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The Long-Run Effects of Fiscal Rebalancing in a Heterogeneous-Agent Model *

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Abstract

This paper evaluates the long-run economic effects of a fiscal rebalancing reform, namely a policy consisting in increasing consumption taxes and simultaneously lowering payroll taxes, all this in a budget neutral way. To this end, we construct a heterogeneous-agent model and compare the pre- and post-reform steady states. The model is calibrated on French data to reproduce key characteristics of disposable income and net wealth distributions. We compare the outcomes of the reform under the benchmark model with those arising in its representative-agent version. Our results indicate that while the fiscal febalancing reform stimulates aggregate labor and capital, (i) it has a larger effect on capital in the heterogeneous-agent model than in its representative-agent counterpart; (ii) it also exacerbates wealth inequality, where wealthier households capture the whole macroeconomic increase in capital. The results are left unaffected by various perturbations around the baseline calibration. Taking into account the transition between the two stady states, a welfare analysis suggests that the reform entails a welfare cost even though a majority of agents would benefit from it.

JEL Classification: E62, D31, C54.

Keywords: Fiscal Policy, fiscal rebalancing, Income & Wealth Distributions, Heterogeneous Agent Model.

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1 Introduction

In a series of papers, Prescott (2004), Rogerson (2006), and Ohanian et al. (2008) argue that high overall labor taxes explain why workers in continental Europe work less than Americans. The policy implications are straightforward: Policy makers interested in boosting labor should drastically lower labor taxation. However, against the backdrop of an elevated level of public indebtedness in a number of European countries, in particular France and Italy, there is very limited room of maneuver for tax cuts.

Yet, there may be room for a policy consisting in increasing consumption taxes and simultaneously decreasing payroll taxes, all this in a budget neutral way. Provided the share of consumption in GDP is larger than the labor share, this policy may result in a lower fiscal wedge on labor, thus promoting labor supply. We call such a policy a "Fiscal Rebalancing" policy. In effect, this policy has received considerable attention in the European policy debate over the years. Passed on March 14, 2012 and repealed on July 17 of the same year in France (under the label "TVA Sociale"), it has been implemented in Denmark in 1987 and in Germany in 2007.[1] In this paper, we propose to study the long-run macroeconomic consequences of such a reform.

To this end, we develop a heterogeneous-agent model with endogenous labor supply à la Pijoan-Mas (2006) that we calibrate to French data and, in the tradition of Kydland and Prescott (1996), we use this model as a laboratory to explore the long-run effects of a Fiscal Rebalancing reform. We systematically compare the outcome of the reform in the heterogeneous-agent (HA) model with those arising in its representative-agent (RA) counterpart. While the heterogeneous-agents model is very simple, we strive to take it seriously to the data, using a calibration strategy that borrows from Castañeda et al. (2003). This calibration step is essential as it results in a welfare loss attached to the reform under the HA model while its RA counterpart would unequivocally conclude to a welfare gain.

We start our analysis by deriving analytical conditions under which the Fiscal Rebalancing reform would promote labor supply in the RA model. At this stage, we make sure that the RA model is calibrated in such a way that it has the same output, capital, and labor as its HA counterpart in the pre-reform steady state. We find that, provided the economy has a sufficiently low labor supply elasticity and a sufficiently low income effect on labor supply, the reform will exert a positive effect on labor whenever the consumption-output ratio inclusive of consumption taxes is larger than the labor share net of taxes. In the limit when both consumption and labor are almost unresponsive to the reform, this condition is a mere accounting condition that states that the tax to be increased must have a larger fiscal basis than that of the tax to be decreased.

[1] To some extent, this reform could also be interpreted as a first step towards the Fair Tax proposal in the US debate. See, for example, Bachman et al. (2006). It also resembles a fiscal devaluation, as studied by Farhi et al. (2014) and Erceg et al. (2023).

Next, we explore quantitatively a range of fiscal rebalancing policies, with a focus on a benchmark scenario with an increase in consumption taxes of 3 percentage points, as was the case in point in the French debate in 2012 and in the Danish and German reforms. We find quantitatively that the long-run labor effect of the reform in the HA model is somewhat lower than what obtains in the RA framework, even though the long-run cut in the overall fiscal wedge on labor in larger in the former than in the latter. The magnitude of these differences is not large however. By contrast, the long-run impact of the reform on capital is substantially larger in the HA economy than in its RA counterpart, by a factor of five in our benchmark policy scenario.

Two forces shape this result in the HA economy. First, everything else equal, a higher consumption tax leads agents to form higher precautionary savings in order to reach the same degree of intertemporal consumption smoothing. Second, and more importantly, if successful, the reform results in higher wages, which in turn increases the stochastic share of income in the individual problem. This too contributes to a higher rate of capital accumulation. In equilibrium, these forces are counteracted by the implied decline in the real interest rate, but this effect is ultimately dominated by the two forces just discussed.

While the fiscal rebalancing reform generates positive long-run aggregate effects in terms of capital accumulation, the distribution of the implied increase in wealth is very unbalanced, leading to an increase in inequality. In particular, in our benchmark policy scenario with an exogenous increase in consumption taxes amounting to 3 percentage points, aggregate wealth increases by approximately 1.5% and this increase is almost entirely absorbed by the 10 percent richest.

We complement our investigation by a welfare analysis. Taking the transition between the pre- and post-reform steady states into account, we find that the benchmark fiscal rebalancing policy would induce a welfare loss in the HA economy according to a Utilitarian criterion, as opposed to the welfare gain that would obtain in the RA economy. We analyze how different agents would vote for the reform, that is, would draw individually a welfare gain from the reform. We find that agents in the last two quintiles of the wealth distribution would unambiguously vote against the reform; at the same time, agents with low individual productivity and low wealth would also vote against the reform. We also show that our conclusion no longer holds in a HA model calibrated with a process for individual productivity that does not help to match the concentration in the French wealth distribution. All in all, our results illustrate that assessing the welfare effects of this reform through the lens of a RA model could prove highly misleading.

The rest of the paper is organized as follows. Section 2 expounds our benchmark heterogeneous-agent model. Section 3 uses the benchmark model to assess the effects of the fiscal rebalancing policy. Section 4 offers a welfare analysis. The last section offers concluding remarks.

2 A Benchmark Heterogeneous-Agent Model

In this section, we describe the benchmark heterogeneous-agent (HA henceforth) model and the fiscal reform that we implement. We also describe the representative-agent version (RA henceforth) of the setup and briefly outline the solution procedure. Finally, we describe how the benchmark model is calibrated on French data.

2.1 Economic Environment

We consider a discrete time economy without aggregate risk similar to that studied in Aiyagari and McGrattan (1998). Time is indexed by $t \in \mathbb{N}$. The final good Y_t, which is the numeraire, is produced by competitive firms, according to the technology

$$Y_t = K_t^{\theta}(\Omega N_t)^{1-\theta},$$

where $\theta \in (0,1)$ denotes the elasticity of production with respect to capital, $\Omega > 0$ is a labor-productivity parameter, and K_t and N_t are the inputs of capital and efficient labor, respectively. Firms rent capital and efficient labor on competitive markets at rates $r_t + \delta$ and $(1+\tau_{S,t})w_t$, respectively. Here, $\delta \in (0,1)$ denotes the depreciation rate of physical capital, r_t is the interest rate, w_t is the wage rate, and $\tau_{S,t}$ denotes payroll taxes.

The first-order conditions for profit maximization are

$$r_t + \delta = \theta\left(\frac{K_t}{\Omega N_t}\right)^{\theta-1},$$

$$(1+\tau_{S,t})w_t = (1-\theta)\Omega\left(\frac{K_t}{\Omega N_t}\right)^{\theta}.$$

The economy is populated by a continuum of infinitely lived households. At the beginning of each period, households receive an individual productivity level $z_t > 0$. We assume that z_t is $i.i.d.$ across agents and evolves over time according to a Markov process, with bounded support $\boldsymbol{Z}$ and stationary transition function $\Pi(z,z')$.[2] We assume that there are no insurance markets to hedge against the individual shock. The typical household lifetime utility is given by

$$\mathbb{E}\left\{\sum_{t=0}^{\infty}\beta^t\left(\frac{c_t^{1-\sigma}}{1-\sigma} - \nu\frac{h_t^{1+\eta}}{1+\eta}\right)\Big|s_0\right\},$$

[2]The transition Π has the following interpretation: for all $z \in \boldsymbol{Z}$ and for all $\boldsymbol{Z}_0 \in \mathscr{B}(\boldsymbol{Z})$, where $\mathscr{B}(\boldsymbol{Z})$ denotes the Borel subsets of $\boldsymbol{Z}$, $\Pi(z,\boldsymbol{Z}_0)$ is the probability that next period's individual state lies in $\boldsymbol{Z}_0$ when current state is z.

where $\mathbb{E}\{\cdot|s_0\}$ is the mathematical expectation conditioned on s_0, the individual state at date 0. Here, $\beta \in (0,1)$ denotes the discount factor, $c_t \geq 0$ is individual consumption, $0 \leq h_t \leq 1$ is the individual labor supply, $\sigma > 0$ is the relative risk aversion coefficient, $\eta > 0$ is the inverse of the Frisch elasticity of labor, and $\nu > 0$ is a scaling parameter.

Given time paths for consumption taxes $\{\tau_{C,t}\}_{t=0}^{\infty}$, transfers $\{T_t\}_{t=0}^{\infty}$, wages $\{w_t\}_{t=0}^{\infty}$, and interest rates $\{r_t\}_{t=0}^{\infty}$, households maximize their lifetime utility subject to the sequence of budget constraints

$$(1+\tau_{C,t})c_t + a_{t+1} \leq (1-\tau_N)w_t z_t h_t + [1+(1-\tau_A)r_t]a_t + T_t,$$

where τ_N denotes the labor income tax and a_t denotes available assets at the beginning of period t, paying the after-tax rate of return $(1-\tau_A)r_t$, where τ_A denotes the capital income tax. The individual state at t is $s_t = (a_t, z_t)$.

Assets can consist of units of physical capital and/or government bonds. Given that there is no aggregate risk, once arbitrage opportunities have been ruled out, each asset has the same rate of return. Borrowing is exogenously restricted by the constraint $a_{t+1} \geq 0$.

Finally, there is a government in the economy. The government issues debt B_{t+1}, collects tax revenues, provides rebates and transfers, and consumes G_t units of final goods. The associated budget constraint is given by

$$B_{t+1} = (1+r_t)B_t + T_t + G_t - [\tau_A r_t A_t + (\tau_N + \tau_{S,t})w_t N_t + \tau_{C,t}C_t],$$

where C_t and A_t denote aggregate (per capita) consumption and assets held by the agents, respectively. Given the market clearing condition on the capital market $A_t = K_t + B_t$, the government budget constraint can be restated as

$$B_{t+1} = [1+(1-\tau_A)r_t)]B_t + T_t + G_t - [\tau_A r_t K_t + (\tau_N + \tau_{S,t})w_t N_t + \tau_{C,t}C_t].$$

2.2 Implementing the fiscal rebalancing Reform: Equilibrium and Solution

In this section, we define the two steady state equilibria that we will focus on henceforth and detail the solution procedure used to compute the steady-state allocations.

We let $\boldsymbol{A}$ denote the set of possible values for assets a. For convenience, we restrict a to the compact set $\boldsymbol{A} = [0, a_M]$, where a_M is a large number.[3] We let the joint distribution of asset levels a and individual productivities z be denoted $\lambda(a,z)$, defined on $\mathscr{B}(\boldsymbol{A}\times\boldsymbol{Z})$, the Borel subsets of $\boldsymbol{A}\times\boldsymbol{Z}$.

[3] a_M is selected so that the decision rule on assets for an individual with the highest productivity crosses the 45-degree line below a_M.

Thus, for all $\boldsymbol{A}_0 \times \boldsymbol{Z}_0 \in \mathscr{B}(\boldsymbol{A} \times \boldsymbol{Z})$, $\lambda(\boldsymbol{A}_0, \boldsymbol{Z}_0)$ is the mass of agents with assets a in $\boldsymbol{A}_0$ and individual productivity z in $\boldsymbol{Z}_0$.

2.2.1 The Pre- and Post-Reform Steady-State Equilibria

In the remainder of this paper, we focus exclusively on two alternative steady-state equilibria of the above economy. In the first one, consumption taxes and payroll taxes are set to $\bar{\tau}_C$ and $\bar{\tau}_S$, respectively, and we adjust steady-state transfers $\bar{T}$ so that the government budget constraint holds. We refer to this steady state as the "pre-reform steady state".

