission more than one individual receiving two doses while another remains unvaccinated. Regarding optimal policies, evidence is mixed: Brito, Sheshinski and Intriligator (1991) argue that mandatory vaccination can be less efficient than market allocation, while Geoffard and Philipson (1997) show that subsidies may even reduce vaccine uptake by lowering private demand. In our luxury-good framework, direct public provision of health services may be more effective than subsidies, provided individual contributions to health externalities are imperfect substitutes.

Empirical evidence. In addition to the empirical evidence on health externalities, we also present cross-country correlations between GDP per capita and both the average level of health and health inequality. Specifically, we use country-level panel data to estimate the effects of health expenditures and health inequality on GDP per capita. For health inequality, we rely on the dataset of Aburto et al. (2020), which computes a Gini coefficient of women's life expectancy based on the Human Mortality Database. We complement this with GDP per capita data from the World Bank and the top 10% wealth share from the World Inequality Database. As a control, we also include average life expectancy from the UN World Population Prospects (2024). The resulting dataset covers 184 countries i between 2000 and 2022, with one observation per country per year. We then estimate the following regression:

$$\begin{aligned}\ln(\text{gdp per capita}_{i,t}) = \alpha + \beta_1 \ln(\text{health exp. per capita}_{i,t}) + \beta_2\,\text{lifespan inequality}_{i,t} \\ + \beta_3\,\text{top 10\% wealth share}_{i,t} + \beta_4\,\text{mean life expectancy}_{i,t} + \lambda_t + \mu_i + \epsilon_{i,t}\end{aligned}$$

Table 7: Health expenditures and inequalities in life expectancy on GDP per capita

	log(GDP per capita)				
	(1)	(2)	(3)	(4)	(5)
Constant (α)	5.740***				
	(0.3473)				
$\log(\frac{\text{health exp.}}{\text{capita}})$ (β_1)	0.6359***	0.6447***	0.6688***	0.5259***	0.8705***
	(0.0378)	(0.0408)	(0.1388)	(0.0552)	(0.0688)
Lifespan inequality (β_2)	−2.348**	−2.356**	−3.988***	−3.998***	−8.505***
	(0.9387)	(1.009)	(1.361)	(1.257)	(1.885)
Top 10% wealth share (β_3)				0.0214***	
				(0.0027)	
Gini income					0.5548
					(0.4001)
Mean life expectancy				−0.0081	−0.0340**
				(0.0105)	(0.0134)
Time FE (λ_t)		✓	✓	✓	✓
Country FE (μ_i)			✓	✓	✓
Observations	4,005	4,005	4,005	4,005	1,725
R^2	0.94	0.94	0.99	0.99	0.99

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

Our results are showed in Table 7. Column (1), without fixed effects and income inequality, shows a clear negative correlation between GDP per capita and lifespan inequality. As illustrated by column (4), this effect increases when controlling for income inequality. Moreover, the coefficient β_2 stays significantly below 0 by adding fixed effects in column (2) to (5). Adding mean life expectancy as a control does not change the results. Controlling using the gini income from the World Bank database instead of the top 10% wealth share, we get a similar result with fewer observations (1,725).

Taking stock. Despite the limited evidence directly linking externalities and inequality, we find indications that the externality function must involve imperfect substitutability between individual contributions. In addition, we provide empirical evidence that inequality in education and health attainment reduces economic development (measured through GDP per capita), beyond the effect of income inequality, which supports our hypothesis.

4 Quantitative model

In this section, we extend the analytical model from Section 2 along several dimensions to obtain quantitative results on the optimal provision of in-kind benefits. First, the static framework cannot capture dynamic fiscal consolidation or wealth accumulation. We therefore adopt a dynamic framework in which agents can save and adjust to future policies, allowing us to maximize welfare along the transition path. Second, the analytical model's two-good setting – one normal and one luxury good – precludes a distinction across sectoral policies with different degrees of luxury and private demand. We thus introduce six goods: education, health, security, culture, transportation, and housing, plus the private normal good, and a pure public good with no private consumption. Third, instead of a static productivity distribution, we incorporate dynamic productivity shocks and savings behavior, enabling us to closely match both the income and wealth distributions. Fourth, whereas the analytical model featured only a linear labor tax to finance expenditures, the quantitative model includes progressive labor taxation, capital income and consumption taxes, as well as cash transfers, subsidies, and direct provision, which are our main focus. Finally, we replace the linear labor disutility with a nonlinear specification, allowing us to calibrate the elasticity of labor supply with respect to labor taxation.

4.1 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:

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

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 η 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.

4.2 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 $y_i^l = wz_ih_i$ 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.

4.3 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,[16] 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 equal 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 an unanticipated shock, the household's 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 differs from the realized return. Then, the ex-post household return r^p_t satisfies the condition $(1+r^p_t)a_t = (1-\gamma)\Pi_t + q_t + (1+r_t)d_t$.

4.4 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

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

[16] 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

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

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.

5 Calibration

The four key ingredients in our model are the consumption basket for households, the households heterogeneity, the composition of government expenditures, and the externality function. All parameter values and targets can be found in Table 15.

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. We also use other sector-specific household-level datasets, and administrative reports. For details of these datasets, see Appendix D. Our method for each good is described below, and our targets and model fit are shown in Table 8.

Table 8: 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 billion for consumption of treatment and medical goods, and 76 billion of other expenditures, mostly long-term care. Among treatment and medical goods, 80% is paid by the government and 20% by the private sector. We assume other expenditures follow the same public/private proportion. This means that $325 * 20\% = 65$ billion euros are paid by households. As households consumption is 1,985 billion,[17] 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). 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 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.

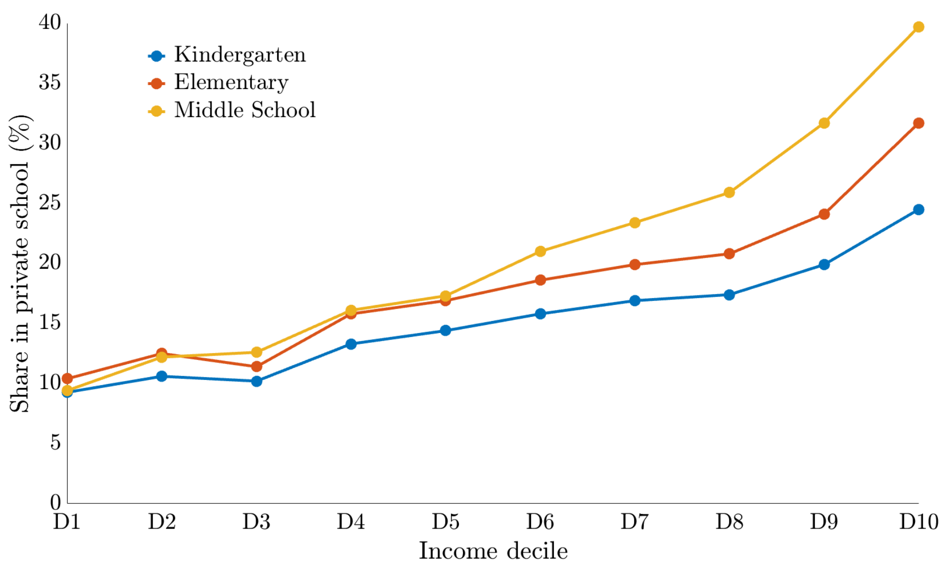
Education: for *average consumption*, we use 3 sources: government report, consumption survey and bank data. In 2023 French report, education expenditures are 190

[17] National account 2023.

billion euros (6.7% of GDP): 82% is paid by the government and 18% by the private sector. This means that $190 * 18\% = 32$ billion euros are paid 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 respectively 15,000 students in kindergarten, and 35,000 students in 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 9 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 9: Transports data by income decile

	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[18] 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).

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

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 10 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%.

