Budget neutral reduction in capital tax

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Abstract

We evaluate the consequences of a budget neutral reduction in capital taxation on both aggregate level and the wealth distribution. Based on a theoretical standpoint, we examine the macroeconomic and distributional effects of a budget neutral decrease in the capital income tax financed with an increase in the labour income tax, in a heterogeneous agents model with incomplete market and stochastic employment opportunity. While this policy is economy enhancing on the long-run, it is the contrary on the short-run. The distributional effects are different along the transition: while the reform is a progressive redistribution in the long-run towards the poorest, it provokes a widening of wealth concentration and inequality on impact, when the wealth of the first and second quintiles decreases and the richest benefit of the drop in capital taxation.

Keywords : Fiscal Policy, Heterogeneous Agents, Wealth Redistribution

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1 Introduction

Since the financial crisis, most developed countries have faced a worsening of their economic situation, facing an increase in inequality while the sustainability of their public debt has been questioned.

Consequently, euro area countries have implemented important macroeconomic reforms to answer the issues triggered by the crisis. In this context, fiscal policies and especially budget neutral tax reforms have become a serious option. Indeed, these fiscal reforms are often considered as a tool for redistribution toward the poorest individuals while avoiding the deterioration of public finance.

As shown in many papers, the aggregate effects of fiscal policies have been widely studied (Heathcote [2005], Domeij and Heathcote [2004], d'Autume [2007], Garcia-Milà et al. [2009]), the dynamic consequences on inequality and wealth distribution is not yet well understood. This paper contributes to fill this gap by asking what are the effects of a reduction in capital income tax financed by an increase in labour income tax on the wealth distribution and inequality not only in a steady state analysis, but also along the transition. To do so, we focus on a recent policy implemented in France, affecting capital income taxation. However, this paper is not built as a strict evaluation of the consequences of a specific fiscal reform, but as a theoretical exercise to assess the impacts of a rigorous budget neutral decrease in capital income tax financed by an increase in labour income taxation.

This question triggers crucial aspects in policy evaluation, such as the temporality and acceptability. Indeed, as highlighted by the 2018-2019 strikes in France, long-run positive impacts are not sufficient to justify the implementation of a policy if it comes to a greater cost on the short-run, triggering a sense of injustice, especially for the poorest individuals.

To analyse this question, we use as a baseline model, a heterogeneous agents framework, matching data in the French economy, with incomplete markets, uninsured idiosyncratic labour income risk as in Bewley [1986], Huggett [1993], Aiyagari [1994] and endogenous labour choice. The inclusion of heterogeneity with incomplete markets and stochastic employment opportunity allows us to study the distributional consequences, taking into account precautionary saving behaviours, which are crucial in the analysis of

the response to a tax policy.

To solve this problem, we use the method developed recently by Achdou et al. [2017], solving heterogeneous agents problems in continuous time using a set of two partial differential equations.

Our main results can be summarized as follows. Firstly, the behaviour of aggregate variables is consistent with what is generally accepted in the literature. On the long-run, the drop in capital income taxation has an overall positive impact on the economy. By opposition, on impact, the reform is mainly negative, as the capital stock is fixed, the only mechanism affecting the aggregates is the increase in labour income taxation, reducing the consumption, hours worked and the production.

However, the core results of this paper concentrate on the wealth distribution dynamics and inequality. The policy leads to opposite results regarding long-run and short-run consequences. On the short-run, the poorest individuals (the 1^{st} and 2^{nd} quintile) are negatively impacted while the wealthiest part of the distribution benefits from the policy in terms of wealth accumulation. One of the causes of the decrease in wealth for the poorest individuals is mainly driven by a reduction in precautionary savings. Nonetheless, it is no longer the case when we investigate the long-run consequences. Indeed, a budget neutral reduction in the capital tax rate leads to a progressive redistribution of wealth. The wealthiest an individual is, the least he gains from the policy in terms of wealth but the most in terms of consumption.