In the second steady state, consumption taxes are tilted up to $\bar{\tau}_C + \Delta_C$ and payroll taxes are simultaneously adjusted to $\bar{\tau}_S - \Delta_S$, where Δ_S is adjusted so that the government budget constraint holds, holding transfers constant to their pre-reform value $\bar{T}$. We refer to this steady state as the "post-reform steady state".[4]

We can now write an agent's problem in recursive form

$$\begin{aligned} V(a,z) &= \max_{c,h,a'} \left\{ \frac{c^{1-\sigma}-1}{1-\sigma} - \nu \frac{h^{1+\eta}}{1+\eta} + \beta \int_{\boldsymbol{Z}} V(a',z') \Pi(z,dz') \right\} \\ \text{s.t.} \quad & (1+\bar{\tau}_C+\Delta_C)c + a' \leq (1-\tau_N) wzh + (1+(1-\tau_A)r)a + \bar{T}, \\ & a' \geq 0, \;\; c \geq 0, \;\; 0 \leq h \leq 1. \end{aligned} \tag{1}$$

The solution to this problem yields decision rules $g_a(s)$, $g_c(s)$, and $g_h(s)$. In turn, the decision rule on assets and the transition Π induce a transition for the individual state s

$$\forall \boldsymbol{S}_0 = \boldsymbol{A}_0 \times \boldsymbol{Z}_0 \in \mathscr{B}(\boldsymbol{A} \times \boldsymbol{Z}), \quad Q(s, \boldsymbol{S}_0) = \int_{\boldsymbol{Z}_0} \mathbb{1}[g_a(a,z) \in \boldsymbol{A}_0] \Pi(z, dz'), \tag{2}$$

where $\mathbb{1}[g_a(a,z) \in \boldsymbol{A}_0]$ is an indicator function taking value one if the statement is true and zero otherwise. Thus $Q(s, \boldsymbol{S}_0)$ is the probability that an agent of type s has of becoming of a type in $\boldsymbol{S}_0 \in \mathscr{B}(\boldsymbol{A} \times \boldsymbol{Z})$ in the next period. We can now define a post-reform, stationary, recursive equilibrium in the following way.

Definition 1 *Given a policy vector* $(\Delta_C, \bar{\tau}_C, \bar{\tau}_S, \tau_A, \tau_N, \bar{T}, \bar{G}, \bar{B})$, *a steady-state equilibrium is a constant system of prices* $\{r, w\}$, *a value function* $V(a,z)$, *time-invariant decision rules for an individual's assets holdings, consumption, and labor supply* $\{g_a(a,z), g_c(a,z), g_h(a,z)\}$, *a fiscal adjustment rule* Δ_S, *a measure* λ *of agents over the state space* $\boldsymbol{A} \times \boldsymbol{Z}$, *aggregate quantities* $A \equiv \int g_a(s)\lambda(ds)$, $C \equiv \int g_c(s)\lambda(ds)$, $N \equiv \int z g_h(s)\lambda(ds)$, *and* K *such that:*

[4] In Section 4, we also consider the transition between these two steady states.

1. *The value function $V(s)$ solves the agent's problem stated in Equation* (1), *with associated decision rules $g_a(s)$, $g_c(s)$ and $g_h(s)$;*

2. *Firms maximize profits and factor markets clear so that*

$$(1+\bar{\tau}_S-\Delta_S)\,w=(1-\theta)\Omega\left(\frac{K}{\Omega N}\right)^{\theta},\quad r+\delta=\theta\left(\frac{K}{\Omega N}\right)^{\theta-1};$$

3. *The fiscal rule ensures the government budget constraint holds*

$$(\tau_N+\bar{\tau}_S-\Delta_S)\,wN+\tau_A rK+(\bar{\tau}_C+\Delta_C)C=\bar{T}+\bar{G}+(1-\tau_A)r\bar{B};$$

4. *Aggregate savings equal firm demand for capital plus government debt*

$$A=K+B;$$

5. *The distribution λ is invariant*

$$\forall \boldsymbol{S}_0=\boldsymbol{A}_0\times\boldsymbol{Z}_0\in\mathscr{B}(\boldsymbol{A}\times\boldsymbol{Z}),\quad \lambda(\boldsymbol{S}_0)=\int_{\boldsymbol{A}\times\boldsymbol{Z}}Q(s,\boldsymbol{S}_0)\lambda(ds),$$

where Q is the transition induced by g_a and Π, given by Equation (2).

For comparison purposes, we also consider a version of the model in which (i) we impose idiosyncratic labor income shocks z_t set to 1, so that there is no ex post heterogeneity; (ii) we relax the borrowing constraint. We refer to this environment as the "representative agent" (RA henceforth) environment. Notice that in this RA setup, the distinction between effective labor $H\equiv\int g_h(s)\lambda(ds)$ and efficient labor N is no longer useful, since these quantities coincide in this particular context.

2.2.2 Solution Method

The solution method is now briefly described.[5] Given the structural parameters, we postulate candidate values for the interest rate r and aggregate efficient labor N. Using the representative firm's first-order conditions, we obtain K and w, and using the aggregate resource constraint, we determine C. We then solve the government budget constraint either for the transfer in the "pre-reform" steady state or for Δ_S in the "post-reform" steady state.

Given these values, we solve the agent's problem using the endogenous grid method proposed by Carroll (2006) and adapted to deal with the endogenous labor supply in the spirit of Barillas and

[5] Further details are reported in Appendix A.

Fernandez-Villaverde (2007). Using the implied decision rules, we then solve for the stationary distribution, as in Young (2010), and use it to compute aggregate quantities. We then iterate on r and N and repeat the whole process until the markets for capital and labor clear.

For a given N, the interest rate is updated via a hybrid bisection-secant method. The bisection part of the algorithm is activated whenever the secant would update r to a value higher than the RA interest rate (which would result in diverging private savings, as shown in Aiyagari 1994). Once the market-clearing r is found, N is updated with a standard secant method.[6]

2.3 Calibration to the French Economy and Model's Fit

The model is calibrated to the French economy. A period is taken to be a year. We divide structural parameters into two subsets. The first one comprises parameters that we set prior to calibtation. The second subset regroups parameters that we calibrate to match a set of moments.

2.3.1 Pre-Set Parameters

Concerning the first subset of parameters, we set $\sigma = 1.5$, as is conventional in the literature. In our benchmark calibration, we set $\eta = 2$, yielding a Frisch elasticity of labor supply equal to 0.5. In the robustness section, we consider alternative values, yielding larger or even lower Frisch elasticities.

The fiscal parameters $\bar{B}$ and $\bar{G}$ are set to match the debt-output ratio and the government consumption-output ratio observed in 2018, both drawn from the Annual macroeconomic database of the European Commission (AMECO), i.e., $s_B \equiv B/Y = 97.78\%$ and $s_G \equiv G/Y = 23.27\%$. The tax rates are calibrated to match estimates of effective tax rates as reported in European Commission (2018). This yields $\tau_N = 0.40$, $\tau_A = 0.352$, and $\bar{\tau}_C = 0.20$. Since, with this method, all the sources of labor taxation are merged into τ_N, without loss of generality, we set $\bar{\tau}_S = 0$ in the pre-reform steady state. Using these parameters, the pre-reform value of transfers $\bar{T}$ is endogenously computed to balance the government budget constraint. In the initial steady state, we obtain the transfers to output ratio $T/Y = 0.126$. Later, when we compute the post-reform steady state, $\bar{T}$ is frozen.

We set θ so that the labor share is 66 percent and we set the depreciation rate of capital to 10 percent, i.e. $\theta = 0.34$ and $\delta = 0.10$. Finally, we normalize labor productivity $\Omega = 1$.

[6] Absent the fiscal block, in a Aiyagari (1994)-like model with an endogenous labor supply, the outer loop on N would not be necessary. In our setup, because we also need to balance the government budget constraint, this extra loop is needed. This is further discussed in Appendix A.

2.3.2 Calibrated Parameters

We assume that the process for (logged) individual productivity $\log(z_t)$ follows an AR(1) process

$$\log(z_t) = \rho_z \log(z_{t-1}) + \sigma_z \epsilon_t, \quad \epsilon_t \sim N(0,1).$$

We approximate this $AR(1)$ process via the Rouwenhorst (1995) method, as advocated by Kopecky and Suen (2010), using $n_z = 7$ points. This yields a transition matrix $\tilde{\Pi}$ and a discrete support for individual productivity levels $\{z_1, \ldots, z_{n_z}\}$.

In the spirit of Boar and Midrigan (2022), Castañeda et al. (2003), Fève et al. (2018), and Kindermann and Krueger (2022), we then allow for an extra state corresponding to "exceptional" circumstances, associated with a very high labor productivity. As Kindermann and Krueger (2022) argue, such a state is a reduced form for entrepreneurial or artistic opportunities yielding very high labor income. We refer to this exceptional individual state as the "superstar" state.

The "superstar" state can be reached from any "normal" state with probability p_{ns}. Conditional on having reached the "superstar" state, an agent stays in this state with probability p_{ss}. By contrast, with probability $1 - p_{ss}$, the agent goes all the way down to state $\ell = 4$. Letting $\tilde{\Pi}_{ij}$ denote the (i, j) element of $\tilde{\Pi}$, the final transition matrix is then

$$\Pi = \begin{pmatrix} \tilde{\Pi}_{1,1}(1-p_{ns}) & \cdots & \tilde{\Pi}_{1,\ell}(1-p_{ns}) & \cdots & \tilde{\Pi}_{1,n_z}(1-p_{ns}) & p_{ns} \\ \vdots & & \vdots & & \vdots & \vdots \\ \tilde{\Pi}_{n_z,1}(1-p_{ns}) & \cdots & \tilde{\Pi}_{n_z,\ell}(1-p_{ns}) & \cdots & \tilde{\Pi}_{n_z,n_z}(1-p_{ns}) & p_{ns} \\ 0 & \cdots & 1-p_{ss} & \cdots & 0 & p_{ss} \end{pmatrix}.$$

This specification of the labor productivity shocks gives us five parameters ($\rho_z, \sigma_z, p_{ns}, p_{ss}, z_{n_z+1}$), which, together with the subjective discount factor β and the scale parameter ν, are adjusted to match, as closely as possible the following empirical targets: (i) the Gini coefficient (35.70%) and the inter-decile ratio (4.72) of the disposable income distribution, drawn from INSEE (2021) for the year 2018; (ii) the Gini coefficient of the wealth distribution (70.39%), the share of total wealth held by the 10 percent (53.41%) and 5 percent richest (39.70%), all from the ECB database *Distributional Wealth Accounts*[7]; (iii) aggregate hours worked $H \equiv \int g_h(s)\lambda(ds)$, corresponding to the average value of total hours worked (divided by the total amount of hours available in a given year) over the period 1965-2018, drawn from the OECD Economic Outlook database, i.e. $H = 19.23\%$; (iv) the average value of the capital-output ratio over the same sample, $K/Y = 2.9$, also drawn from the AMECO database. The calibration is summarized in Table 1.

[7] See ECB (2024a) and ECB (2024b).

Table 1: Calibration Summary

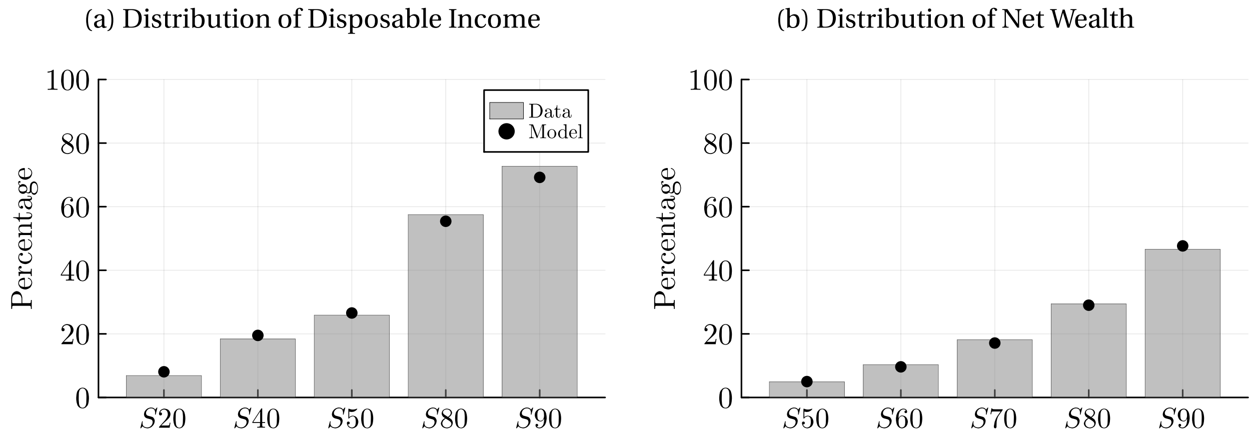
Parameter	Interpretation	Value
Calibrated Parameters		
β	Subjective discount factor	0.9686
ν	Labor disutility scale parameter	172.8876
ρ_z	Persistence of individual productivity shock	0.9123
σ_z	Standard deviation of individual productivity shock	0.2976
p_{ns}	Probability of reaching superstar state	0.0013
p_{ss}	Probability of staying in superstar state	0.8705
z_{n_z+1}/z_{n_z}	Superstar productivity as a fraction of previous productivity level	2.2855
Pre-Set Parameters		
σ	Coefficient of relative risk aversion	1.5000
η	Inverse of Frisch elasticity	2.0000
θ	Share of capital	0.3400
δ	Depreciation rate	0.1000
Ω	Labor productivity	1.0000
$\bar{\tau}_C$	Pre-reform consumption tax	0.2000
$\bar{\tau}_S$	Pre-reform payroll tax	0.0000
τ_N	Aggregate labor income tax	0.4000
τ_A	Capital income tax	0.3520
s_G	Government expenditures-output ratio	0.2327
s_B	Government debt-output ratio	0.9778

Several points are worth noting. First, the probability of reaching the superstar state is rather low, amounting to about 0.1%. The probability of staying in the superstar state is approximately 0.87, so that on average an individual who reached this state stays there for about 8 years. By permanent-income logic, the transitory nature of the superstar state explains why people in this state form large savings. Notice that the superstar state corresponds to a productivity level 80 times higher than the lowest productivity level. While this value may seem large in absolute terms, it should be compared to its counterpart from Castañeda et al. (2003) for the US, about 1000. This is the mere reflection of the fact that the wealth distribution is much more concentrated in the US than in France. Finally, the parameters ρ_z and σ_z fall in the ballpark of available estimates on French data. For example, Fonseca et al. (2023) estimates of the AR(1) parameters are $\rho_z = 0.9588$ and $\sigma_z = 0.2150$.