Table 10: Share with security equipments by income quintile

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
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
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, culture, 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 29), 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* in 2018, 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 11. 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 11: Non-participation to the activity in the last 12 months by income quintile (%)

	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: 2018 *Enquête sur les pratiques culturelles des Français.*

5.2 Households heterogeneity

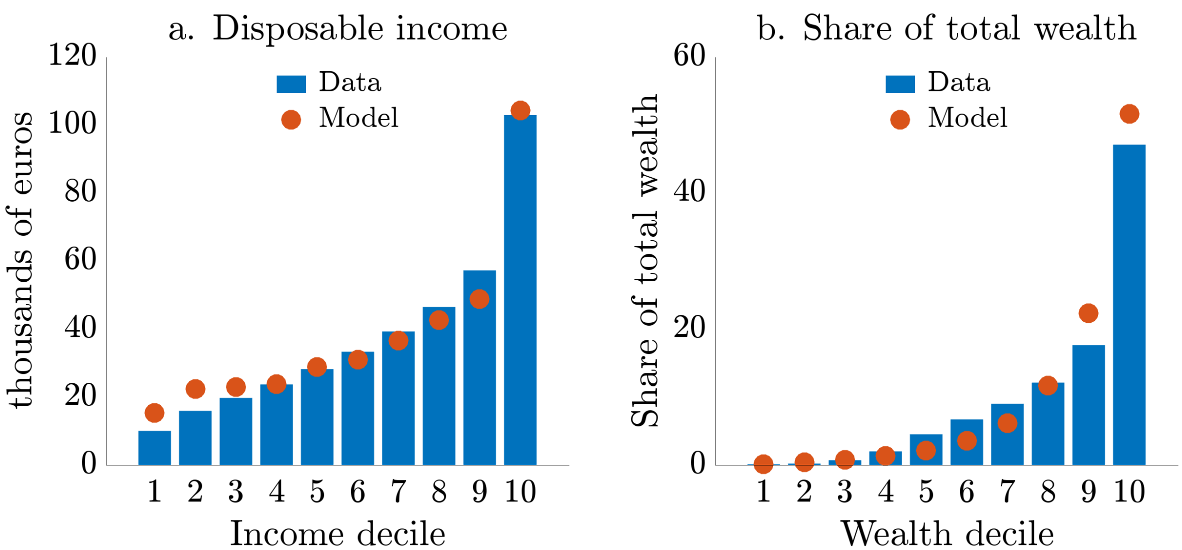
Our strategy to calibrate households heterogeneity is the following. We assume idiosyncratic productivity shock z follows a Markov chain, and we directly compute this Markov chain using a matched employer-employee panel data from France known as *Panel tous salariés* (Details in Appendix) between 2015 and 2019, covering around 3 millions workers. First, we compute for each households the net hourly wage, by dividing the net wage by hours worked. Second, we normalize net hourly wage for each year, to neutralize growth, inflation and business cycle fluctuations. Third, we compute a 7-points grid: 6 points evenly spaced points around the mean and a superstar point for the top 2% net hourly wage. 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, normalized values of the grid and invariant probabilities of the matrix, are shown in Table 12 below:

Table 12: Markov probabilities for productivity process z

	z'_1	z'_2	z'_3	z'_4	z'_5	z'_6	z'_7	Sum	Value z	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 surveys *Enquête Revenus fiscaux et sociaux* and *Histoire de Vie et Patrimoine.*

5.3 Government expenditures

Total public spending in France amounts to €1,610 billion in 2023, or 57% of GDP (see Appendix C.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, executive and legislative organs, defense, and 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.[19] More details on our imputation are provided in Appendix C.1. Overall, we find that direct provision accounts for 72% of total in-kind transfers, while subsidies represent 28%.

The resulting policies and model fit, expressed in percent of GDP, are shown in Table 13 (see Appendix C.1 for the decomposition in percent of total public spending). 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 interest 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%).

[19] *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).

Table 13: Calibration of government expenditures (% GDP): data and model

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

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%[20]. 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 $\tau^k = 0.274$.[21]

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. We aggregate these to obtain deciles[22] and report the results in Table 14, in thousand euros per year per consumption unit. Then we proceed as follows. First, we com-

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

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

[22]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.

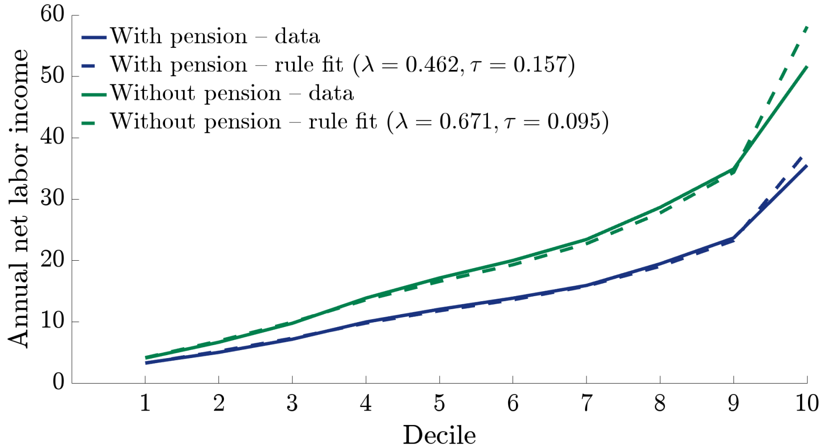
pute incomes. National income is divided into 5 categories: gross wages, mixed income of the self-employed, property income, undistributed profits, and income of non-profit institutions. We sum the first two categories to obtain "labor income" and the next two to obtain "capital income". Second, we compute 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 14: 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 14 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 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: 2023 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.[23] As the debt-to-GDP ratio is 1, the sum of the equity-to-GDP and capital-to-GDP ratios must equal 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 $\frac{q}{Y} = 0.5$.

[23] $5.6(1 - 0.56) + 1.5(1 - 0.34) = 3.5$.

Table 15: 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	
η	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

5.5 Calibrating the externality function

The level and curvature of the externality function are difficult to identify. In this section, we first use our quantitative model to retrieve the parameter of the externality functions that are consistent with observed policies. We then discuss the plausibility of our externality estimates, comparing them to previous studies discussed in Section 3.3.

5.5.1 Revealed externalities from observed policies

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 $K = \{\text{health, education, transportation, security, culture, housing}\}$, 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.

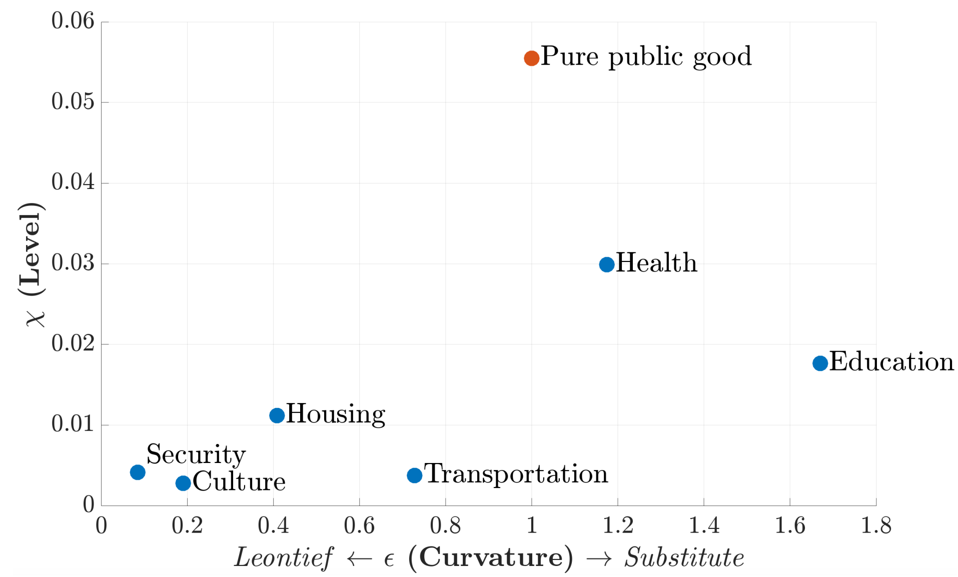
We assume a utilitarian planner who maximizes the sum of steady state individual value functions:

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

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:

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

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: even if direct provision is the most part of education policy, a relatively high ϵ rationalizes such a policy due to very low private consumption). 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").

5.5.2 Relation to literature

We have obtained our externality parameters by assuming that observed government policies are optimal. In this section, we instead consider estimates from the literature on education and health externalities, and derive the associated parameters of our externality function.

Education: average and inequality. There exist many estimates of the external effect of an additional year of average schooling on GDP per capita. We assume that one more year of average education increases GDP by 1.5% beyond the internal return, a midpoint between Rauch (1993); Acemoglu and Angrist (2000); Ciccone and Peri (2006); Bils and Klenow (2000); Moretti (2004). Therefore, we set the external return of average education to $r_1 = \frac{\mathrm{d}\ln(\mathrm{GDP})}{\mathrm{d}\,1\text{ year educ}} = 1.5\%$. Regarding education inequality, Castelló and Doménech (2002) show that a 0.1 decrease in the Gini coefficient of human capital is associated with an increase in economic growth of between 0.15% and 0.3%. Later, Castelló-Climent (2010) find an effect of 0.86%. We take a middle value of 0.5%, so our estimate for the external return of education inequality is $r_2 = \frac{\mathrm{d}\ln(\mathrm{GDP})}{\mathrm{d}\,\mathrm{Gini\ educ}} = \frac{0.5\%}{-0.1} = -5\%$.