Related Literature A wide range of papers in the literature has analysed the aggregate and distributional effects of changes in fiscal policy. Firstly, numerous papers have studied what should be the optimal tax rates, especially for capital taxation. Papers by Judd [1985] and Chamley [1986] have shown that it is optimal to set capital tax rate at zero, and this result was also valid when switching to heterogeneous agents. However, more recent studies, introducing a wide range of heterogeneity has proven the contrary. d'Autume [2007] showed that the optimal constant capital tax should be much bigger than zero, especially when introducing two different types of households, employees and capitalists. The main results obtained, studying different fiscal scenarios, show that, in a representative agent framework, optimal capital taxation is close to zero but, with the introduction of heterogeneity, this tax rate almost reaches 20 %. Conesa et al. [2009] has confirmed this result, also in a heterogeneous framework proving that optimal labour and

capital taxation have to be positive. Some papers, have also studied some budget neutral reforms, as Barro [1974], who predicts an equivalence in prices and allocations for all time path of taxes implying the same decrease in tax revenues in a representative agents framework, and Bussière et al. [2017] who show that different neutral reforms can be growth enhancing but affect differently constrained and unconstrained individuals Other papers have studied the aggregate impacts of a change in fiscal policy. Heathcote [2005], who studied the impact of switching labour and capital taxation between two values to maintain public debt in a predefined bandwidth, has shown that deviation from the Ricardian Equivalence and temporary fiscal changes can have a large impact on aggregate variables. More recently, Kaymak and Poschke [2016] investigates macroeconomic and distributional impacts of progressive wealth taxes.

Closest papers to our work are Domeij and Heathcote [2004], Correia [2010], Garcia-Milà et al. [2009] and Dyrda and Pedroni [2018]. Domeij and Heathcote [2004] investigates the welfare gain of capital tax reduction. Indeed, their main finding is that while a capital tax cut implies welfare gains in a representative agent economy, it leads to welfare losses for most of the households in a heterogeneous agents economy. However, they do not look at the dynamic effect of such policy on wealth distribution, this difference being the heart of our contribution to the literature.In Garcia-Milà et al. [2009], they investigate the consequences of shifting capital taxation to labour under complete markets in the long-run. The main difference with our paper is that they do not consider the impact of such policy along the transition for the distribution and neglect the consequences of incomplete market introduction. Similarly, the paper by Dyrda and Pedroni [2018] investigates what should be the optimal path for capital and labour taxation when a social planner care for redistribution and equality. Finally, Correia [2010] finds that an increase in consumption taxes simultaneous to a decrease in labour taxes has positive distributional effects compared to an equivalent system with capital taxes and labour taxes.

The rest of the paper is organized as follows. In Section 2 we present the different elements in our baseline economy. Section 3 deals with the properties of our model, presenting the calibration and how our model succeeds to reproduce key moments in the French economy. Section 4 presents how our budget neutral policy capital tax reduction is implemented as well as the aggregate and distributional results of the paper. This

section also contains robustness elements, where we consider some alternate assumptions regarding our baseline model. Finally, Section 5 concludes.

2 Model

As a baseline economy, we use a Aiyagari-based economy with a continuum of heterogeneous agents with endogenous labour choice. Sources of households' heterogeneity rely on individual wealth and stochastic employment opportunity. There is a representative firm using both capital and labour to produce. Finally, government finances its spending using capital and labour taxation and government debt.

2.1 Households

The economy is composed of a continuum of infinitely-lived heterogeneous agents maximizing their intertemporal utility function, discounted at rate $\rho > 0$ and subjected to their individual budget constraint.

$$E_0 \int_0^\infty e^{-\rho_t} u\left(c_{ijt}, n_{jt}\right) dt, \tag{1}$$

Households' utility function depends on c_{ijt}, the individual consumption (with the indices i, j and t being respectively, the individual wealth, labour status and time) and n_{jt} is either individual labour supply or a fixed amount of time looking for a job (denoted e later on) if the individual is unemployed. We assume that the period utility function is a GHH function[1] given by

$$u\left(c, n\right) = \frac{1}{1-\sigma}\left(c - \psi \frac{n^{1+1/\epsilon}}{1+1/\epsilon}\right)^{1-\sigma},$$

with $\sigma > 0$, the parameter driving the coefficient of relative risk aversion, ψ the labour disutility and $\epsilon > 0$, the Frisch elasticity of labour supply.