2.3.3 Calibration of the RA Economy

In the RA economy, the parameters pertaining to the individual productivity process are no longer useful. All the other parameters are set to the values reported in Table 1, with only two exceptions: the productivity index in the production function Ω and the subjective discount factor β. These

Figure 1: Model Fit



Note: Sj denotes the share of total disposable income (left chart) or net wealth (right chart) held by the j percent poorest in terms of disposable income or in terms of wealth. The grey bars correspond to the data, drawn from INSEE (2021) for the left chart and from the ECB *Distributional Wealth Accounts* for the right chart. The black dot is the model outcome.

two parameters are adjusted so that the HA and the RA economy start with the same initial values for the interest rate r, output Y, and capital K.

As argued before, in the RA model total hours worked H and aggregate efficient labor N do not differ while they do in the heterogeneous-agent economy. This creates a discrepancy between the two model economies that we compensate by setting Ω in the RA model such that $\Omega H_{RA} = N_{HA}$, where H_{RA} is total hours worked in the pre-reform steady state in the RA model and N_{HA} corresponds to aggregate efficient labor in the pre-reform steady state in the HA economy. Likewise, the real interest rate will differ in the RA and the HA economies. We thus set β in the RA model so that both the RA and the HA model have the same real interest rate in their respective pre-reform steady state. Using these restrictions on β and Ω, we make sure that both the HA and the RA models share the same pre-reform steady-state values for the interest rate, output, and capital.

2.3.4 Assessing the Model's Fit

Figure 1a reports the pre-reform shares of total disposable income held by the 20%, 40%, 50%, 80%, and 90% poorest (black dots), compared to their empirical counterparts (grey bars). We let Sj denote the share of total disposable income held by the j% poorest. None of these moments are explicitly targeted at the calibration stage (recall that the only moments from the distribution of income that we target are the Gini coefficient and the inter-decile ratio).

Overall, the model's fit is pretty good. The model very slightly over predicts the shares at the bottom of the distribution and under predicts the shares at the top of the distribution. However, the model shares are by and large consistent with their empirical counterparts.

Figure 1b reports the pre-reform shares of net wealth held by the 50%, 60%, 70%, 80%, and 90% poorest (black dots), compared to their empirical counterparts (grey bars).[8] Recall that the share $S90$ is explicitly targeted at the calibration stage.

The model reproduces the shares held by the 50 and 60 percent poorest and slightly under predicts the shares held by the 70 and 80 percent poorest. Again, these differences are negligible and the model is consistent with the data.

3 Long-Run Effects of the Reform

In this section, we study the long-run effects of the reform. We start by deriving analytical results in the context of the RA model. Next, we study the quantitative effects of the reform in both the RA and the HA economy. We then explore the distributional consequences of the reform.

3.1 The RA Case

In the RA case, we are able to derive a condition under which the fiscal rebalancing reform results in a higher long-run equilibrium labor. The condition is stated in Proposition 1.

Proposition 1 *Letting $s_C \equiv C/Y$ and $s_K \equiv K/Y$, both evaluated in the pre-reform steady state*

$$\frac{\partial \log(H)}{\partial \Delta_C} > 0 \iff \text{Sign}\left((1+\bar{\tau}_C)s_C - \frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\right)$$
$$= \text{Sign}\left(\frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\left(1+\frac{1-\delta s_K}{s_C}\sigma+\eta\right) - \bar{\tau}_C(1-\delta s_K) - (1-\theta) - \tau_A r s_K\right).$$

Proof. See Appendix B ■

Provided the economy is sufficiently inelastic (i.e., η and σ are sufficiently high), the right-hand side of the above expression will be positive, as will be the case in our calibration. Under these conditions, Proposition 1 states that the reform will exert a positive effect on labor provided the consumption share inclusive of taxes is larger than the labor share net of taxes. In the fully inelastic limit ($\sigma \to \infty$, $\eta \to \infty$), the condition boils down to a simple accounting condition, reflecting the quasi inertia of fiscal bases in this context.

Reciprocally, in a very elastic economy (low σ, low η), the right-hand side expression will be negative. This can be readily verified for the limit case $\sigma = \eta = 0$. However, the left-hand side is not likely to be negative since, be it in France or in other developed countries, the consumption share in GDP is larger than the labor share, i.e., $s_C > (1-\theta)$.

[8] The split of the share of net wealth held by the bottom 50 is not made available by the ECB.

Taken together, these two remarks suggest that inelastic economies are likely to witness an increase in aggregate labor after a fiscal rebalancing, while very elastic economies should rather go through a labor supply contraction after such a reform.

3.2 Effects on Aggregate Variables and Capital Accumulation

Figure 2 reports the steady-state effects of fiscal rebalancing, considering various Δ_C, ranging from 0 percentage points (no reform) to 10 percentage points. For each Δ_C, we compute the associated steady-state equilibrium, using the same procedures as outlined before. Labor N, capital K, output Y, consumption C, and wages w are reported in percentage deviation from their pre-reform steady-state value. The cut in payroll taxes Δ_S and the fiscal wedge are reported as percentage points deviations, while the impact on the real interest rate r is stated as basis points deviation.[9] The figure shows the steady-state effects of the reform in the HA economy (dark curves) together with the effects in the RA economy (grey curves). The black dots correspond to the impact of the reform in the benchmark policy with $\Delta_C = 3$ percentage points.

Let us consider first the RA case. Given the selected calibration, the right-hand side of the condition stated in Proposition 1 is positive, so that the reform will result in higher labor if and only if

$$(1+\bar{\tau}_C)s_C - \frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta) > 0.$$

This condition holds as well, so that we expect a positive impact of the reform on labor.

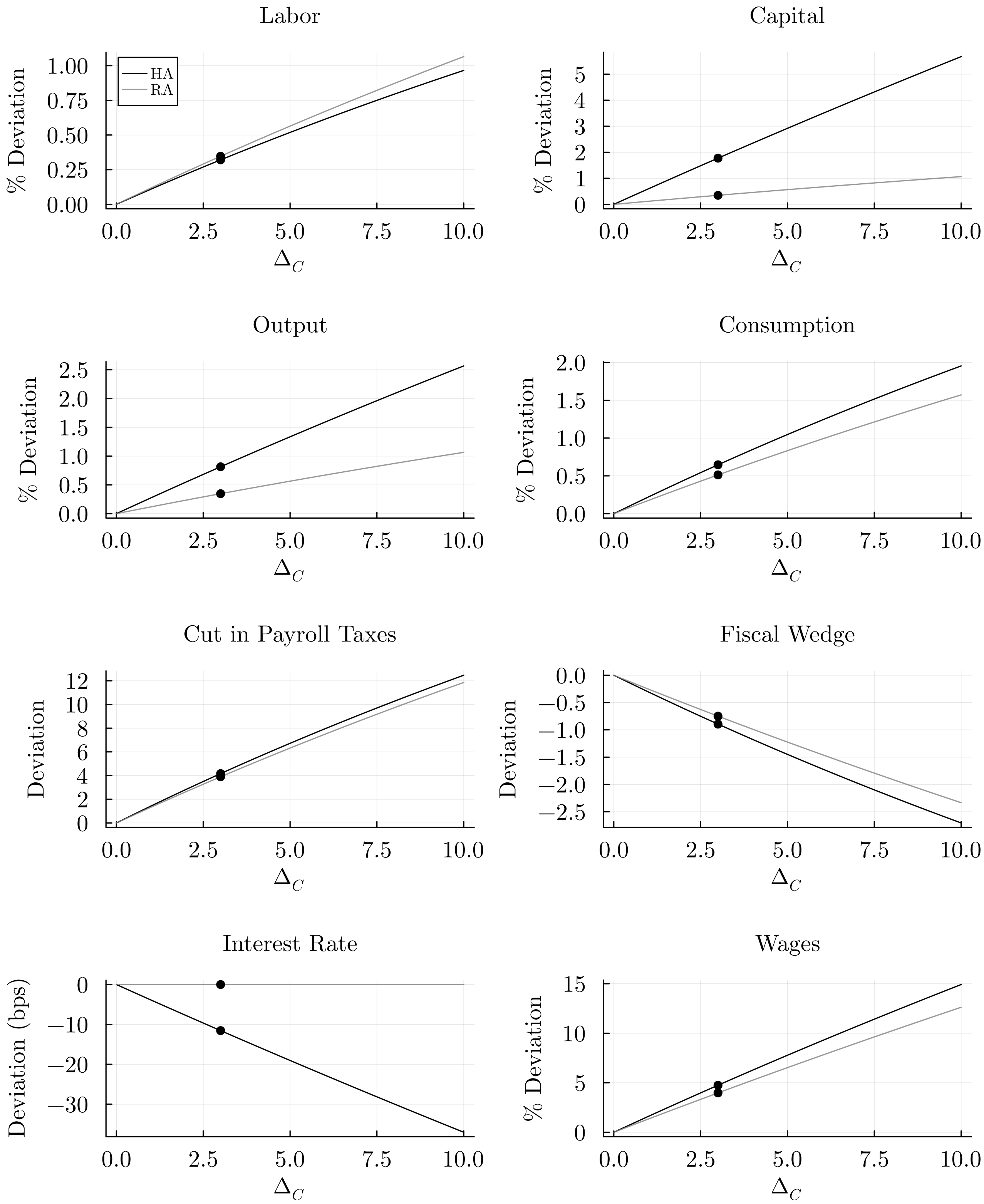
In this environment, the real interest rate r is completely determined by τ_A and β, as shown in Appendix B. Thus, the reform does not affect the steady-state capital-labor ratio. It follows that N, K, and Y experience the same relative deviations. In the benchmark policy scenario with $\Delta_C = 3$ percentage points, the relative impact on output is about 0.35%. Because of constant government expenditures $\bar{G}$, the effect on consumption is slightly larger than those on output, amounting to about 0.5%. The cut on payroll taxes is approximately -4 percentage points. Overall, the reform translates into a cut in the fiscal wedge of -0.75 percentage points.

Consider now the HA case. First, notice that the effects on Δ_S and N are in the same ball park as those found in the RA case. In the benchmark policy scenario with $\Delta_C = 3$ percentage points, the relative impact on labor is about 0.3% and the variation in payroll taxes is approximately -4 percentage points. By way of contrast, the impact on capital is much larger in the HA environment than in its RA counterpart. For $\Delta_C = 3$ percentage points, we obtain an increase in steady-state

[9] The fiscal wedge is

$$1 - \frac{1-\tau_N}{(1+\bar{\tau}_S-\Delta_S)(1+\bar{\tau}_C+\Delta_C)}.$$

Figure 2: Long-Run Effects of Fiscal Reform



Note: For each value of Δ_C, the associated steady-state equilibrium is computed. Labor N, capital K, output Y, consumption C, and wages w are reported as percentage deviation from the initial steady-state value (no reform). The cut in payroll taxes Δ_S is reported as deviation, stated in percentage points. The impact on the interest rate is in deviation from the initial steady state, reported in basis points. The black dots indicate the benchmark reform with $\Delta_C = 3$ percentage points.

capital by approximately 1.7% (i.e., almost a five-fold increase compared to the RA model). This translates into an output effect of about 0.8%.

To understand the difference between the increase in capital in a RA setup and in a HA setup, we note that three terms are affected by the fiscal rebalancing reform in the budget constraint in Problem (1): τ_C, w, and r. Consequently, we can decompose the steady-state effect on capital according to

$$dK = \left(\frac{\partial K}{\partial \tau_C} + \frac{\partial K}{\partial r}\frac{\partial r}{\partial \tau_C} + \frac{\partial K}{\partial w}\frac{\partial w}{\partial \tau_C}\right) d\tau_C.$$

This corresponds to a decomposition according to which items in the households' budget constraint are affected. Note that this is a general equilibrium decomposition insofar as we interpret the variations in r and in w as resulting from a variation in τ_C. Letting

$$dr \equiv \frac{\partial r}{\partial \tau_C} d\tau_C, \quad dw \equiv \frac{\partial w}{\partial \tau_C} d\tau_C,$$

we can reinterpret this decomposition in a partial equilibrium perspective, where we treat each of r, τ_C, and w parametrically:

$$dK = \frac{\partial K}{\partial \tau_C} d\tau_C + \frac{\partial K}{\partial r} dr + \frac{\partial K}{\partial w} dw$$

where dK, $d\tau_C$, dr, and dw are the differences between the post- and pre-reform capital stocks, consumption tax, interest rates, and wage rates, respectively.