We assume the externality function is given by

$$X(\chi, \epsilon, a, d) = \chi \frac{\epsilon}{\epsilon - 1} \ln \left(\int_i [(1+a)(g_i + G)^{1+d} \mu]^{\frac{\epsilon-1}{\epsilon}} \right)$$

where parameter a controls the *average* level of education, parameter d controls its *dispersion*, $\mu = \frac{\int_j (g_j + G)}{\int_j (g_j + G)^{1+d}}$ ensures that changes in d do not alter the average, and g_i and G are the steady-state values.

To map the model to our empirical targets, we assume welfare is approximated by ln(GDP), so that an increase in the externality by x corresponds to an increase in GDP of x%. As average education is about 11 years in the cited papers, one additional year of schooling corresponds to a $\frac{1}{11} = 9.1\%$ increase in our measure of average education, which yields a 1.5% increase in GDP. Thus, our first target is $\frac{\mathrm{d}X}{\mathrm{d}a}\big|_{d=0} = \frac{r_1}{9.1\%} = 0.16$, *i.e.*, the change in the externality induced by higher average education, holding dispersion constant. Our second target links changes in the education Gini to growth: $\frac{\mathrm{d}X}{\mathrm{d}d} \frac{\mathrm{d}d}{\mathrm{d\ Gini\ educ}}\big|_{a=0} = r_2 = -5\%$, *i.e.*, the change in the externality induced by higher dispersion in education, holding the average constant.

Finally, we choose (χ, ϵ) to minimize the distance between these two empirical targets and their model counterparts. The scaling parameter, which ensures that one year of additional schooling raises GDP by 1.5%, is estimated at $\chi^{\text{data}} = 0.16$. The curvature parameter, which ensures that a decrease of 0.1 in the education Gini raises GDP by 0.5%, is estimated at $\epsilon^{\text{data}} = 4.1$. This compares to $\chi = 0.02^{\text{model}}$ and $\epsilon^{\text{model}} = 1.7$ that we have found by assuming observed policies are optimal.

Health: average. Miguel and Kremer (2004) finds that de-worming treatment in Kenya reduces prevalence of infection by 0.27 percentages point for the treated group, and 0.21 for the untreated group. This means that the total effect of the treatment is 56% private, 44% external. Bloom, Canning and Sevilla (2004) finds that a one-year improvement in a population's life expectancy contributes to a 4% increase in output per capita, and Bloom, Canning, Kotschy, et al. (2024) shows that a value that reconciles micro and macro estimate is around 1%, so that we choose this value. As average life expectancy is 67.5 years in 2000, this means that increasing life expectancy by 1.5% (one year) improves GDP per capita by 1%. Applying the private to external ratio computed above, this means that 44% of this 1% GDP increase comes from the external effect, *i.e.* the externality effect of one additional year of life expectancy is 0.44%. Therefore, the derivative of the externality with respect to change in average health is equal to $\frac{0.44\%}{1.5\%} = 0.29$. As this derivative is also equal to χ, this means that $\chi^{data} = 0.29$.[24]

For inequality, Mackenbach, Meerding and Kunst (2011) find that increasing the health of the lowest 50 percent of the European population to the average health of the top half would improve labour productivity by 1.4 percent of GDP. We reproduce this experiment in our model: we divide the distribution of $g_i + G$ in two groups, and replace health of the lowest group by the average of the highest group. We do this experiment with $\chi^{data} = 0.29$, and find the ϵ^{data} such that this reduction in dispersion increases welfare by 0.014. We find $\epsilon^{data} = 2.72$. This compares to $\chi = 0.03^{\text{model}}$ and $\epsilon^{\text{model}} = 1.2$ that we have found by assuming observed policies are optimal.

For education and health, $\chi^{\text{model}} < \chi^{\text{data}}$, implying that externalities in the data are substantially higher than what is revealed by observed policies, and $\epsilon^{\text{model}} < \epsilon^{\text{data}}$, implying that individual contributions in the data are more substitutable. Taken at face value, this may suggest that France should spend more on education and health, relying more on subsidies rather than direct provision. However, in both cases, the literature estimates are obtained across all countries, or specifically for developed countries. This may induce an upward bias in these estimates if we assume that health and education externalities exhibit decreasing returns to scale. Therefore, finding higher values of χ in the literature does not necessarily imply that current policies in France are too low: it may also reflect that policies are already sufficiently high so that the marginal external return is low under decreasing returns. Similarly, finding higher values of ϵ in

[24] Alternatively, the external-to-private ratio in Miguel and Kremer (2004) is $0.21/0.27 = 0.78$. In our model, increasing $g_i + G$ by x increases individual utility by $\omega_{health} \frac{g_i+G}{g_i+G+\bar{g}} \cdot x$, and externality by $\chi \cdot x$, implying an external-to-private ratio of $\frac{\chi}{\omega_{health}}\left(1 + \frac{\bar{g}}{g_i+G}\right)$. With our calibration $\omega_{health} = 0.0684$, $\bar{g} = 0.34$, $g_i = 0.0663$ and $G = 0.04$, equalizing this ratio to 0.78 yields $\chi = 0.013$.

the literature does not necessarily imply that individuals are more substitutable: it may also reflect that existing policies reduce dispersion in health and education outcomes, making individuals sufficiently equal to appear more substitutable.

Taking stock. We use our quantitative model to discipline the externality functions for health, education, security, culture, housing, and transportation, by assuming that observed policies are optimal. For education and health, we also use empirical evidence to obtain alternative parameters. As our focus is to study fiscal consolidation, we use the first set of parameters in our quantitative model to start at an optimal level, and we study the best path to reduce public debt.

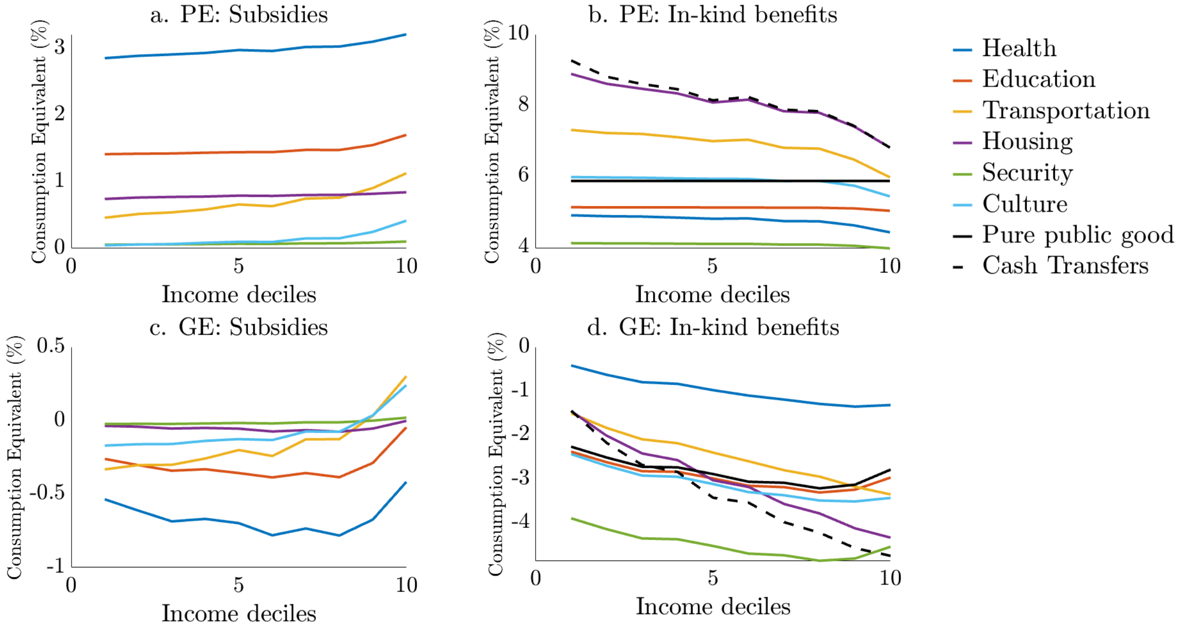
6 Public spending and inequalities

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.