The different sources of heterogeneity between agents are simultaneously driven by individual asset levels and employment statuses. The first level of heterogeneity is through individual wealth, based on asset holdings, denoted a_{ijt}.

A second layer of heterogeneity is generated through idiosyncratic uncertainty. Following a Poisson process, labour income switches between three labour market status,

[1] As wealth effects are small (cf Chetty et al. [2013]), we use the GHH utility function for simplicity

each individual being either employed or unemployed. Exogenous transition rates $\lambda_{j,U}$ and $\lambda_{U,j}$ denote respectively the job separation and finding rate between unemployment (state "U") and employment (with productivity z_j). Consequently, the proportion of individuals in each "state" remains fixed over time. We firstly describe the different sources of income for the employed individuals before presenting the unemployed's ones. Employment status is split in two different cases, low and high productivity jobs, denoted respectively hereafter as "bad-jobs" and "good-jobs". An individual having a good-job is granted with productivity z_G while those with a bad-job are with z_B, with $z_G > z_B$.

The evolution of the individual wealth depends on both labour and capital income. The labour income for an employed agent is a function of the productivity z_j, the individual labour supply n_{jt}, the wage w_t and is taxed at rate τ_{Wt}. Employed agents also receive capital income, based on their individual wealth, remunerated at rate $(1-\tau_{Kt})r_t$, where r_t is the equilibrium interest rate and τ_{Kt} the capital tax rate. Finally, the level of assets held by each individual is also ruled by the borrowing constraint $a \geq \underline{a}$, where $-\infty < \underline{a} < 0$. Then, the budget constraint of an employed agent ($j = B, G$) is

$$\dot{a}_{ijt} = (1-\tau_{Wt}) w_t z_j n_{jt} + (1-\tau_{Kt})\, a_{it}\, r_t - c_{ijt}, \tag{2}$$

Thus, the optimal decision rule of an employed agent with wealth a and productivity z_j, is driven by a Hamilton-Jacobi-Bellman (HJB) equation and a state-constraint boundary condition such that

$$\rho V(a, z_j, t) = \max_{c,n} u(c,n) + \partial_a V(a, z_j, t)\ [(1-\tau_{Wt}) w_t z_j n\ + (1-\tau_{Kt})\, a\, r_t\ - c] + \lambda_{j,U}\left(V(a, U, t) - V(a, z_j, t)\right) + \partial_t V(a, z_j, t) \tag{3}$$

$$\partial_a V(\underline{a}, z_j, t) \geq u_c'\left((1-\tau_{Wt}) w_t z_j n\ + (1-\tau_{Kt})\, \underline{a}\, r_t\right) \tag{4}$$

From the maximization program, we obtain the first order condition :

$$u_c'(c_t, n_t) = \partial_a V(a, z_j, t) \tag{5}$$

$$u_n'(c_t, n_t) = -\partial_a V(a, z_j, t)\,(1-\tau_{Wt})\, w_t z_j \tag{6}$$

With GHH utility function, these two first order conditions translate into an individual supply curve of the form

$$n_{jt} = \left[\frac{z_j w_t\,(1-\tau_{Wt})}{\psi}\right]^{\epsilon}. \tag{7}$$

The third labour situation is unemployment. An unemployed individual receives benefits b, this grant being fixed over time and not linked to the previous income [2].