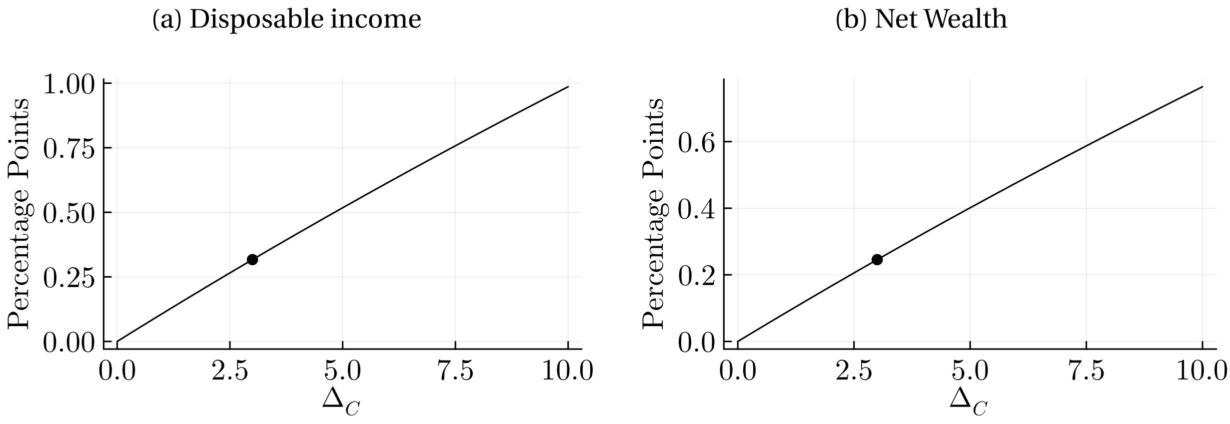
An increase in τ_C will induce agents to accumulate more capital. Indeed, agents have the same desire to smooth consumption as before but this time, consumption is more expensive, due to the increase in the consumption tax. Hence, the required amount of savings increases as well. Next, assuming for now that the marginal product of labor does not respond to the fiscal reform, the wage rate will nevertheless increase mechanically as Δ_S is lowered. This increases the stochastic share of income in the individual budget constraint, inducing agents to form extra precautionary savings. Finally, these forces result in higher capital. In equilibrium, the increase in capital feeds into the marginal product of labor, which reinforces the effects already discussed. At the same time, a higher level of capital will translate into a lower real interest rate. In turn, a lower r induces people to reduce their savings.

In practice, we evaluate these formulas for a small $d\tau_C = 10^{-4}$. For this small increase in consumption taxes, we obtain $dK \approx 0.63$. This decomposes into

$$\frac{\partial K}{\partial \tau_C} d\tau_C \approx 0.22, \quad \frac{\partial K}{\partial w} dw \approx 2.55, \quad \frac{\partial K}{\partial r} dr \approx -2.14.$$

Thus the labor income uncertainty effect together with the increase in the relative price of consumption dominate the negative impact of the decline in r on capital accumulation.

Figure 3: Impact of the Reform on the Gini Coefficients of Disposable and Wealth Distributions



Note: For each value of Δ_C, the associated steady-state equilibrium is computed. The Gini coefficient are then computed on the equilibrium wealth and disposable income distributions. All the results are reported in percentage points. The black dots indicate the benchmark reform with $\Delta_C = 3$ percentage points.

In passing, we note that the size of the government, defined as the ratio $(\bar{G} + \bar{T} + (1 - \tau_A) r \bar{B}) / Y$ decreases with Δ_C, as a result of the increase in Y and the decrease in r.

3.3 Distributional Effects of the Reform

We now explore the distributional effects of the fiscal rebalancing reform. In particular, we are interested in identifying whether the substantial increase in capital is evenly distributed across the population or highly concentrated in a particular section of the wealth distribution.

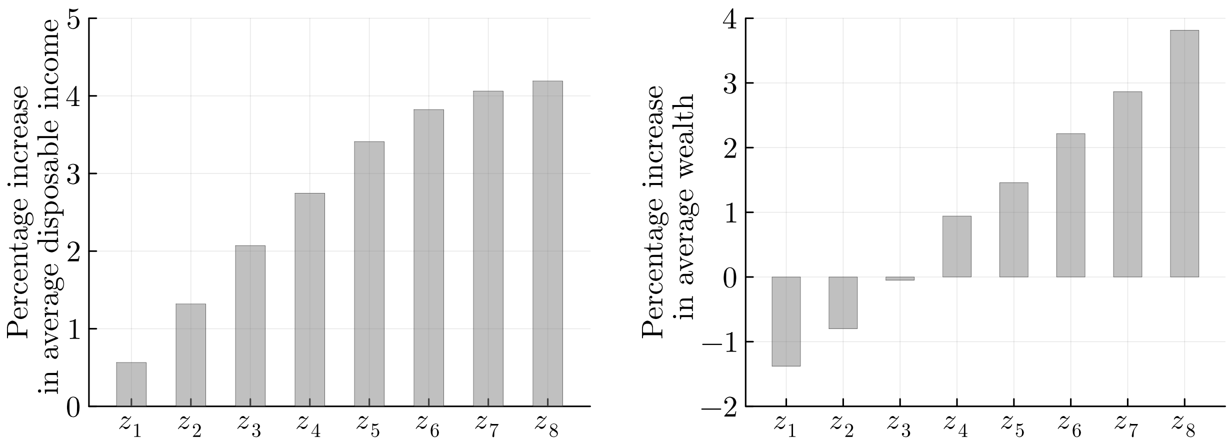
To begin with, Figure 3 shows the variation in the Gini coefficients of disposable income (left chart) and net wealth (right chart) for different values of the increase in consumption taxes Δ_C. In each case, the variation is reported in percentage points. For example, this means that starting from a Gini coefficient of the wealth distribution equal to 70.0% in the pre-reform steady state, a fiscal rebalancing reform associated with an increase in consumption taxes of $\Delta_C = 3$ percentage points results in a Gini coefficient of about 70.25%.

Both Gini coefficients are increasing in Δ_C, implying that disposable income and net wealth inequalities increase when larger fiscal rebalancing reform are implemented. At first glance, these increases seem fairly modest. As discussed above, for $\Delta_C = 3$ percentage points, the Gini coefficient on net wealth has an increase of 0.25 percentage points. While such an increase does not seem very large, it is slightly more than half the historical standard error of its empirical counterpart from the Distributional Wealth Account over the sample 2009Q4-2023Q3 (0.455) for France.[10]

[10] See Appendix C .

Figure 4: Distribution of Changes in Income and Wealth Across Individual Productivity Levels

(a) Disposable income (b) Net Wealth



Note: For each individual productivity level z_i, $i \in \{1,\ldots,8\}$, we compute the percentage variation in the average disposable income (left chart) or in the average wealth (right chart) after a fiscal rebalancing reform with $\Delta_C = 0.03$.

Thus, this increase is not a negligible one with respect to historical standards. The increase in the Gini coefficient of the disposable income distribution is even larger.

To investigate the sources of the increase in the Gini coefficients, we start by studying the distribution of net wealth and disposable income by individual productivity levels. The interest of this approach is that these levels are exogenous to the reform and thus do not vary after an increase in consumption taxes. Figure 4 shows the distribution of the relative change in average wealth and income across individual productivity levels, expressed in percentage. Figure 4a reports the relative changes in average income and Figure 4b reports the relative changes in wealth, both evaluated after the fiscal rebalancing reform with $\Delta_C = 3$ percentage points.

Figure 4a shows that the relative change in average disposable income is not split evenly across the various individual productivity levels, with larger z benefiting from a larger increase in average income. This pattern is the result of two different forces. First, the labor income component of disposable income would show the reverse configuration, with smaller z benefiting from a larger relative increase in average labor income. Indeed, agents with a larger z are on average wealth-richer, so that the negative wealth effect on labor supply explains the declining pattern of the distribution of relative changes in labor income across individual productivity levels. Thus, in spite of a lower interest rate, the fact that the average labor income for a given z increases with z reflects the higher wealth concentration after the reform. This is illustrated in Figure 4b. For the first three individual productivity levels, the average wealth actually decreases. For higher z's, it starts to increase, all the more so as z is high. Overall, agents with large z account for the increase in capital accumulation.

Since, as argued above, these agents are also wealth rich, we anticipate that the increase in capital accumulation is highly concentrated.

3.4 Robustness Analysis

Proposition 1 suggests that the inverse of the intertemporal elasticity of substitution σ and the inverse of the Frisch elasticity η play a crucial role in determining whether the fiscal rebalancing reform exerts a positive impact on labor in the RA model. Presumably, they also play a role in the HA model. We thus start our robustness analysis by exploring how changes in these parameters affect our earlier conclusions. To this end we consider two alternative calibration: (i) one with $\eta = 4$; (ii) another one with $\sigma = 3$. In each case, all the other parameters are left unchanged.

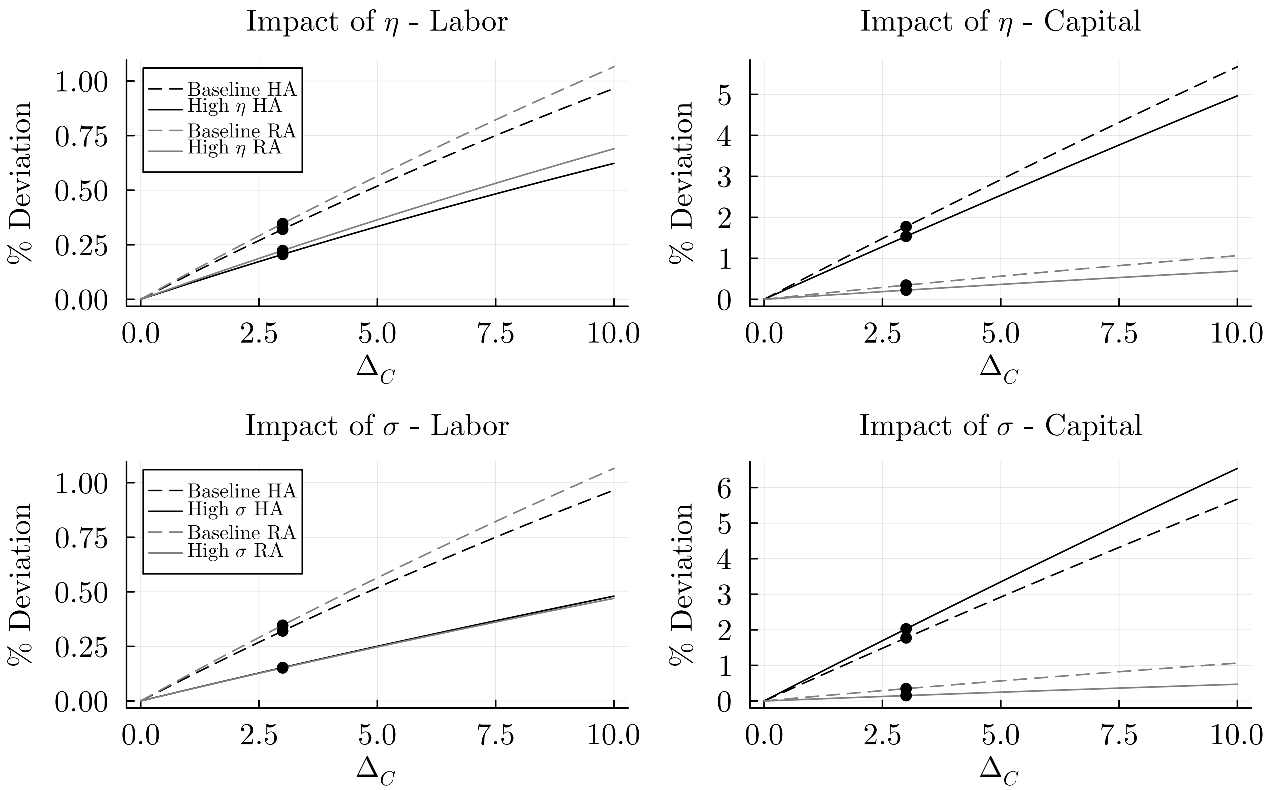
Figure 5 reports the outcome of these robustness analyses. The top row shows the impact of a higher η on labor and capital (solid curve), both expressed as percentage deviation from the pre-reform steady state. For ease of comparison, the figure also reports the results from the baseline calibration (dashed curve). As before, the black curves correspond to the HA model and the grey ones correspond to the RA model. The bottom row reports a similar exercise, this time concerned with the impact of a higher σ.

Overall, our earlier results are robust to a change in η or σ. In both cases, the fiscal rebalancing reform has a similar impact on labor whether we consider a HA or a RA economy, and a much larger impact on capital in a HA model than in its RA counterpart. Obviously, a higher η results in a response of labor and/or capital that is somewhat muted compared to the benchmark calibration. Notice than in the higher σ case, we obtain an even larger difference in capital between the RA and the HA setup. First, with a higher σ the response of labor to an increase in consumption taxes is smaller in the RA model.[11] At the same time, because a higher σ means a higher risk aversion, it also implies a larger wage effect in the HA model (agents are even more sensitive to the increase in the share of stochastic income in overall income). This translates into an even higher capital accumulation in the HA model.