6.1 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.

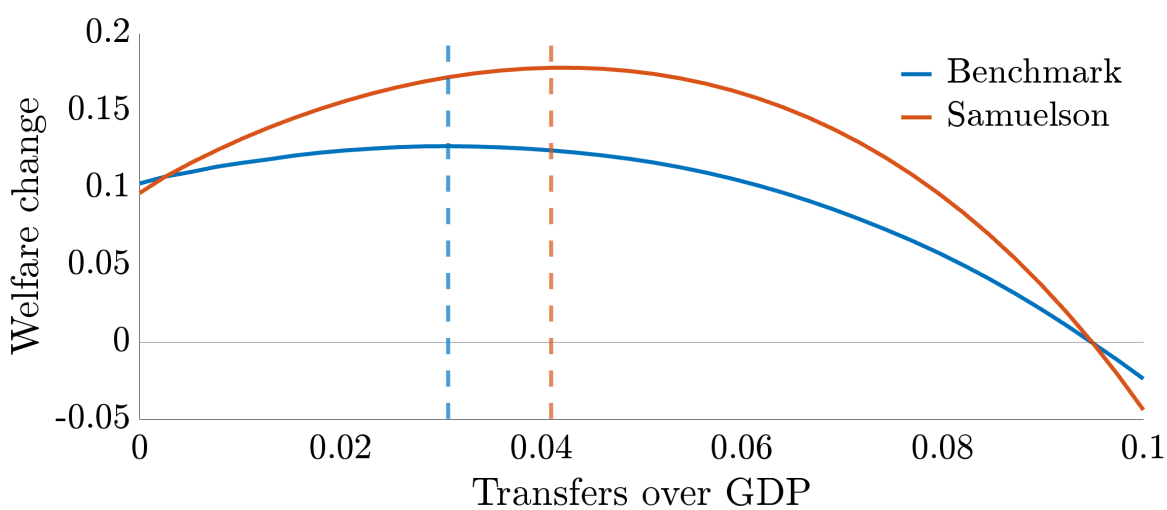
General equilibrium. In general equilibrium, because the model is calibrated such that existing policies are optimal, any deviation from steady-state values reduces aggregate welfare. Yet the incidence of these welfare losses varies across households. For instance, subsidies to culture and transportation 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.

6.2 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 tool of redistribution policies 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 $-\eta\frac{h^{1+\psi}}{1+\psi}$. 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) where households face a discrete choice: $h \in \{0, \bar{h}\}$, subject to a linear utility cost $-Bh$, with a Gumbel shock on the choice of hours (see Appendix E for details). We compute labor participation elasticities – *i.e.* the percent change in labor supply when the labor tax rate increases by 1% – in both models, and report the results in Table 16 by income quintile.

Table 16: Labor participation elasticities by income quintile for alternative labor supply

	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: changes in labor tax raise participation among low-income households and barely reduce labor supply among the rich, that already work because they have a high productivity. In this case, we find a much higher optimal value for tax progressivity, $\tau^{l\star} = 2.2$, compared to the observed one, because you can tax very productive households without any reduction in they labor supply. 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" than in our model. 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, because in-kind benefits already redistribute.

6.3 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 2, 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 1 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 5, 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 17 reports the results, expressed as percent changes relative to GDP, $\Delta(x) = 100 \times (x^{\sigma=0.21} - x^{\sigma=0.20})$.

Table 17: 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.

7 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 new steady state with less debt. Then, we compute the optimal transition between our two steady states, with different policy scenarios. Finally, we relax the assumption of uniform in-kind provision and show that targeted in-kind benefits can deliver the same welfare while generating substantial fiscal surpluses.

7.1 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 18: 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, so that 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.

7.2 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.[25] 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:

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

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

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

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

with $\mathbb{W}^d(\mathbf{k})$ the welfare during the transition between $t = 1$ and ∞, $V_1(a_1, z_1)$ the value function[26] 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 E. 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.

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.

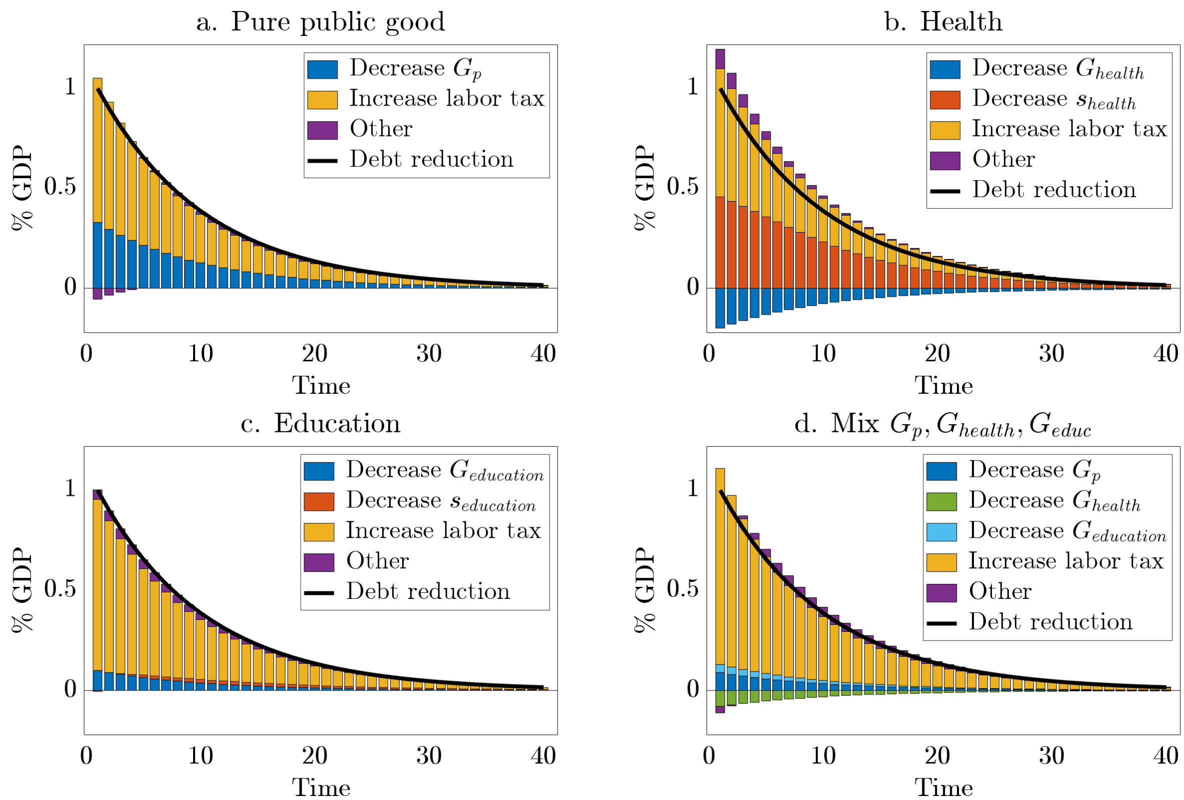
To address this issue, we propose a simple and, in our view, reasonable way to isolate the true consolidation response. We first compute the transition without any shock ($d_{t+1} = d_t = 90\%$ GDP, with other policies constant), at the final steady state, and solve the problem above. This yields the vector $\boldsymbol{\alpha}^{\text{no shock}}$, which determines the

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

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, as 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.[27] 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 result is also tied to changes in inequality. As debt is repaid through higher labor taxes, the burden is proportionally smaller for poor households, whose consumption is largely financed by public transfers, and for rich households, who derive a higher share of income from capital, than for middle-income households, whose income comes primarily from labor. These middle-income households are pushed to zero consumption of luxury goods, which increases consumption dispersion and therefore lowers the externality. This, in turn, leads the planner to increase public provision, thereby reducing dispersion. The opposite holds for subsidies, which are biased toward rich households and therefore must decrease during the transition – particularly for goods with high private consumption where they are more effective, such as health.

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 sectors, 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 hinges on how the government budget constraint is

[27] 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.

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, as it places a proportionally higher tax burden on middle-income households, thereby reducing 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, inequality during the transition would likely be reduced, weakening the inequality-driven motive for higher in-kind benefits. We would still find an increase in G_k, since the main channel is the reduction in average consumption of luxury goods, but the optimal reduction in subsidies would be smaller.

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 2, while a full quantitative Ramsey solution remains a task for future research.