$$\dot{a}_{ijt} = b + (1 - \tau_{Kt})\, a_{ijt}\, r_t - c_{ijt}$$

Similarly to the employed agent problem, the optimal decision rule of an unemployed with wealth a, is driven by a Hamilton-Jacobi-Bellman (HJB) equation and a state-constraint boundary condition such that

$$\rho V(a,U,t) = \max_c u(c,e) + \partial_a V(a,U,t)\ [b + (1-\tau_{Kt})\, a\, r_t - c] + \lambda_{U,G} V(a,z_G,t) + \lambda_{U,B} V(a,z_B,t) - (\lambda_{U,G} + \lambda_{U,B}) V(a,U,t) + \partial_t V(a,U,t) \quad (8)$$

$$\partial_a V(\underline{a},U,t) \geq u_c'(b + (1-\tau_{Kt})\, a\, r_t) \quad (9)$$

2.2 Firms

There is a representative firm with a Cobb-Douglas production function maximizing its profit Π_t with respect to aggregate capital K_t and labour N_t

$$\Pi_t = A K_t^{\alpha} N_t^{1-\alpha} - w_t N_t - (\delta + r_t) K_t, \quad (10)$$

with δ, the quarterly capital depreciation rate, and $\alpha \in [0,1]$, the capital share in the production function. Firm's equilibrium conditions are given by :

$$r_t = \alpha A K_t^{\alpha-1} N_t^{1-\alpha} - \delta \text{ and } w_t = (1-\alpha)\, A K_t^{\alpha} N_t^{-\alpha} \quad (11)$$

2.3 Government

The government uses taxes on capital and labour income to finance public spending, unemployment benefit, the debt and its interest. Therefore, government budget constraint satisfies

$$\dot{B}_t + G_t + r_t B_t + b\, \bar{U} = \tau_{Kt} r_t A_t + \tau_{Wt} w_t N_t, \quad (12)$$

with $\bar{U}$ the proportion of unemployed agents and b the unemployment benefit, A_t the aggregate wealth in the economy, G_t the public spending and B_t the level of government

[2] More detailed later on, see Calibration.

debt. However, in our framework, we consider only a budget neutral policy. Consequently, for any change in tax rates, the level of government debt and public spending remain unchanged. Thus, the government's constraint becomes

$$G + r_t B + b\,\bar{U} = \tau_{Kt} r_t A_t + \tau_{Wt} w_t N_t \tag{13}$$

2.4 Equilibrium

An equilibrium is a sequence of individual decisions $(a_{ijt}, c_{ijt}, n_{jt})$, wage w_t, interest rate r_t, fiscal instruments $(\tau_{Kt}, \tau_{Wt}, G_t, B_t)$, the distributions $(g_B(a,t), g_U(a,t), g_G(a,t))$ and aggregate variables, such that, for t $\in [0; \infty]$:

• Households choose a, c and n to solve their maximization program and such that boundary constraints hold,

• Given the solution of the household's maximization program, distributions satisfy

$$\frac{\partial g(a,t)}{\partial t} = -\frac{\partial [s(a,t)g(a,t)]}{\partial a} + \Lambda^T g(a,t), \text{ with } g\,(a,t) = \begin{bmatrix} g_B(a,t) \\ g_U(a,t) \\ g_G(a,t) \end{bmatrix}, \tag{14}$$

$g_B(a,t), g_U(a,t), g_G(a,t)$ being the joint distribution of wealth a and income respectively in a "bad-job", unemployed and "good-job", with $\iint_{\underline{a}}^{\infty} g_j(a,t)dadj = 1$ and Λ^T the transition matrix between labour status. Hereby, $\bar{B}$, $\bar{U}$ and $\bar{G}$ are the fixed proportion of individuals in each labour status such that

$$\bar{B} = \int_{\underline{a}}^{\infty} g_B(a)da,\ \bar{U} = \int_{\underline{a}}^{\infty} g_U(a)da \text{ and } \bar{G} = \int_{\underline{a}}^{\infty} g_G(a)da.$$