Another legitimate concern for robustness is the way we calibrated the idiosyncratic productivity shock. While standard in the literature, it is still possible that this particular approach induces a bias in the way the extra wealth induced by the reform is split among the population, resulting in an unwarranted extra capital accumulation. To investigate this issue, we modify the individual productivity process and adopt the specification estimated for France (among other countries) by Fonseca et al. (2023). It consists of the same AR(1) process as our pre-superstar process, this time with $\rho_z = 0.9588$ and $\sigma_z = 0.2150$. As before, we convert this process into a discrete Markov chain with 8 states, using the Rouwenhorst (1995) method, as advocated by Kopecky and Suen (2010).

[11] This is apparent in the proof of Proposition 1.

Figure 5: Robustness: η, σ

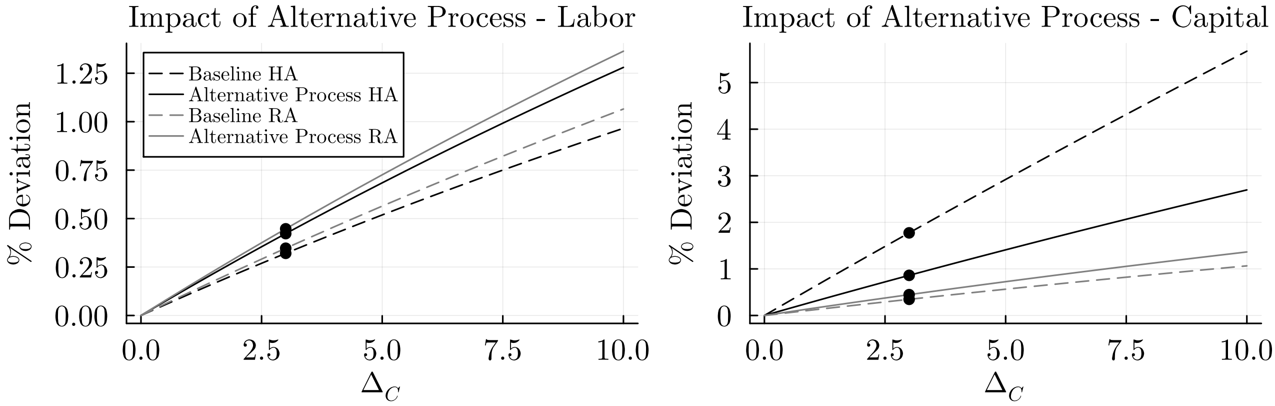


Note: High η corresponds to $\eta = 4$, a value twice as high as in the benchmark calibration. High σ corresponds to $\sigma = 3$, here too a value twice as high as in the benchmark calibration. The black dots indicate the benchmark reform with $\Delta_C = 3$ percentage points.

Figure 6 reports the outcome of this additional robustness analysis. The left chart shows the impact of the alternative process on labor and the right chart on capital (solid curve), both expressed as percentage deviation from the pre-reform steady state. For ease of comparison, the figure also reports the results from the baseline calibration (dashed curve). As before, the black curves correspond to the HA model and the grey ones correspond to the RA model.

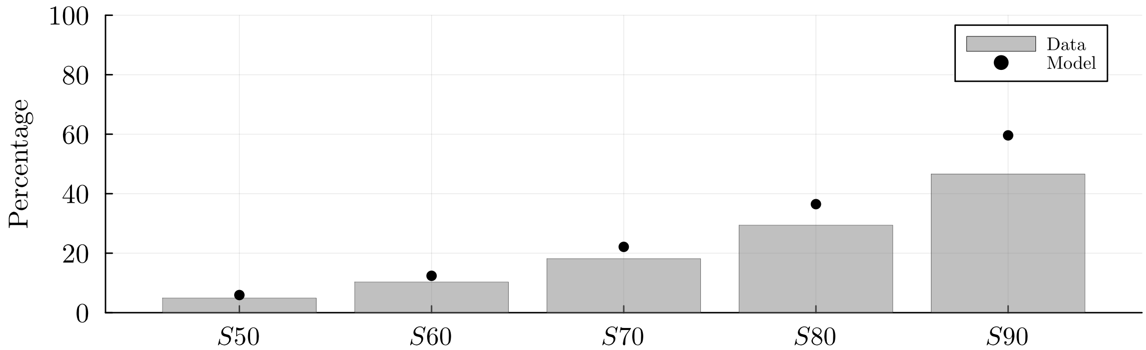
Overall, our conclusion is qualitatively unchanged. The effect of the reform on labor is very similar in the HA and RA economies, as before. However, with the alternative process, the magnitude of the effect is a bit larger, with a relative increase of labor in the HA economy equal to about 0.42% with the alternative process rather than 0.32% with our baseline calibration. Turning to capital, while we still obtain a larger effect of the reform on capital in the HA economy than in the RA one, the over accumulation effect (HA versus RA) is somewhat less pronounced with the alternative process. Notice however that there is less extra accumulation in the RA economy with the alternative process than with the baseline process (i.e., the distance between the solid grey curve and the solid black curve is smaller than the distance between their dashed counterparts).

Figure 6: Robustness: Alternative Process for Individual Productivity



Note: Alternative process for individual productivity estimated by Fonseca et al. (2023).

Figure 7: Counterfactual Distribution of Net Wealth under Alternative Process for Individual productivity



Note: Sj denotes the share of net wealth held by the j percent poorest in terms of wealth. The grey bars correspond to the data, drawn from the ECB *Distributional Wealth Accounts*. The black dot is the model outcome under the alternative calibration.

One explanation for this lower over accumulation effect is that the alternative process does not capture well the high degree of concentration of net wealth in the French data. This is apparent in Figure 7, which shows the Lorenz curves for net wealth in the data and in the model under the alternative calibration. The figure highlights that the share of wealth held by the 90% poorest is too large in the model compared to the data.

4 Welfare Analysis

So far, we have documented that a fiscal rebalancing reform would result in modest macroeconomic effects in the RA model but substantially larger effect on capital in the HA setup (about a five fold increase relative to the impact in the RA model). To judge whether such an increase in capital and its associated wealth concentration are good or bad, we need a welfare analysis. In particular, we are interested in knowing which agents would benefit from the reform, depending on their initial individual states. However, because the reform triggers a potentially painful transition between two steady states, we cannot directly compare the steady-state welfare levels. We thus start by computing the transition between the pre- and post-reform steady states.

4.1 Transitional Dynamics

As is usual, we assume that the transition takes a finite number of periods T^s. In practice, we assume that after T^s periods of transition, the economy has reached the post-reform steady state. The fiscal rebalancing policy is implemented in period $t = t_0$. Prior to period $t = t_0$, the economy is assumed to be in the pre-reform steady state. The transition is then computed using ideas borrowed from the last section of Auclert et al. (2021), where it is shown how to use the sequence-space Jacobian to compute the transition between two steady states. Appendix D gives additional details and shows the transition paths for a number of aggregate variables, both in the HA and in the RA economies.[12]

As a by product of these calculations, for all $(a,z) \in \boldsymbol{A} \times \boldsymbol{Z}$, we obtain the sequence of value functions $\{V_t^R(a,z)\}_{t=t_0}^{t_0+T^s-1}$ along the transition triggered by the reform. By construction, $V_{t_0}^R(a,z)$ is the value function just after the reform. We can thus compare $V_{t_0}^R(a,z)$ with its pre-reform steady-state counterpart $V_*^N(a,z)$. We let $\chi(a,z)$ denote the indicator function taking value 1 if $V_{t_0}^R(a,z) > V_*^N(a,z)$ and zero otherwise. Whenever $\chi(a,z) = 1$, an agent in the initial individual state $s = (a,z)$ would benefit from the reform. It follows that, given the pre-reform distribution λ_{t_0-1}, the quantity $\int_{\boldsymbol{S}} \chi(s)\lambda_{t_0-1}(ds)$ is the mass of agents who would benefit from the reform, from the standpoint of period $t = t_0$.

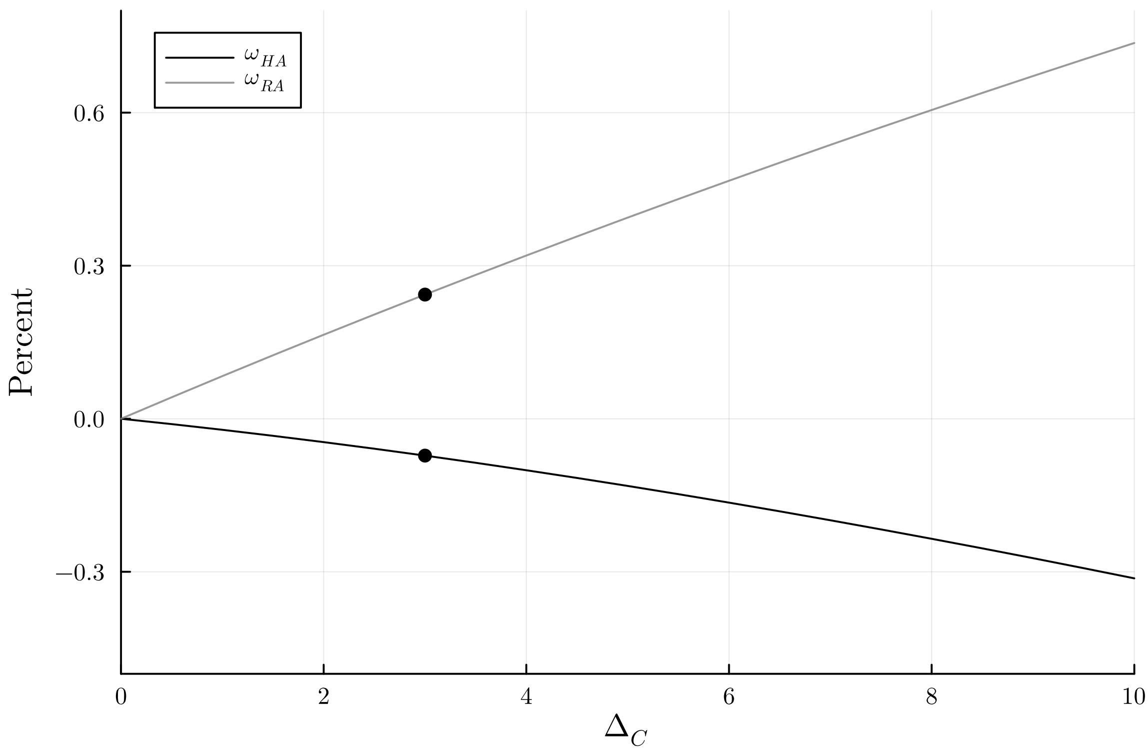
Borrowing ideas from the Sequence Space logic advocated by Auclert et al. (2021), we also compute the expected paths of individual consumption and labor in the initial steady state: $\mathscr{E}_{c,t_0+j}^N(a,z) = \mathbb{E}_{t_0}\{c_{t_0+j}^N|a,z\}$ and $\mathscr{E}_{h,t_0+j}^N(a,z) = \mathbb{E}_{t_0}\{h_{t_0+j}^N|a,z\}$, where $\{c_t^N\}_{t=t_0}^{\infty}$ and $\{h_t^N\}_{t=t_0}^{\infty}$ denote feasible paths for individual consumption and labor supply, respectively, starting from the initial state $s = (a,z)$ in the pre-reform steady state. We also adapt these calculations to the case of the transition and define $\mathscr{E}_{c,t_0+j}^R(a,z) = \mathbb{E}_{t_0}\{c_{t_0+j}^R|a,z\}$ and $\mathscr{E}_{h,t_0+j}^R(a,z) = \mathbb{E}_{t_0}\{h_{t_0+j}^R|a,z\}$, where, this time, $\{c_t^R\}_{t=t_0}^{\infty}$ and $\{h_t^R\}_{t=t_0}^{\infty}$ denote feasible paths for individual consumption and labor supply, respectively, starting from the initial state $s = (a,z)$ along the transition triggered by the fiscal rebalancing reform.

4.2 Distribution of Welfare Gains

We begin our investigation by analyzing the welfare implications of the fiscal rebalancing reform in the RA economy. To this end, as is now classic in the literature, we compute the compensation

[12] Computing the transition in the RA model is much simpler. We just solve for the decision rule on capital in the post-reform steady state and recursively compute the path of capital starting from its pre-reform level.

Figure 8: Welfare Cost/Gain of Fiscal Rebalancing for Alternative Values of Δ_C



Note: The black line corresponds to the Utilitarian welfare gain/cost ω_{HA} in the HA economy, given in Equation (4). The grey line corresponds to the welfare gain/cost in the RA economy, given in Equation (3). For each value of Δ_C, we compute the transition between the initial steady state and its post-reform counterpart, from which we compute ω_{HA} and ω_{RA}. The black dot indicates the benchmark reform with $\Delta_C = 3$ percentage points.

parameter in the RA economy ω_{RA} such that

$$\frac{1}{1-\beta}\left(u((1+\omega_{RA})C_*^N) - v(H_*^N)\right) = \sum_{t=t_0}^{\infty} \beta^{t-t_0}\left(u(C_t^R) - v(H_t^R)\right), \tag{3}$$

where C_*^N and H_*^N denote consumption and labor, respectively, in the pre-reform steady state and $\{C_t^R\}_{t=t_0}^{\infty}$ and $\{H_t^R\}_{t=t_0}^{\infty}$ denote the consumption and labor sequences along the transition triggered by the reform. Thus ω_{RA} is the consumption compensation that makes the representative agent equally happy in the pre-reform steady state and along the transition triggered by the reform.