Fourth, our recommendation to cut public provision of goods that are not privately consumed – especially military spending – is at odds with the current increase in defense spending in many countries. However, the military situation constitutes an independent shock, and including it would not alter our findings. For example, we could imagine a positive shock to the externality parameter χ_p, which captures the strength of the externality associated with the pure public good. This would raise the optimal value of G_p, but our theory would still predict that the increase should be smaller during fiscal consolidation.

7.3 Fiscal surplus through targeted in-kind benefits

We now relax the assumption of uniform in-kind provision and ask whether targeted in-kind benefits can deliver the same welfare while generating substantial fiscal surpluses. So far, we have assumed a uniform in-kind benefit G_k for each sector k, meaning that the government provides the same level of these goods to all households. While this assumption captures an important part of government intervention, it rules out 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 denoting the progressivity of in-kind transfers and $\mu_k = \frac{G_k}{\int_i (y_i)^{-\gamma_k}}$ a scaling parameter ensuring that $\int_i G_{i,k} = G_k$. In this section, we first provide empirical estimates of our function across seven sectors of government intervention in France, using Distributional National Accounts data. Our benchmark resembles the tax rule of Heathcote, Storesletten and Violante (2017)[28] 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 a uniform, "one-size-fits-all" policy. Table 19 presents our results.

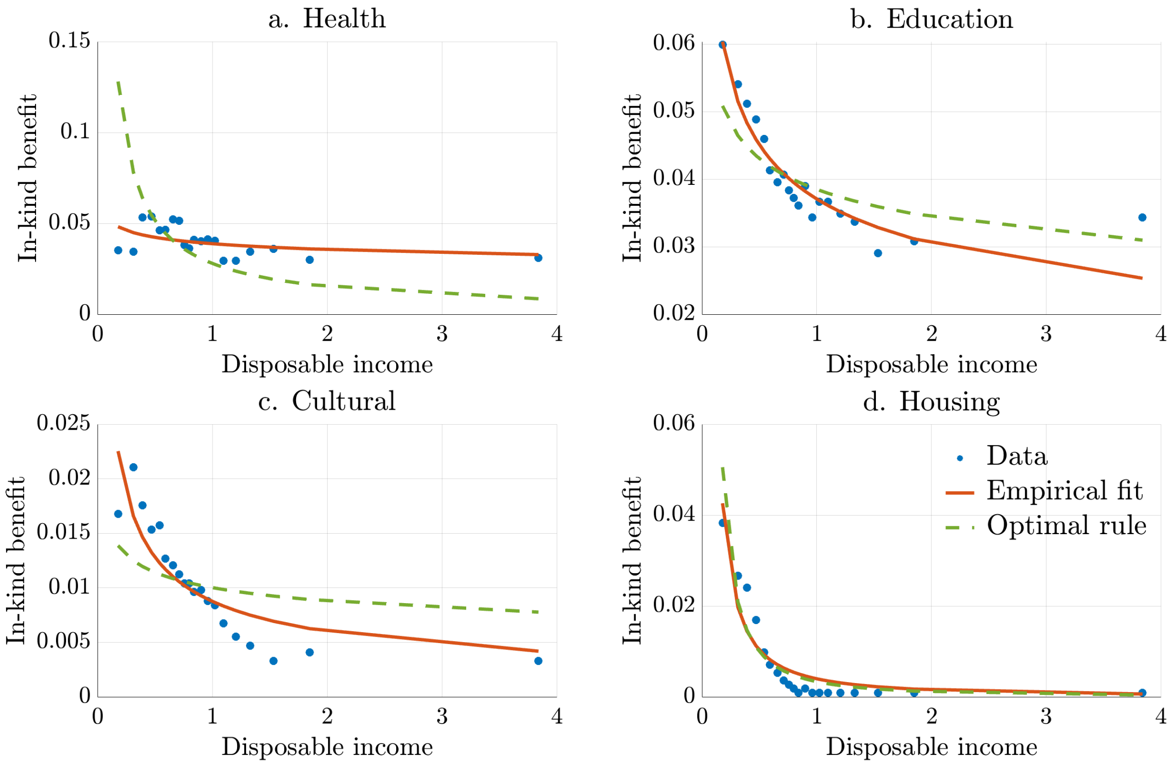
Table 19: In-kind benefit rule, γ_k

	Health	Education	Transport	Housing	Security	Culture
Observed (France)	0.12	0.28	–	1.38	–	0.55
Optimal rule	0.88	0.16	1.46	1.58	0.53	0.19

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 8. When aggregating across all sectors, we obtain an overall in-kind benefit function with $\gamma = 0.31$. The optimal progressivity relative to observed progressivity varies by sector. For Health, 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 and Culture, the current system is overly progressive, largely because of the high value of direct provision in these sectors.

[28] Other contributions include Feldstein (1973); Persson (1983); Benabou (2000).

Figure 8: Empirical fit, power law



Replacing the uniform distribution of in-kind benefits in our benchmark model with these targeted rules increases overall welfare by 0.5% in consumption-equivalent (CE) terms, while keeping aggregate spending constant. In other words, *holding public spending fixed*, targeting in-kind benefits raises household welfare by 0.5% CE annually. We then ask how much fiscal space the government could create by implementing these policies. To answer this, we scale each policy $G_{i,k}$ by a factor μ so that welfare matches the level achieved under uniform policies. We find that $\mu = 0.978$, together with the optimal progressivity parameters γ_k described above, delivers the same welfare as the benchmark while reducing expenditures. This implies that, *holding welfare fixed*, targeting in-kind benefits increases the fiscal surplus by 0.7% of GDP, or 1.25% of current expenditures, equivalent to €21 billion annually for the French government.

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. Significant fiscal surplus can be achieved through these targeting policies.

8 Methodological contribution: distributional effects of in-kind benefits

8.1 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.[29] 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: it is a "monetary imputation". 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 "weighted imputation rule" for in-kind benefits, 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

$$\omega_i = \frac{\partial u_i/\partial G}{\partial u_i/\partial y_i} = \min\left\{\frac{y_i/\bar{y}}{F^{-1}(S)}, 1\right\} \tag{3}$$

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.

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

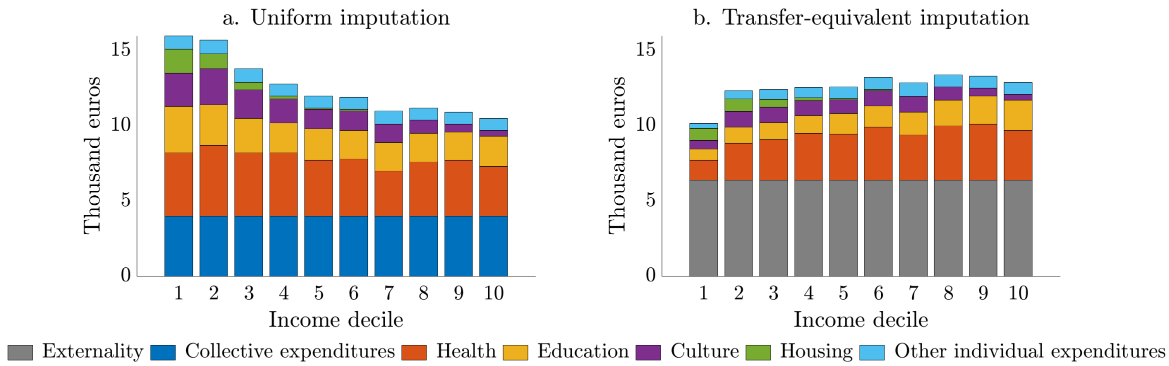
To illustrate, suppose income follows a Pareto distribution, and that we focus on education in-kind benefits (see Appendix F for details). Assume the Pareto distribution has a mean equal to 1, a tail index $\alpha = 2.2$, and that average net disposable income in France is $\bar{y} = 26{,}000$. For education, suppose the share of households with zero private spending is $S = 0.8$. The weighted 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 ($y_i = 23{,}000$), the equivalent is €0.80, and for households above average income, it is €1.

8.2 Application

With only three statistics and rule 3, we can impute the monetary value of all publicly provided goods and assess the redistributive impact of the French tax–transfer–spending system. An Insee study on France (Germain, André and Blanchet (2021)) provides a precise breakdown of in-kind benefits across the income distribution. In the left panel of Figure 9, we reproduce their "monetary 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 9, we present our "weighted 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. Alternatively, we could impute externality in a non-uniform way, for example proportionally to income, or such that it does not modify the inequality, which will further reduce the redistributive effects of in-kind benefits.