• The distributions allow consistency between aggregate variables (A_t, C_t) and individual decisions,

$$A_t = \int_{\underline{a}}^{\infty} a dG_B(a,t) + \int_{\underline{a}}^{\infty} a dG_U(a,t) + \int_{\underline{a}}^{\infty} a dG_G(a,t) \tag{15}$$

$$C_t = \int_{\underline{a}}^{\infty} c_{B,t} dG_B(a,t) + \int_{\underline{a}}^{\infty} c_{U,t} dG_U(a,t) + \int_{\underline{a}}^{\infty} c_{G,t} dG_G(a,t) \tag{16}$$

• The government budget constraint (Eq. 13) holds ,

• And all market clearing conditions are satisfied, so that :

$$A_t = B_t + K_t \tag{17}$$

$$N_t = \bar{B} n_B z_B + \bar{G} n_G z_G \tag{18}$$

$$Y_t = C_t + I_t + G_t \tag{19}$$

3 Properties of the model

3.1 Calibration

In this paper, we seek to evaluate the effect of a budget neutral reduction in the capital tax rate compensated by an increase in labour income taxation. To deal with this question, our model is calibrated to match key macroeconomic and distributional elements in the French economy between 1995 and 2017, where the model's period is a quarter. Table 1 summarizes the calibration.

Definition & Parameters	Values	Sources
Rate of Time Preference ρ	0.01	Prescott [1986]
Coefficient of Relative Risk Aversion σ	2	Attanasio [1999]
Labour disutility ψ	55	Calibrated
Frisch Labour supply elasticity ϵ	0.3	Heathcote [2005]
Capital Share α	0.33	Insee
TFP scale parameter A	1	-
Capital Depreciation δ	0.025	Prescott [1986]
Ratio of good job wage to bad job wage z_G/z_B	1.6	Algan et al. [2003]
Time for search activity e	0.3317	Algan et al. [2003]
Unemployment Insurance Replacement Rate μ	0.7	Hairault et al. [2012]
Job finding rate ϕ	0.2	Insee
Probability of "good-job" offer ξ	$0,054$	Algan et al. [2003]
Job destruction rate "good" job λ_{gu}	0.0069	Algan et al. [2003]
Job destruction rate "bad" job λ_{bu}	0.020	Calibrated
Share of Output for Public Spending ξ	28.68	Calibrated
Tax rate of labour income τ_w	39%	Eurostat
Tax rate of Capital before policy τ_{K1}	44%	Eurostat

Table 1: Summary of calibration

3.1.1 Preferences

Main preferences parameters are set using standard values in the literature. The rate of time preference ρ is set to 0.01 which corresponds to a yearly subjective discount rate of 4%. The parameter that determines the coefficient of relative risk aversion σ is set to 2 since the empirical literature (see Attanasio [1999]) has estimated risk-aversion coefficient between one and three. The Frisch labour supply elasticity is set to 0.3 following Heathcote [2005] and corresponds to estimates of Frisch elasticities for male labour supply that range between 0 and 0.5 (Domeij and Floden [2006]). The labour disutility ψ is set to 55 to target the aggregate labour the value of 0.33 in steady-state. As in the macroeconomic literature, we assume people are working a third of their time. The borrowing constraint $\underline{a}$ is exogenously set at around one times average quarterly labour income (as in Kaplan et al. [2018]) .

3.1.2 Production

The parameter α is set to match the capital share in France is roughly around one third of total value added. We normalize A to 1. The depreciation rate δ is set to match a yearly 10% depreciation, as usually in the literature.