Next, we turn to the HA economy. This time, we define the Utilitarian compensation parameter ω_{HA} as the solution to the equation

$$\int_{\boldsymbol{S}} \mathbb{E}\left[\sum_{t=t_0}^{\infty} \beta^{t-t_0}\left(u((1+\omega_{HA})c_t^N) - v(h_t^N)\right)\middle| a, z\right] \lambda_{t_0-1}(ds) = \int_{\boldsymbol{S}} V_{t_0}^R(s)\lambda_{t_0-1}(ds) \tag{4}$$

Thus ω_{HA} is the compensation parameter that equalizes the Utilitarian welfare in the pre-reform steady state with the Utilitarian welfare immediately after the reform.

Figure 8 shows ω_{HA} (black curve) and ω_{RA} (grey curve) for various values of Δ_C, ranging from 0 percentage points (no reform) to 10 percentage points. For all the reforms considered, the figure shows that ω_{HA} is negative (welfare cost) while ω_{RA} is positive. Put differently, had we used the RA version of the model, we would have concluded that a fiscal rebalancing reform is unambiguously welfare improving while the HA version of model points to the opposite conclusion.

As before, focusing on the benchmark reform with $\Delta_C = 3$ percentage points (black dot), we find $\omega_{RA} = 0.24\%$. This means that the representative agent would demand an increase in pre-reform steady-state consumption by 0.24 percent to be as well off in this situation as under the fiscal reform. We note in passing that the transition per se is painful since the compensation parameter obtained by comparing steady-state welfare levels is about 0.27%.[13] By way of contrast, we obtain $\omega_{HA} = -0.07$. Thus, while the reform was perceived as welfare improving through the lens of the RA model, it would decrease Utilitarian welfare in the HA model.

It is important to note here that the welfare reversal that we obtain depends crucially on our calibration of the individual productivity process. Again, considering the alternative process borrowed from Fonseca et al. (2023), we would obtain substantially different results, as shown by Figure E.1 in appendix. In this case, the reform would be welfare-improving from a Utilitarian point of vie even under the HA specification of the model.

Going back to our preferred specification of the individual productivity process, Figure D.1 in appendix hints at why the fiscal rebalancing reform deteriorates welfare in the HA economy. In the initial stage of the transition toward the new steady state, on average, agents increase their labor supply by a larger amount than what the representative agent does. Likewise, on average, they reduce their consumption while the representative agent benefits from an immediate increase in consumption.

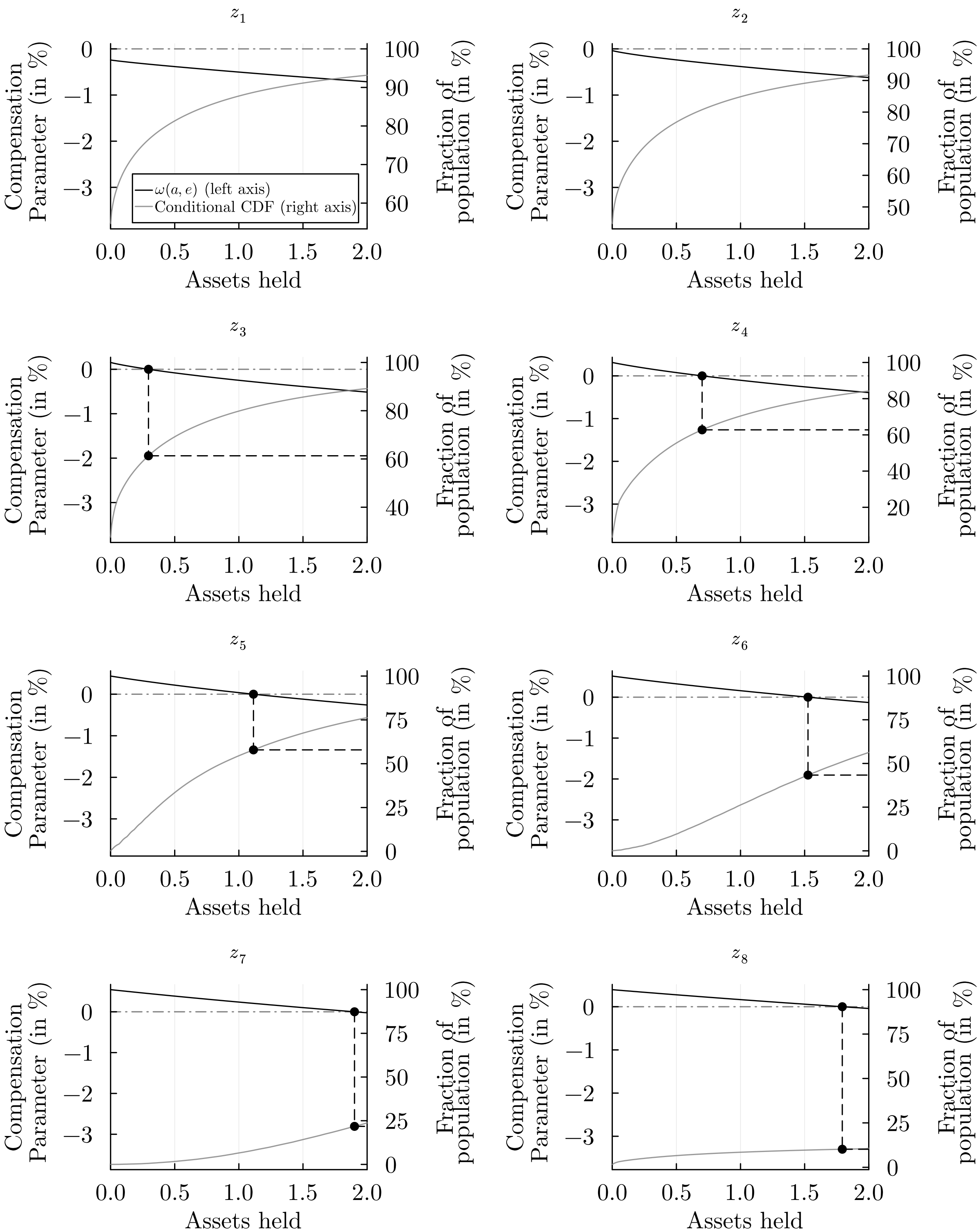
The problem with average consumption or the Utilitarian welfare, though, is that they mask the potential heterogeneity in how individual agents perceive the fiscal reform. To address this issue, we define the individual consumption compensation $\omega(a,z)$ as the solution to the equation

$$\mathbb{E}\left[\sum_{t=t_0}^{\infty}\beta^{t-t_0}\left(u((1+\omega(a,z))c_t^N)-v(h_t^N)\right)\Bigg|\,a,z\right]=V_{t_0}^R(a,z). \tag{5}$$

Thus $\omega(a,z)$ is the consumption compensation that would make an individual agent with initial condition $s=(a,z)$ indifferent between staying in the pre-reform steady state or going though the transition triggered by the reform. Whenever $\omega(a,z)>0$, the individual agent would have to be compensated to stay in the pre-reform steady state.

[13]The compensation parameter computed while ignoring the transition is best interpreted as the compensation that would make the representative agent indifferent between living in the pre-reform economy or moving without cost to another economy in which the fiscal rebalancing reform was implemented years ago.

Figure 9: Individual Compensation Parameters



Note: Each panel is attached to a particular value of the individual productivity z. In each panel, the black curve corresponds to compensation parameter $\omega(a,z)$ given in Equation (5), viewed as a function of assets a, measured in percent, on the left axis. The black dot, if any, identifies the critical value of assets a such that $\omega(a,z) = 0$. This dot is reported on the grey curve corresponding to the CDF of distribution of assets within the sub-population with the individual productivity level under consideration, on the right axis.

Figure 9 illustrates how the individual compensation parameter $\omega(a,z)$ varies with a and z. Each panel corresponds to a particular value of the individual productivity level z. For each z, $\omega(a,z)$ is reported as a function of a, on the left axis (dark curve). We note that $\omega(a,z)$ is a decreasing function of a. To facilitate the interpretation of these charts, we also report a horizontal line corresponding to a zero level for the individual compensation parameter (dash-dot). Whenever $\omega(a,z)$ crosses this horizontal line, a cut-off asset level a is identified, corresponding to a wealth level such that this particular agent is indifferent between the reform and the status quo. We can read the fraction of the population (within the sub-population with the particular productivity level z) with a wealth level below the cut-off value, as reported on the right axis. By construction, this corresponds to the fraction of this sub-population that would benefit from the reform.

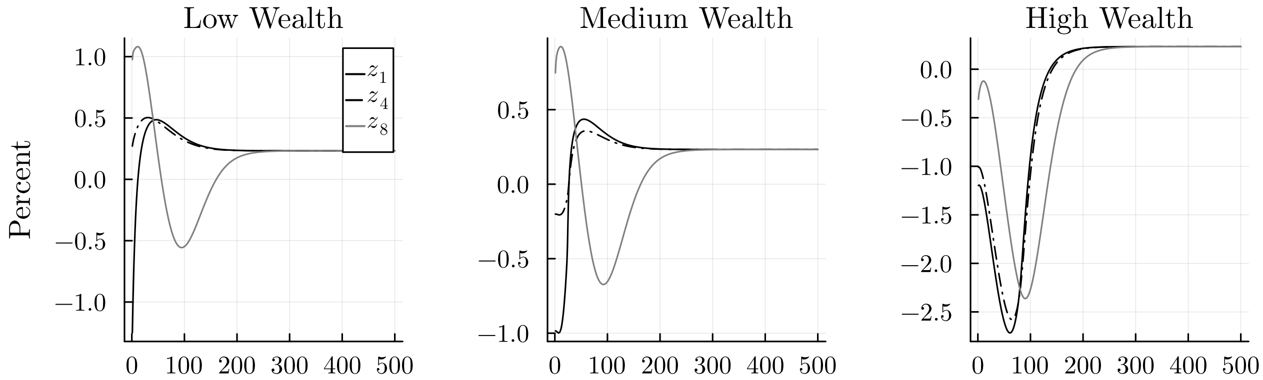
Several interesting results stand out. First, in the first two individual productivity levels z_1 and z_2, the curve $\omega(a,z)$ is negative for $a \geq 0$. In these cases, irrespective of their wealth level at the time the reform is implemented, these agents would not benefit from the reform. In fact, they would be willing to sacrifice part of their consumption no to go through the transition toward the post-reform steady state. These two levels of individual productivity concern about 10.7 percent of total population in the HA economy. Second, more than half of the agents with any of the last three productivity levels z_6, z_7, and z_8 would vote against the fiscal reform. This is all the more pronounced as individual productivity z is high. Overall, the mass of agents with these productivity levels is about 11.7 percent of total population. Third, only agents with productivity levels equal to z_3, z_4, or z_5 would mostly benefit from the fiscal rebalancing reform, with in each case between 50 and 60 percent of the sub-populations in favor of the reform. Overall, Figure 9 suggests that the welfare gain from the reform are not evenly distributed. Agents with very low or very high productivity levels would reject the reform. Similarly, agents with large asset detention are in general more likely to reject the reform.

At first glance, the fact that agents with very low productivity levels experience a welfare loss after the reform is somewhat counter-intuitive. Indeed, as Figure 9 suggests, these agents mostly hold few assets. Thus the reform, by increasing their average labor income, should be positive. To resolve this apparent paradox, it may be useful to inspect the expected paths of consumption and labor supply after the reform and contrasting these paths with their counterparts from the pre-reform steady state.