Figure 9: Distribution of in-kind benefits



Our imputation rule in Figure 9 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 welfare-based 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 Table 20, we show share of total income held by the bottom 50% of the distribution, the next 40% and the top 10%, and the associated Gini index (the associated monetary values can be found in Figure 10 in Appendix). The first three lines describe 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: taxes and transfers in France reduce the Gini coefficient from 0.41 to 0.29 and lower the top 10%–to–bottom 50% income share ratio from 1.47 to 0.80.

In the bottom part of Table 20, we add the distribution of in-kind benefits discussed above to disposable income. The usual method – the monetary imputation – is progressive, and further reduces the Gini coefficient from 0.29 to 0.18, and lower the top 10%–to–bottom 50% income share ratio from 0.80 to 0.51. In our proposed imputation, with an individual specific weight, the Gini and the top 10%–to–bottom 50% ratio fall much less: from 0.29 to 0.24, and from 0.80 to 0.65, respectively, since our imputation is regressive and excludes collective expenditures that households do not privately value. Finally, when accounting for externalities (third line), the Gini decreases to 0.21 and the top 10%–to–bottom 50% ratio to 0.56, still above the 0.18 and 0.51 obtained under the standard uniform imputation.

Table 20: Share of total income by income group (%), and Gini

	Bottom 50%	Next 40%	Top 10%	$\frac{\text{Top 10\%}}{\text{Bottom 50\%}}$	Gini
Gross income	22.0	45.6	32.4	1.47	0.41
After taxes	24.4	44.8	30.9	1.27	0.38
After taxes and transfers	30.5	45.1	24.4	0.80	0.29
Monetary imputation	38.3	42.2	19.5	0.51	0.18
Weighted imputation	33.6	44.7	21.7	0.65	0.24
Weighted with externality	36.0	44.0	20.0	0.56	0.21

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 the distributive effects of in-kind benefits. When we apply and individual-specific weight to each good provided by the government, based on the luxury nature of the good and the rank of the household in the income distribution, we show that the inequality-reducing effect of public spending is smaller compared to the usual monetary imputation.

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 the model to study the optimal adjustment of government policies during a fiscal consolidation exercise. 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. We also relax the uniform in-kind provision assumption and find that targeted in-kind benefits yield substantial welfare gains. We estimate that optimal targeting could generate 21 billion euros in fiscal revenues, with no aggregate welfare change.

Finally, we compute in-kind benefits progressivity. Contrary to previous studies with uniform imputations, we propose a simple welfare-based formula of public spending. We weight 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 one third less redistributive than commonly thought.

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: proofs of Section 2

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

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

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

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

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:

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

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

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

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

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

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

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

Finally, the externality term X is the following:

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

Denoting $t.i.p.$ the terms independent from policies (τ, s, T, G),[30] the individual utility function is given by

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

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

with $a_1 = \omega \ln\left(\frac{\omega z_i}{\phi}\right) - \omega$ 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

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

which, associated with the government budget constraint, gives

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

Finally, we assume a utilitarian planner with the welfare $\mathbb{W} = \int_i u_i$. Using the fact that $\mathbb{E}[1/z] = e^{v}$[31] and $\int g_i = \int_{z\geq\zeta}(\frac{\omega}{\phi}\frac{1-\tau}{1-s}z_i - G - \bar{g})$, the planner problem is the following:

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

such that

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

A.1 Proposition 1: missing market and Samuelson rule

In this first Proposition, 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:

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

such that

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

[31] $z \sim \text{log-Normal}(\mu,\sigma^2) \iff \alpha = \ln(z) \sim \mathcal{N}(\mu,\sigma^2)$, 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:

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

We have the first-order conditions:

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

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

Plugging these solutions into the transfer and output:

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

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

Finally, we obtain:

$$\boxed{\begin{array}{l} \dfrac{G^{\star}}{Y^{\star}} = \dfrac{\chi}{1+\chi} \\ \dfrac{T^{\star}}{Y^{\star}} = \dfrac{1}{1+\chi} - e^{-\nu} \end{array}}$$

A.2 Proposition 2: undetermined T and G

In this second Proposition, we allow households to privately consume g, and we assume $\bar{g} = 0$. We also assume that $z_i \geq \frac{\phi G}{\omega}\frac{1-s}{1-\tau}$ 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:

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

such that

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

or equivalently,

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

such that

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

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.3 Proposition 3: luxury good and concave externality

We now assume $\bar{g}>0$, and obtain a threshold $z_i\geq\zeta=\frac{\phi}{\omega}\frac{1-s}{1-\tau}(G+\bar{g})$ 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

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

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:

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

The trick to simplify computation is to replace s by the threshold $\zeta = \frac{\phi}{\omega}\frac{1-s}{1-\tau}(G+\bar{g})$. 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:

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

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:

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

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

Moreover, we have

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

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

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

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

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

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

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

Replacing M by its expression for the FOC:

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

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

Note that this implies that

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

B Datasets

B.1 Surveys

We use the latest versions available of French households surveys, covering the following sectors: health, education, culture, transportation and security.

Budget de Famille 2017. This is the household budget survey for France. It is made every 5 years and puts together the entire household accounts: expenditure and resources of households in France. The 2016-2017 survey was conducted in 6 waves of approximately 8 weeks each, from September 2016 to September 2017. The sample (random self-weighted sample) covers about 20,700 dwellings in Metropolitan France, 8,000 in the overseas departments and an upsample of single-parent families of 2,000 dwellings from administrative data source (CNAF). The Household Budget Survey uses two data collection instruments: (i) a questionnaire using computer-assisted data collection, broken down over 2 visits, which records income and expenditure over the last 12 months, socio-demographic information and dwellings' characteristics; and (ii) a self-completed diary in which all members of the household aged over 14 record all their expenditure over 7 days.

EU-SILC 2023. The European Union Statistics on Income and Living Conditions (EU-SILC) is an annual survey aiming at collecting comparable cross-sectional and longitudinal multidimensional microdata on income, poverty, social exclusion and living conditions. The SRCV survey (*Statistiques sur les ressources et conditions de vie*) is the French component of the EU-SILC.

Panel d'élèves du premier degré: 2011-2016. This is a survey that collects information on the educational pathways and academic performance of pupils in elementary school. It consists of a cohort of 15,188 pupils entering first grade for the first time in the 2011 school year, who were followed for six years.

Panel d'élèves du second degré: 2007-2017. This survey covers students that enter middle school in France. A total of 35,000 students were recruited for this new panel and are being tracked throughout their schooling. The purpose of this survey is to describe and explain educational trajectories in secondary education, in connection with primary schooling, and to evaluate the effects of policy changes in middle schools. The panel makes it possible to examine the sociological and academic profiles of students reaching different levels of secondary education and to explain how their schooling unfolds.

Conditions de vie des étudiants (CdV) – 2016. The 8th National Student Living Conditions Survey was carried out by the *Observatoire de la vie étudiante* in spring 2016. It targeted a representative sample of students enrolled in higher education during the 2015–2016 academic year. Conducted at the same time in nearly 30 European countries as part of the Eurostudent program, the survey aimed to better understand the living conditions and challenges of students in France. Between March and May 2016, over 220,000 students were invited by mail to complete an online questionnaire, and about 46,340 responded, giving a corrected response rate of 20.3%.

Enquête Nationale Transports et Déplacements 2007-2008. The 2007-2008 National Transport and Travel survey is the fifth in the series of Transport surveys conducted in France since the 1960s (1966-1967, 1973-1974, 1981-1982 and 1993-1994). The 2007-2008 survey covered 20,000 households. The aim of this survey is to gather knowledge about the travel patterns of households living in mainland France and their use of both public and private modes of transport. It records all trips, regardless of purpose, distance, duration, means of transport used, time of year, or time of day. To better understand mobility-related behaviors, it also looks at households' access to public transport and the individual means of transport they own.

Enquête sur les pratiques culturelles des Français – 2018. This is the sixth edition of a series launched in the early 1970s to measure public participation in leisure and cultural life. The 2018 survey covers 9,200 respondents and studies various forms of participation in cultural life (book reading, music listening, attendance at cultural venues and events, amateur practices), while also devoting significant attention to the use of traditional and digital media.

Enquête de victimation - cadre de vie et sécurité – 2019. Conducted by INSEE since 2007, this annual survey covers 20 to 25,000 French households. It takes into account any criminal act of which households and their members have been victim within the two years preceding the survey. It includes burglaries, theft or damage of vehicles or accommodation, whether or not these offences were the subject of a complaint. The survey also covers personal theft, physical violence, threats and insults as well as the opinions of the respondents on their living environment and security. Finally, it also covers security equipments bought by households.