3.1.3 Labour Market

To characterize the French labour market, we partly use the calibration described in Algan et al. [2003]. Indeed, based on European Panel Data for the French economy, they compute several key parameters for France around 1995 (the beginning of our time period). Labour market status vary following a three-state Poisson process as described below :

$$\Lambda = \begin{bmatrix} -\lambda_{BU} & \lambda_{BU} & 0 \\ \lambda_{UB} & -(\lambda_{UG} + \lambda_{UB}) & \lambda_{UG} \\ 0 & \lambda_{GU} & -\lambda_{GU} \end{bmatrix} \tag{20}$$

We assume that an individual cannot receive a job offer when he is already on the job, i.e $\lambda_{BG} = \lambda_{GB} = 0$ [3]. In order to compute labour market flow between each type of labour market status, we use the job finding rate $\phi = 0.2$, and the probability that the

[3] In Algan et al. [2003], they assume that it is not possible to search for a job while on the job

job offered is a good one $\xi = 0.054$. We compute the job finding rate of a "good job" and "bad job", which are respectively

$$\lambda_{UG} = \phi\,\xi \text{ and } \lambda_{UB} = \phi\,(1-\xi).$$

The destruction rate for good-jobs λ_{GU}, is set at 0.0069 as done in Algan et al. [2003] and the destruction rate for λ_{BU} is set at 0.02 to reach an unemployment rate of 8% which is close to French data (9%).

We use the results of Algan et al. [2003] who estimate that the average good job wage is 1.6 times the average bad-job wage. Following them, we define a good-job as a job for which the wage is above the median. So, we normalize $z_B = 1$ and set $z_G = 1.6$. Unemployed agents devote 0.3317 of their time to search activity e as in Algan et al. [2003]. Following Hairault et al. [2012], we set the replacement rate at $\mu = 0.7$. The benefit for unemployed agents is then computed as a fraction μ of the net weighted average wage before any changes in taxation rates. Thus, we obtain $b = \mu(1-\overline{\tau}_W)\overline{wn}$. In the baseline economy, we maintain the assumption described in Algan et al. [2003], i.e that unemployment benefit was not tied to the previous wage. They set up this assumption by explaining that as the French labour market provides an extensive access to minimum income, justifying the assumption of constant and unique outside opportunity income. However, we will relax this assumption later on in the robustness section and consider an alternative model where the unemployment benefit fluctuates and is tied to the previous period labour income.

3.1.4 Government

Capital and labour tax rates are respectively set to 44 % and 39 %, their implicit rates from Eurostat for the French economy. We calibrate the ratio of public spending on output to match the public debt/output ratio (75 % (OECD)). We obtain a ratio public spending on output of 29 %, which is close to the data (31 %, excluding social protection spending (OECD)) as indicated in Table 2.

3.2 Properties of the baseline model economy

This section looks at the properties of aggregate variables and wealth distribution in the baseline model economy in the initial steady-state, compared with different key values

for France on the period 1995Q1-2017Q4.

3.2.1 Aggregate Variables

In Table 2, we gather aggregates variables, hours worked and the unemployment rate, for both the values observed in the data for the French economy[4] and our benchmark model economy. Our model manages to reproduce key statistics observed in the data for the French economy. In the last row of the table, we show average hours worked by individuals with a bad job (B) and average hours worked by individuals with a good job (G). Although, since we have GHH preferences, there is no wealth effect and individuals with a lower wage supply a lower number of hours. Individuals with a bad jobs have a lower wage than those with a good job. Therefore, they supply less working hours.

Statistics	Model	Data	Sources
Investment/Output (%)	20	21	Eurostat
Debt/Output (%)	75	75	Eurostat
Consumption/Output (%)	51	54	Eurostat
Net marginal revenue from capital (%)	0.9	1	OECD
Public Spending/Output (%)	28.7	31	OECD
Unemployment Rate (%)	8.3	9	Eurostat
Hours Worked (hours)	35 (B) / 41 (G)	38	Eurostat

Table 2: Baseline model and data for France - Aggregates

3.2.2 Wealth Distribution

Our model is set to generate a realistic wealth distribution. As shown in Table 3, we successfully reproduce the quintiles of the wealth distribution, the share of individual with negative (or zero) assets as well as a realistic Gini Index. To do so, we managed to build a realistic calibration of labour income process, which is known to play an important role in shaping a realistic distribution as it is shown in Nirei and Aoki [2016]. However, our model is not sufficient to match the Top 1 % of the distribution. Indeed, as shown in

[4]All data collected from Eurostat and OECD concern only the French economy.