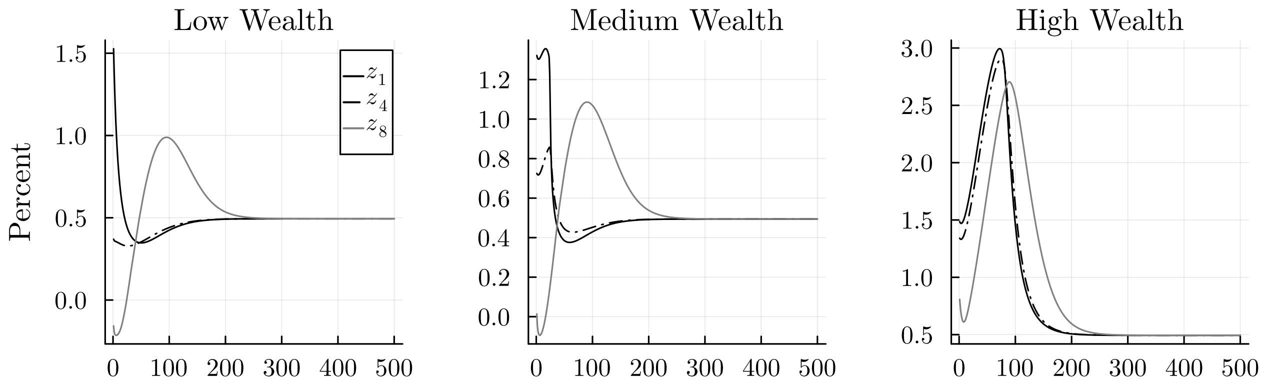
The top panel of Figure 10 reports the expected path of individual consumption after the reform, $\mathscr{E}^R_{c,t_0+j}(a,z)$, in relative deviation from the expected path absent the reform, $\mathscr{E}^N_{c,t_0+j}(a,z)$, in each case starting from the same initial condition $s = (a,z)$. We consider three asset levels: (i) in the "low wealth" case, we simply consider an initial condition $a = \phi$ (the minimal wealth level); (ii) in the "medium wealth" case, we consider $a = A$ as an initial condition (the average wealth level); (iii) finally, in the "high wealth" case, the initial condition is $a = \bar{a}$ (the maximal wealth level). For

Figure 10: Individual Expected Paths

(a) Expected Consumption Path



(b) Expected Labor Path

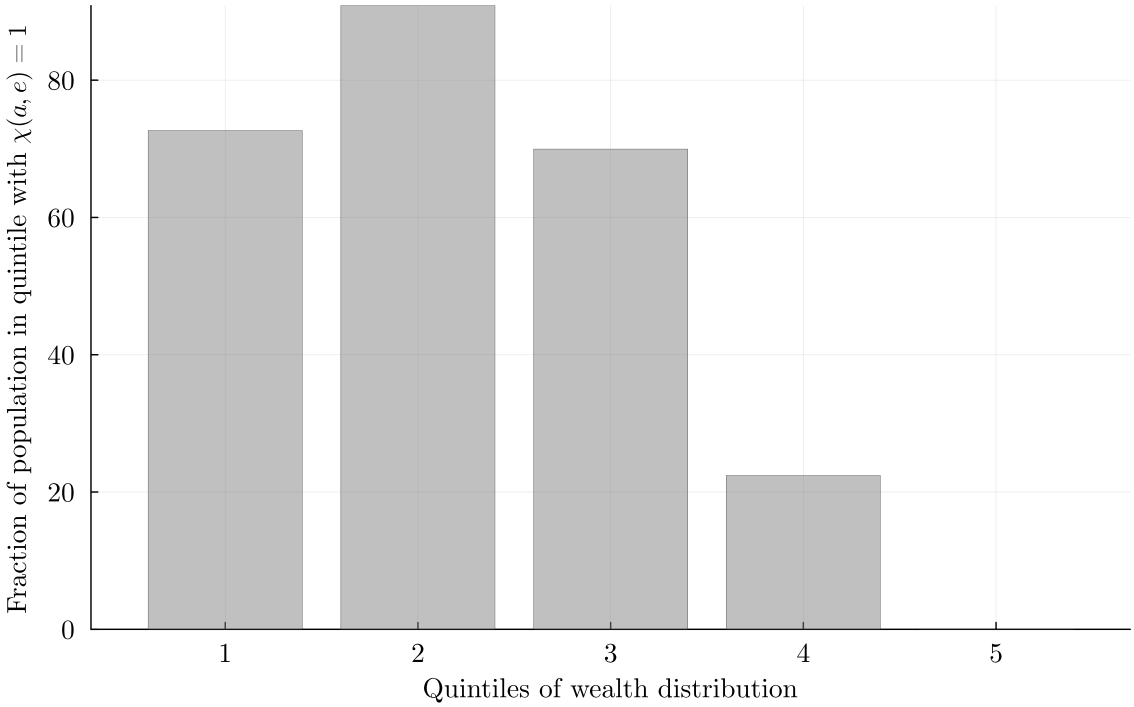


Note: Expected consumption (panel a) and labor supply (panel b) paths along the post-reform transition, expressed in percentage of the expected paths in the pre-reform steady state. In each chart, three initial individual productivity levels are highlighted, z_1 (solid black curve), z_4 (dash-dot black curve), and z_8 (solid grey curve). Each subplot correspond to an initial wealth level. Low wealth corresponds to $a = \phi$; medium wealth corresponds to $a = A$, and high wealth corresponds to $a = \bar{a}$.

each wealth level, we also consider three productivity levels: z_1, z_4, and z_8. Similarly, the bottom panel reports the expected path of labor after the reform in deviation from the expected path under the status quo.

Consider first agents starting in the low productivity–low wealth individual state (black solid curves, left-most charts in Figures 10a and 10b). Clearly, an agent starting with this initial individual state would experience a painful transition after the reform, with a initial drop in consumption relative to the pre-reform expected path by more than 1 percent and an increase in labor supply by about 1.5 percent. Ultimately, this agent will consume more than in the status quo but thanks to discounting, the initial drop in consumption weighs more in utility. Inspecting the columns associated with higher levels of wealth, we see that we obtain the main conclusion. Thus irrespective of

Figure 11: Distribution of Votes Pooled by Net Wealth Quintiles



Note: for each quintile of the net wealth distribution, the grey bar shows the average value of $\chi(s)$ within the particular population in the considered quintile, where $\chi(s)$ is the indicator variable taking value 1 if the agent with initial individual state s benefits from the reform, and zero otherwise.

their initial wealth level, low-productivity agents expect to reduce their consumption and increase their labor supply, relative to the status quo, along the transition toward the new steady state. This contributes to explaining why agents with initial productivity equal to z_1 would unanimously reject the reform, as was shown in top-left panel of Figure 9.

Consider next agents with medium productivity at the time the reform is implemented (black, dash-dotted curves). Those with low wealth expect an increase in consumption together with an increase in labor supply relative to the pre-reform situation. For those agents, Figure 9 suggests that the expected relative increase in consumption will dominate in utility terms the expected relative increase in labor supply. At higher levels of initial wealth, medium-productivity agents would all expect a relative decrease in consumption and a relative increase in labor supply, translating into a smaller post-reform welfare than under the stauts quo.

Finally, consider agents with high initial individual productivity (grey line, solid curves). At low and medium initial wealth levels, these agents expect an increase in consumption and a decrease in labor supply relative to the pre-reform paths. This si obviously synonymous with an increase in welfare. By contrast, at higher wealth levels, these agents would experience an expected drop in consumption together with an expected increase in labor supply.

To conclude this section, we explore how the individual votes $\chi(s)$ are distributed. To this end, Figure 11 shows the distribution of votes pooled by net wealth quintiles, in the context of the benchmark reform with $\Delta_C = 3$ percentage points. Each grey bar indicates the fraction of the concerned population that would vote in favor of the reform within the considered wealth bin. The population in the first three quintiles seems to be massively in favor of the reform, while the population in the last two qunintiles would unambiguously reject the reform.

5 Conclusion

In this paper, we construct a heterogeneous agent model calibrated on France to evaluate the long-term macroeconomic impact of fiscal rebalancing, i.e., a reform consisting in increasing consumption taxes and simultaneously lowering payroll taxes, all this in a budget neutral way. Our findings indicate that this reform will lead to an increase in labor supply and, more notably, result in over-accumulation of capital, highly concentrated among wealthier households. Overall, we find that this reform entails a welfare loss from a Utilitarian point of view, while it would have been conducive to a welfare gain in a representative-agent framework.

While the macroeconomic outcomes prove robust to various modifications in the model's calibration, including changes in labor supply elasticity, the income effect on labor supply, and individual productivity processes, the welfare assessment proves sensitive to the calibration of the individual productivity process. In particular, using a process that does not help to match key moments the empirical wealth distribution in France, we would conclude that the reform is welfare-improving. Our results underscore the importance of carefully calibrating HA models when considering the distributive effects of fiscal policy reforms.

A Details on the Solution Procedure

We impose a constant level of debt $\bar{B}$, a constant level of transfers $\bar{T}$, and a constant level of government expenditures $\bar{G}$. We then let Δ_S be determined by

$$(\bar{\tau}_C + \Delta_C)C + (\bar{\tau}_N + \bar{\tau}_S - \Delta_S)wN + \tau_A rK = \bar{T} + \bar{G} + (1-\tau_A)r\bar{B}.$$

We start by postulating an interest rate r and a demand for labor N. Given r, the first-order condition on capital demand implies

$$r + \delta = \theta\left(\frac{K}{N}\right)^{\theta-1} \Rightarrow k \equiv \frac{K}{N} = \left(\frac{r+\delta}{\theta}\right)^{\frac{1}{\theta-1}}.$$

We then back out $K = kN$ and compute aggregate consumption

$$C = K^{\theta}N^{1-\theta} - \delta K - \bar{G}.$$

and aggregate output

$$Y = K^{\theta}N^{1-\theta}.$$

Next, we want to determine w. To this end, we first need to solve for Δ_S. Recalling that

$$w = \frac{1}{1+\bar{\tau}_S - \Delta_S}(1-\theta)\left(\frac{K}{N}\right)^{\theta},$$

the government budget constraint rewrites

$$(\bar{\tau}_C + \Delta_C)C + \frac{\bar{\tau}_N + \bar{\tau}_S - \Delta_S}{1+\bar{\tau}_S - \Delta_S}(1-\theta)Y + \tau_A rK = \bar{T} + \bar{G} + (1-\tau_A)r\bar{B}.$$

Rearranging this equation yields

$$\Delta_S = \frac{(\bar{\tau}_N + \bar{\tau}_S) - (1+\bar{\tau}_S)Z}{1-Z},$$

where we defined

$$Z \equiv \frac{\bar{T} + \bar{G} + (1-\tau_A)r\bar{B} - [(\bar{\tau}_C + \Delta_C)C + \tau_A rK]}{(1-\theta)Y}.$$

Using these, we can compute Δ_S and back out the real wage w.

Thus, given (r, N), we can compute $w(r, N)$. Since $\bar{T}$ is already known, we have all the required ingredients for solving the individual problem. Once this is achieved, we can compute the steady-state density associated with the decision rule on assets f and we can compute the aggregate supply of assets $A(r,N)$ and the aggregate labor supply $N^s(r,N)$.

Using this, we can form the excess demands on the asset and labor markets

$$E_A(r,N) = K(r,N) + \bar{B} - A(r,N),$$

$$E_N(r,N) = N - N^s(r,N).$$

If $E_A(r,N)$ and $E_N(r,N)$ are both sufficiently close to 0 we can stop. Else, we update (r,N) and repeat the whole process all over again.

B Proof of Proposition 1

In the RA model, the steady-state system is

$$C + \delta K + G = K^\theta (\Omega H)^{1-\theta}, \tag{B.1}$$

$$r + \delta = \theta \left(\frac{K}{\Omega H}\right)^{\theta-1}, \tag{B.2}$$

$$w = \frac{1}{1+\bar{\tau}_S - \Delta_S}(1-\theta)\Omega\left(\frac{K}{\Omega H}\right)^{\theta-1}, \tag{B.3}$$

$$C^{-\sigma}\frac{1-\tau_N}{1+\bar{\tau}_C+\Delta_C} w = \nu H^\eta, \tag{B.4}$$

$$\beta[1+(1-\tau_A)r] = 1, \tag{B.5}$$

$$(\bar{\tau}_C + \Delta_C)C + (\tau_N + \bar{\tau}_S - \Delta_S)wH + \tau_A r K = (1-\tau_A)rB + G + T. \tag{B.6}$$

Equation (B.1) is the economy's resource constraint. Equation (B.2) and (B.3) are the representative firm's first order conditions for profit maximization. Equation (B.4) is the representative household's first order condition on labor supply. Equation (B.5) is the Euler equation on capital. Finally, Equation (B.6) is the revenue-neutrality constraint on the fiscal reform.

Equations (B.2) and (B.5) imply that r and K/H are invariant to the reform. Combining Equations (B.3) and (B.4), we obtain

$$(1-\tau_N)C^{-\sigma}(1-\theta)\Omega\left(\frac{K}{\Omega H}\right)^{\theta-1} = \nu H^\eta(1+\bar{\tau}_C+\Delta_C)(1+\bar{\tau}_S-\Delta_S).$$

Differentiating this equation with respect to Δ_C in the neighborhood of the initial steady state with $\Delta_C = 0$, we obtain

$$\frac{1}{1+\bar{\tau}_S}\frac{\partial \Delta_S}{\partial \Delta_C} - \frac{1}{1+\bar{\tau}_C} = \sigma \frac{\partial \log(C)}{\partial \Delta_C} + \eta \frac{\partial \log(H)}{\partial \Delta_C}$$

Now, using the fact that the ratio K/H is invariant to the reform, differentiating Equation (B.1) with respect to Δ_C in the neighborhood of the initial steady state with $\Delta_C = 0$, we obtain

$$\frac{\partial \log(C)}{\partial \Delta_C} = \frac{1-\delta s_K}{s_C}\frac{\partial \log(H)}{\partial \Delta_C},$$

where we defined $s_K \equiv K/Y$ and $s_C \equiv C/Y$, both evaluated in the initial steady state. Substituting above yields

$$\frac{1}{1+\bar{\tau}_S}\frac{\partial \Delta_S}{\partial \Delta_C} - \frac{1}{1+\bar{\tau}_C} = \left(\frac{1-\delta s_K}{s_C}\sigma + \eta\right)\frac{\partial \log(H)}{\partial \Delta_C}.$$

Rearranging Equation (B.6), we obtain

$$(\bar{\tau}_C + \Delta_C)C + \frac{\tau_N + \bar{\tau}_S - \Delta_S}{1+\bar{\tau}_S - \Delta_S}(1-\theta)\Omega\left(\frac{K}{\Omega H}\right)^{\theta} H + \tau_A r K = (1-\tau_A) r B + G + T$$