B.2 Administrative datasets

Panel tous salariés : All-employee panel. This is the panel version of an administrative matched employer-employee data called the *Base Tous Salariés* (BTS). The BTS is a declarative requirement that every company employing staff must complete. It is exhaustive for the French economy. In this document, which is shared between tax and social administrations, employers provide, on an annual basis and for each establishment, a certain amount of information relating to both the establishment and its employees. It also describes employees' characteristics, their main position, as well as summary data covering all positions combined: remuneration, hours worked, total unemployment benefits. Up to and including 2001, the panel version consisted of a sample of about 1/24th of the population, obtained by keeping individuals born in October of an even-numbered year. From 2002 onward, the sample size was doubled. We use the 2015-2019 period, covering around 3 millions workers.

B.3 La Banque Postale data – transaction-level data

The database used in this study originates from *La Banque Postale* (LBP hereafter), a public bank established in 2006 within the postal group *La Poste*, the historical monopoly responsible for mail delivery; this bank serves nearly 11 million customers. We employ transaction-level data on card payments, paper checks, cash withdrawals, cash deposits, bank transfers, and direct debits, with each transaction recorded in euros. Additionally, we have access to balance sheet data, including end-of-month balances on deposit and various savings accounts, as well as life insurance, stocks, and credits (consumer loans and mortgage loans). We aggregate customers sharing a joint account into the same household, making the household our unit of observation. The data employed is high-frequency, containing transaction-level information timestamped and aggregated daily, while balances are available on a monthly basis. Finally, we observe various socio-demographics, including age, sex, marital status, occupation, *département*, and location of residence (urban/rural/semiurban areas). We aggregate all this data at the yearly level and focus on the period 2023-2024 for which we can recover the COICOP categories for credit card expenditures. At the end, we have a dataset covering around 200,000 households in 2023-2024. We thank Tristan Loisel for numerous discussions and advice.

C Empirical evidence

C.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.

The resulting allocation between in-kind benefits and subsidies is given is the Table 22 below:

Table 22: 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		

C.2 In-kind benefits as luxury goods

C.2.1 Cross-country analysis: additional tables

In this section we report the additional results of our benchmark regressions. Data used is described in Section 3.2.1. Recall that we run the following regression:

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

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.

Controls are good-specific as listed here: controls for health regressions are total-age dependency ratio and life expectancy at 80; control for education is young-age dependency ratio for education; control for culture is old-age dependency ratio for culture; and finally, controls for transportation are old-age dependency ratio and the share of urban households. We tried several specifications and we kept controls that were statistically significant and that raised meaningfully the predictive power (R^2).

Table 23: Fixed effects panel regression: health, education, culture, transportation

	(1)	(2)	(3)	(4)	(5)	(6)
θ_{health}	1.39***	1.28***	1.37***	1.25***	1.32***	1.15***
(4,058 obs.)	(0.044)	(0.057)	(0.041)	(0.060)	(0.024)	(0.051)
$\theta_{\text{education}}$	1.24***	1.32***	1.20***	1.31***	1.34***	1.38***
(4,424 obs.)	(0.052)	(0.086)	(0.035)	(0.055)	(0.106)	(0.127)
θ_{culture}	1.40***	1.67***	1.31***	1.55***	2.18***	2.17***
(2,062 obs.)	(0.137)	(0.174)	(0.075)	(0.106)	(0.410)	(0.411)
$\theta_{\text{transportation}}$	1.37***	1.34***	1.36***	1.29***	1.37***	1.32***
(1,864 obs.)	(0.064)	(0.159)	(0.072)	(0.181)	(0.102)	(0.087)
Controls		✓		✓		✓
Year FE			✓	✓	✓	✓
Country FE					✓	✓

*Standard-errors clustered at the country-level. Signif. Codes: ***: 0.01.*

Table 23 plots our results with and without controls and fixed effects. We conclude this provide a strong robustness checks as for all regressions, with no exception, we estimate an income elasticity above 1. Estimates for education and transportation are particularly robust to all specifications, while we notice more variations for health and culture.

C.2.2 Cross-country: OECD data

In this section, we provide a second robustness check on our cross-country empirical evidence. In Section 3.2.1, we used government spending as a proxi for educational expenditures, and relative sectoral employment (or value-added shares) as a proxi for transportation and culture expenditures. These yields the largest country-level database available and a consistent way to compare countries in sectors were prices and quantities are difficult to measure. Yet, one may worried that these are imperfect measure of total expenditures in these sectors (i.e. public + private). This is why in this section we run exactly the same regressions (with identical controls and population weights) using OECD Annual household final consumption expenditure by purpose (COICOP 2018).

Table 24: Income elasticity, OECD data

	log(Expenditures per capita)									
y	*Health*[a]		*Education*[a]		*Education*[b]		*Culture*[a]		*Transportation*[a]	
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*	*(g)*	*(h)*	*(i)*	*(j)*
θ	2.99***	1.15	1.62*	1.51*	1.30***	1.26**	1.30***	1.46***	1.12	1.29***
	(0.618)	(0.100)	(0.350)	(0.304)	(0.057)	(0.098)	(0.040)	(0.072)	(0.111)	(0.082)
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country FE		✓		✓		✓		✓		✓
Observations	966	966	472	472	444	444	966	966	966	966
# countries	29	29	15	15	31	31	29	29	29	29
# years	53	53	53	53	17	17	53	53	53	53

Observations are weighted by population. Standard errors are clustered at the country level.
[a] *Data from OECD COICOP 2018 classification.* [b] *Data from OECD Education at a Glance 2024.*
Controls are described in Appendix C.2.1. Signif. levels against $\theta = 1$: *.p<0.1; *p<0.05; **p<0.01; ***p< 0.001.*

Our implied income elasticities are presented in Table 24. Notice that our benchmark samples covers 5 times more observations for education, and twice more for transportation. Due to lack of data in education, we also use OECD expenditure on educational institutions per full-time equivalent student, measured in US$ PPP, from the *Education at Glance 2024*. It allows us to cover more countries, but during a smaller time span.

C.2.3 Cross-country: nhCES demand system

As a second robustness for Section 3.2.1, we estimate non-homothetic CES preferences. We use the same dataset as in Comin, Lashkari and Mestieri (2021) but expand there set-up to include public utilities (i.e. health, education, defense), culture and transportation. As explained above, we are not able to distinguish within the public utilities category. The aggregate data come from two sources. Sectoral production value added (nominal and real) and employment come from Groningen's 10-Sector Database as in our benchmark regressions for culture and transportation. Consumption expenditure per capita data come from the ninth version of the Penn World Tables

In this exercise, we estimate the model from the patterns of structural change in employment. We estimate $\{\sigma, \epsilon_i, \zeta_i^n\}_{i\in\mathcal{I}_{-m}}$ via GMM:

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

with L_{it}^n the labor share of sector i in country n at time t, p_{it}^n the price of sector-i goods, E_t^n total expenditures per capita, ζ_i^n a country-sector fixed effect that absorbs constant taste parameters and country-specific heterogeneity in sectoral capital intensity.

Table 25: Estimates, 10-Sector regression, $\epsilon_m = 1$

	World	OECD	Non-OECD
	(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	✓	✓	✓
Observations	1,596	492	1,104

Complete results are presented in Table 25. The price elasticity is less than unity in all estimations. Public utilities, transportation and culture can all be considered as luxuries relative to manufacturing, except culture in OECD countries. All sectors are luxuries relative to agriculture.

C.2.4 Household-level analysis: France

In this section, we replicate our baseline regressions from Section 3.2.2 using some cross-sectional datasets for France. It happens that we have access to a newly transaction-level bank data from La Banque Postale that categorize consumption data using the main COICOP 2018 classification. The dataset is described in Appendix B.3. As data cleaning, we keep households above 25 years old in 2023 with non-zero consumption. We get around 140,000 observations, except for education. We then estimate the income elasticity θ of each good with the following regression:

$$\log(c_i) = \theta \log(y_i) + \gamma X_i + \epsilon_i$$

where c_i denotes expenditures on a given good (health, education, culture, or transportation) for household i, y_i is total expenditures, controlling by age groups[32], household size and number of earners. This keeps us very close to the regressions done in Section 3.2.2 with US data.