Benhabib et al. [2011], bequests, stochastic returns and heterogeneous discount rate are necessary elements to reproduce the right fat-tail of the wealth distribution. Yet, in this paper, the quintiles of the wealth distribution are enough to understand the mechanisms at stake in a tax composition change. We leave the study of the top 1 % for further research.

Proportion of Wealth Held by each Quintile

	Model	Data	Sources (Data)
Statistics			
1^{st} Quintile	0.53 %	0.56%	World Wealth and Inequality Database
2^{nd} Quintile	2.04 %	2.6%	-
3^{rd} Quintile	4.8 %	9.5 %	-
4^{th} Quintile	22.5 %	18.0%	-
5^{th} Quintile	70.1 %	69.2 %	-
Top 1 %	7.4 %	23.8 %	-
Share with $a \leq 0$	8.2 %	6 %	Insee
Gini Coefficient	0.66	0.68	World Wealth and Inequality Database

Table 3: Baseline model and data for France - Wealth distribution

4 The effects of the budget neutral reduction in the capital tax

In this section, we firstly present the consequences of a budget neutral reduction in capital taxation on the aggregate level on both the long-run and along the transition. Then, in a second time, we investigate the consequences on the wealth distribution and inequality dynamic.

4.1 Policy experiment

The government implements a budget neutral tax reduction in the capital income tax, financed by an increase in the labour income tax. The government reduces capital income

taxation from 44% to 30% [5]. Since the tax policy is supposed to be budget neutral, the government adjusts the labour income tax at each period in order to keep the public debt to its initial value. In Domeij and Floden [2006], the capital tax is reduced and the labour tax is simultaneously adjusted in order to maintain long run budget balanced. However, this means that the public debt changes during the transition. Recent literature has shown that the public debt variation has distributional effects (Röhrs and Winter [2017]). In our framework, the tax policy change is budget neutral during the transition in order to offset public debt effects. We solve for the transitional dynamics at a quarterly frequency from 1995q1-2017q4 steady state equilibrium to the one associated with the policy implemented in 2018. To do so, we change the capital tax in the first period. The labour tax is adjusted at each period in order to keep the public to its value in the initial steady state. Figure 1 shows that the government needs to increase the labour tax from 39 % to 42.6 % in the first period. Over time, the labour tax can decrease until a value of 40.4 % in the long run. The capital tax reduction leads to an increase in investment and output that increases the fiscal base and allows the government to alleviate the labour tax in order to keep the public debt constant. We assume that there are no further changes in the institutional environment or the technology of production after 2018. The full trajectory of changes in the environment is announced in 2018 and households are assumed to have perfect foresight over future changes from then on.

4.2 Aggregate Effects

We present, in this subsection, the main results for aggregate variables. We describe the mechanisms behind long-run and dynamics effects of our policy implementation.

The implementation of our budget neutral policy triggers two mechanisms with opposite consequences. On one's hand, the decrease in capital taxation provokes a positive impact on the economy as it raises the net interest rate, which stimulates aggregate investment, production, capital and consumption. On the other side, the rise in labour income taxation triggers a reduction in the net wage, leading to a decrease of labour, production and consumption.

[5] We build on the policy change in France in 2018. In 2011, with a value of 44 %, the effective capital tax was the highest of the European Union. In 2018, the government implemented a flat capital tax of 30 % (a value close to the EU average).