Differentiating this equation with respect to Δ_C in the neighborhood of the initial steady state with $\Delta_C = 0$, we obtain

$$s_C + S\frac{\partial \log(H)}{\partial \Delta_C} = \frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\frac{1}{1+\bar{\tau}_S}\frac{\partial \Delta_S}{\partial \Delta_C},$$

where we defined

$$S \equiv \bar{\tau}_C(1-\delta s_K) + \frac{\tau_N + \bar{\tau}_S}{1+\bar{\tau}_S}(1-\theta) + \tau_A r s_K.$$

Thus

$$s_C - \frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\frac{1}{1+\bar{\tau}_C} = \left(\frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\left(\frac{1-\delta s_K}{s_C}\sigma + \eta\right) - S\right)\frac{\partial \log(H)}{\partial \Delta_C}$$

We conclude that the reform has a positive impact on the equilibrium labor supply if and only if

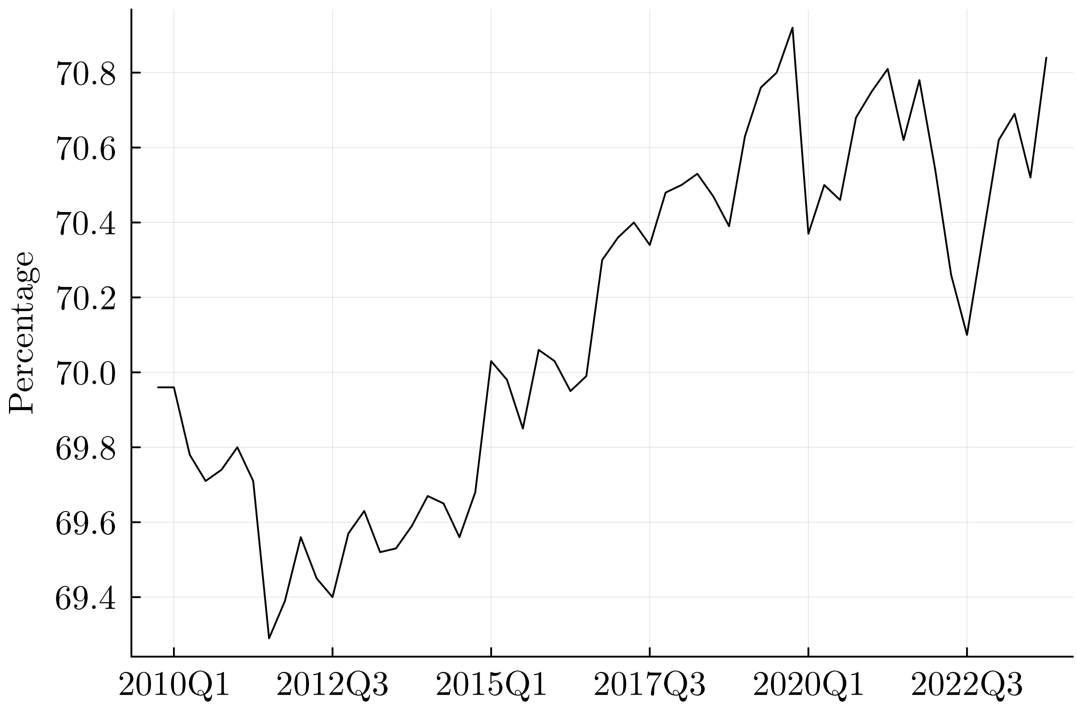
$$\text{sign}\left((1+\bar{\tau}_C)s_C - \frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\right) = \text{sign}\left(\frac{1-\tau_N}{1+\bar{\tau}_S}(1-\theta)\left(\frac{1-\delta s_K}{s_C}\sigma + \eta\right) - S\right).$$

C Historical Path of Gini Coefficient on Net Wealth

To illustrate the size of the impact of the fiscal rebalancing reform on the Gini coefficient of the wealth distribution, we extract historical data from the ECB's *Distributional Wealth Accounts* showing the dynamics of this coefficient over the period 2009Q4–2023Q3.

Figure C.1 shows the result.

Figure C.1: Gini Coefficient on Net Wealth



Note: The Gini coefficient is reported in percentage, and is extracted from the ECB Distributional Wealth Accounts.

D Transition

The transition between the pre- and post-reform steady states is computed as follows. As is usual, we assume that (i) the economy is in the pre-reform steady state in period $t = 0$; (ii) the fiscal rebalancing policy is implemented in period $t = 1$; (iii) the transition takes a finite number of periods $T^s = 250$. In practice, we assume that from period $t = T^s + 1$ on, the economy has reached the post-reform steady state.

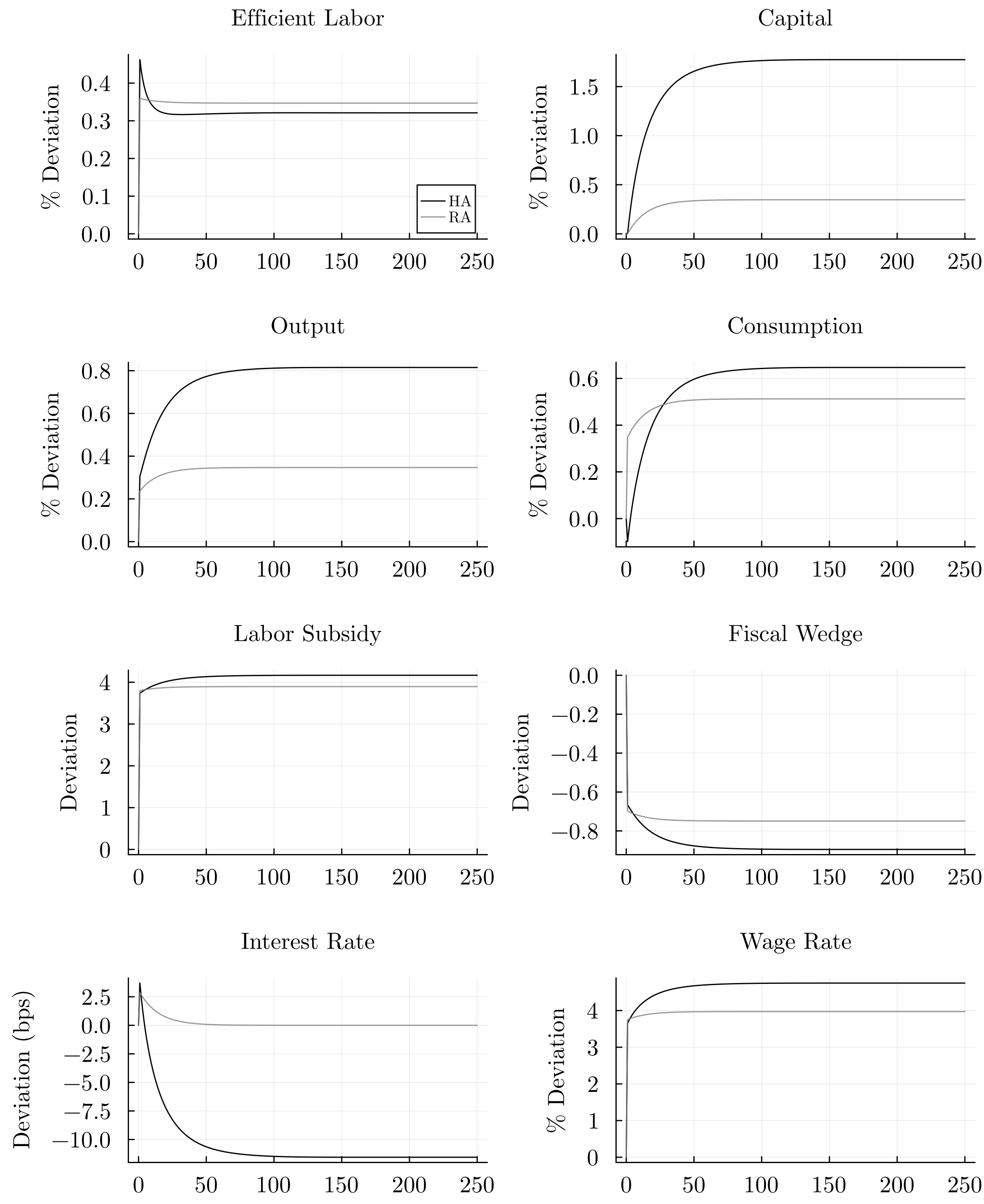
Next, we compute three $T^s \times 1$ vectors of residuals associated with three inputs (in the parlance of Auclert et al. 2021) : $T^s \times 1$ paths for consumption, capital, and efficient labor. The $3T^s \times 1$ vector of residuals is denoted $F(X)$, where X is a $3T^s \times 1$ vector stacking the paths of consumption, capital, and efficient labor. We compute the Jacobian of F in the neighborhood of the post-reform steady state, which we denote $\mathscr{J}$. Given a vector $X^{(0)}$, we update our guess using the quasi-Newton scheme

$$X^{(k+1)} = X^{(k)} + \mathscr{J}^{-1} F(X^{(k)}).$$

We stop the process whenever $\|F(X^{(k)})\| < \epsilon_F$ and $\|X^{(k+1)} - X^{(k)}\| < \epsilon_X$, where ϵ_F and ϵ_X are pre-set numerical tolerances.

Figure D.1 shows the transition of key macroeconomic variables after a fiscal rebalancing reform with $\Delta_C = 3$ percentage points.

Figure D.1: Transtion

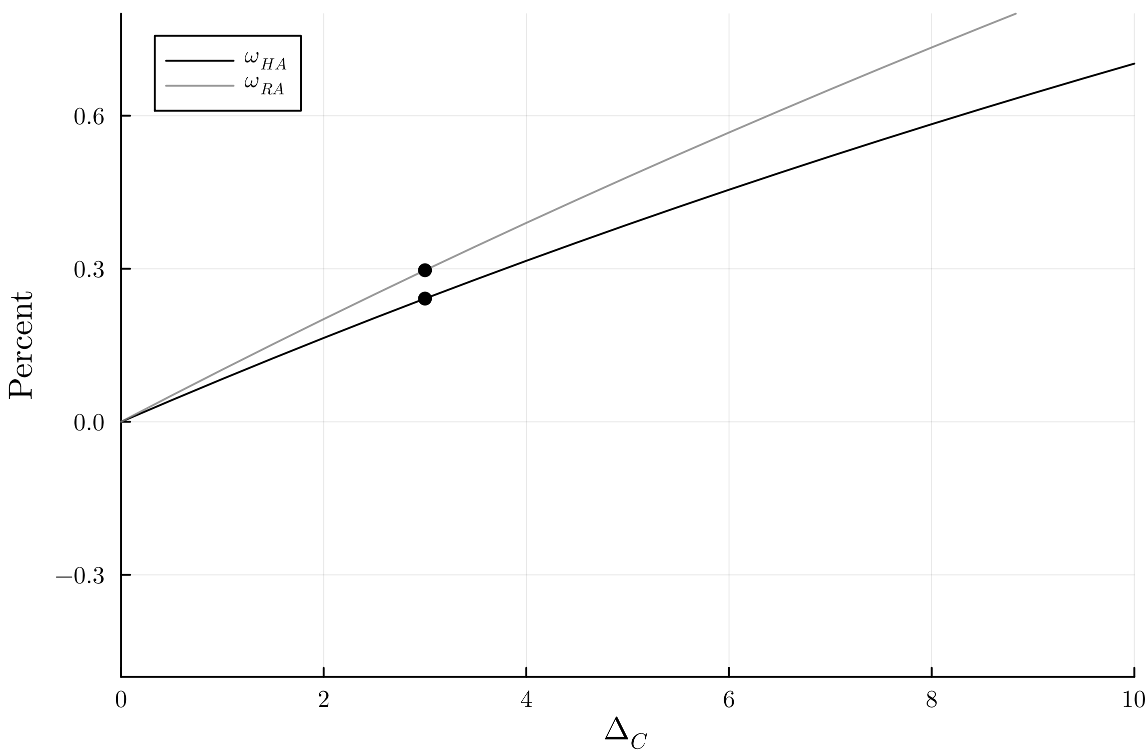


Note: Transition triggered by a fiscal rebalancing reform with $\Delta_C = 3$ percentage points. The dark curves correspond to the HA economy and the grey curves to the RA economy. Efficient labor, capital, output, consumption, and wages are reported in percentage deviation relative to their pre-reform value. The labor subsidy and the fiscal wedge are reported as deviations from their initial values, stated in percentage points. The interest is reported as a deviation stated in basis points.

E Welfare Analysis under Alternative Calibration of Individual Productivity Process

In this section, we redo the welfare calculations using the alternative process for individual productivity proposed by Fonseca et al. (2023). We proceed as before, i.e., for each considered value for Δ_C, we compute the transition between the pre-reform and the post-reform steady states. We then compare the value functions before and after the reform, as in Section 4.

Figure E.1: Welfare Cost/Gain of fiscal rebalancing for Alternative Values of Δ_C



Note: The black line corresponds to the Utilitarian welfare gain/cost ω_{HA} in the HA economy, given in Equation (4). The grey line corresponds to the welfare gain/cost in the RA economy, given in Equation (3). For each value of Δ_C, we compute the transition between the initial steady state and its post-reform counterpart, from which we compute ω_{HA} and ω_{RA}. The black dot indicates the benchmark reform with $\Delta_C = 3$ percentage points.

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