Table 26: Income elasticity, Bank data 2023

$\log(c)$	*Health*		*Education*		*Culture*		*Transportation*	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
θ	0.98	1.06*	0.73***	0.65***	1.31***	1.28***	1.36***	1.26***
	(0.004)	(0.011)	(0.016)	(0.029)	(0.002)	(0.004)	(0.004)	(0.006)
Controls		✓		✓		✓		✓
Observations	140,521	140,521	15,923	15,923	149,227	149,227	147,966	147,966
Adj R^2	0.26	0.32	0.11	0.16	0.62	0.63	0.36	0.37

Signif. levels against $\theta = 1$: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Our results in Table 26 are very similar to what we found in US data, except for educational expenditures. Indeed, for healthcare, cultural and transportation spending, we estimate high income elasticities, while for education we find that $\theta < 1$, a result that is statistically significant. This result might be explained by the fact that in France, even higher education is mostly public, and therefore few private expenditures covers its costs.

As described in Appendix B.1, we also have access to the French households budget survey called Budget de Famille. We use the 2017 cross-section and run the same regressions with identical controls. Our results, showed in Table 27, are similar to those found in the Bank data. Indeed, we find high elasticities for all goods, but evidence for $\theta > 1$ is only significant for health, culture and transportation.

[32] Thanks to the large number of observations, we can add a dummy for each age level

Table 27: Income elasticity, Budget de Famille 2017

log(c)	*Health*		*Education*		*Culture*		*Transportation*	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
θ	1.43***	1.33***	0.84***	0.54***	1.50***	1.50***	2.76***	2.49***
	(0.027)	(0.073)	(0.025)	(0.201)	(0.015)	(0.049)	(0.027)	(0.106)
Controls		✓		✓		✓		✓
Observations	16,739	16,739	16,739	16,739	16,739	16,739	16,737	16,737
Adj R^2	0.14	0.16	0.06	0.19	0.37	0.38	0.38	0.43

Signif. levels against $\theta = 1$: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

In both Tables, education stands out with a lower income-elasticity. These results clash with our evidence presented in Section 5 about the luxury nature of education goods. In several education-related surveys, we find that the share of parents that put their kids in private schools steeply rise with income. We also encover that the share of households that spend 0 on education related goods decrease a lot with income. We leave this discussion open for future empirical research.

C.2.5 Household-level analysis: nhCES demand system

As a robustness to Section 3.2.2, we now estimate nhCES demand system using household-level data from the US. We use the 1999–2010 Consumption Expenditure Survey (CEX) for household-level consumption, income and socio-demographics data. For price data, we use disaggregated regional quarterly price series from the BLS's urban CPI (CPI-U) and follow Comin, Lashkari and Mestieri (2021) to construct household-level price data. Our main difference is that we build 7 different sectors, going beyond the traditional agriculture, manufacturing and services decomposition.

We estimate $\{\sigma, \epsilon_i, \zeta_i^n\}_{i \in \mathcal{I}_{-m}}$ via GMM:

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

with ω_{it}^n and p_{it}^n denote the share of consumption and the price of sector-i goods of household n at time t, E_t^n their total expenditure, ζ_i^n an household-level times sector fixed effect that accounts for relative taste parameters, and υ_{it}^n the error terms.

We present our results in Table 28. In all regressions, we estimate a σ between 0.238 and 0.377, a number that is consistent with previous estimations. Our favored specifications are columns (1) to (3). In columns (4) to (6) we merge education and health together, while in columns (7) to (9) we create a separate education category. These last regressions yield very high standard deviations due to the lack of data in educational expenditures.

Table 28: Estimates, CEX final-good expenditures, $\epsilon_{\text{manufacturing}} = 1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
σ	0.325	0.328	0.252	0.346	0.377	0.283	0.316	0.287	0.238
	(0.023)	(0.024)	(0.034)	(0.024)	(0.024)	(0.032)	(0.052)	(0.065)	(0.076)
$\epsilon_{\text{agriculture}}$	0.347	0.432	0.330	0.371	0.420	0.406	0.569	0.453	0.405
	(0.073)	(0.095)	(0.084)	(0.076)	(0.103)	(0.087)	(0.223)	(0.272)	(0.226)
$\epsilon_{\text{other services}}$	1.971	3.038	2.776	1.888	2.917	2.733	2.293	3.895	3.033
	(0.160)	(0.297)	(0.262)	(0.157)	(0.304)	(0.264)	(0.578)	(1.302)	(0.832)
ϵ_{health}	1.080	1.720	1.558	–	–	–	1.210	2.788	2.639
	(0.151)	(0.216)	(0.175)	–	–	–	(0.477)	(0.978)	(0.765)
$\epsilon_{\text{education}}$	–	–	–	–	–	–	0.306	0.781	0.650
	–	–	–	–	–	–	(0.419)	(0.522)	(0.258)
$\epsilon_{\text{health \& education}}$	–	–	–	1.227	1.775	1.487	–	–	–
	–	–	–	(0.162)	(0.240)	(0.179)	–	–	–
$\epsilon_{\text{transportation}}$	0.857	1.326	1.357	1.01	1.319	1.370	1.564	2.817	2.338
	(0.107)	(0.154)	(0.134)	(0.115)	(0.167)	(0.139)	(0.439)	(0.902)	(0.618)
$\epsilon_{\text{culture}}$	2.204	2.487	2.257	2.232	2.557	2.335	3.613	4.644	3.601
	(0.174)	(0.236)	(0.203)	(0.179)	(0.259)	(0.215)	(0.872)	(1.527)	(1.001)
Region FE		✓	✓		✓	✓		✓	✓
Year × Quarter FE			✓			✓			✓
Observations	36,083	36,083	36,083	36,281	36,281	36,281	4,152	4,152	4,152

Observations are weighted by survey weights. Standard errors clustered at the household level.
All regressions include region and year × quarter fixed effects.

D Calibration: households budget survey and bank data

Data description. In BdF 2017, 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 us 15,412 observations. In the Bank data, we use the 2023 cross-section and we make the same data cleaning. We get over 140,000 observations. In Table 29 we plot the share in total consumption of our sectors of interest: namely health, education, transportation and culture. In Table 30 we compute the share of households with less than 10 euros in each sector every year.

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
Transportation	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 2023						
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

Table 30: Share of households (%) spending less than 10, 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 2023						
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

E 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.

F Distributional effects of in-kind benefits: proofs of Section 8

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 2. 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

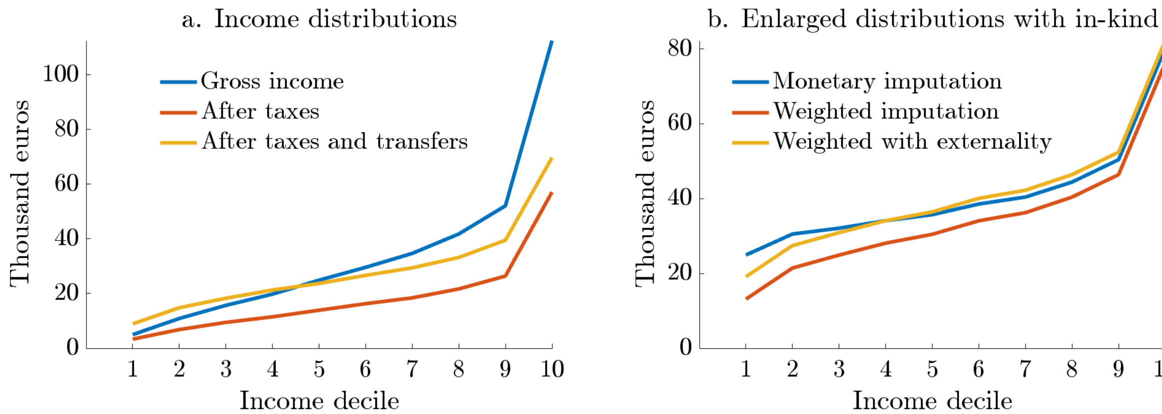
$$\boxed{\frac{\frac{du_i}{dG}}{\frac{du_i}{dy_i}} = \min\left(\frac{y_i}{\bar{y}}\frac{\alpha}{\alpha-1}(1-S)^{\frac{1}{\alpha}}, 1\right)}$$

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

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

In the left panel of Figure 10 below, we show the values, in euros, of gross income, after-tax income, and after-tax-and-transfer income, by decile. These numbers are used to compute Gini and income share in Table 20. For example, gross annual income is €110,000 in D10, against €5,000 in D1; after taxes and transfers, the disposable income in €70,000 and €10,000, respectively. In the right panel, we add the in-kind benefits, with the usual monetary imputation (blue line), with our weighted imputation (red), and with weights and uniform externality (yellow).

Figure 10: Distribution with and without in-kind benefits



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