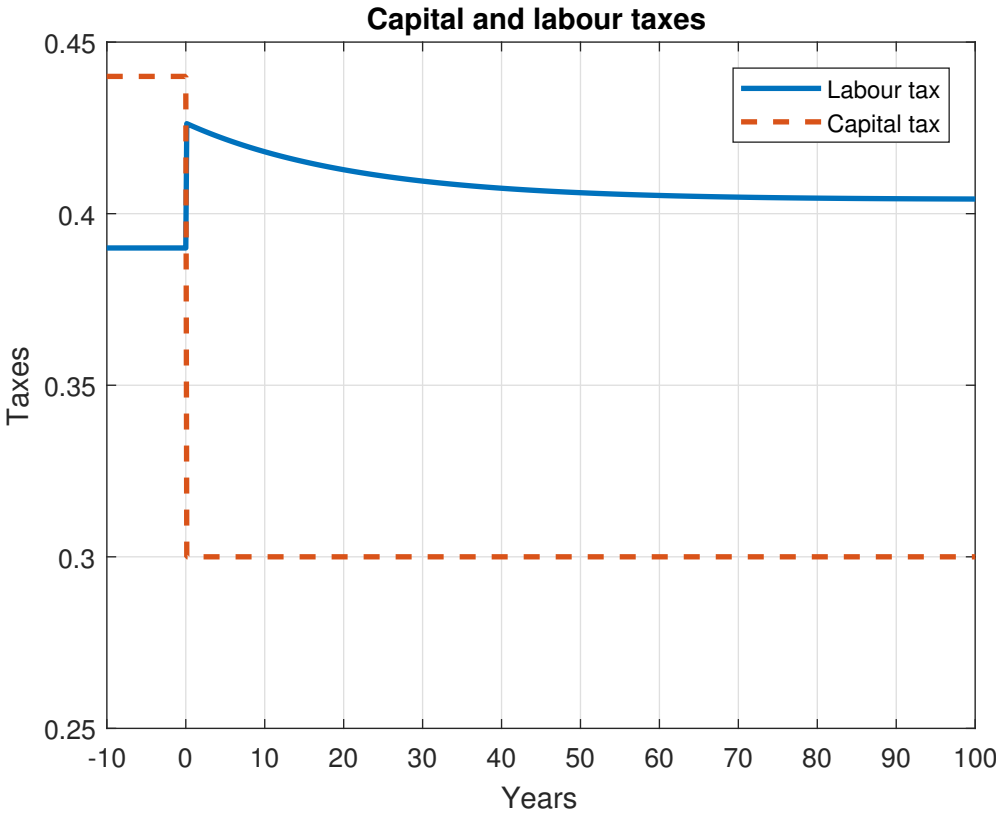

Figure 1: Change in capital and labour tax

These two opposite mechanisms lead to an ambiguous response of aggregate variables. As shown in Figure 2, on impact, all aggregate variables drop except for the net interest rate and investment. Indeed, on impact, as the stock of capital is fixed, the economy does not benefit fully from the the drop in capital income taxation, as it will mainly affect aggregate capital. So, on the very short-run, the overall negative impact of the policy is mainly driven by the increase in τ_{Wt} and the change in τ_{Kt} will only affect aggregate variables through net interest rate and investment.

As soon as the capital adjusts due to the increase in investment, all other aggregate variables such as consumption, output or labour benefit from this increase in capital and progressively go to their new steady state values. These results are similar to what is widely accepted in the literature. As shown in Domeij and Heathcote [2004] and Garcia-Milà et al. [2009], eliminating the capital taxation is economy enhancing in the long run, and mainly driven by the progressive increase in capital. However, we find opposite results concerning the hours worked compared to Garcia-Milà et al. [2009].

The long-run impact of the reform is summarized in Table 4. As expected, the consequences induced by the changes in capital income taxation has the upper hand on the

aggregate level.

Table 4: Steady State Analysis - Aggregates

Change w.r.t Initial Steady State (%)

Prices		**Aggregates**	
Variables	Impact	Variables	Impact
Wage	3.98	**Output**	4.45
Net Wage	1.51	**Labour**	0.45
Interest Rate	-19.30	**Consumption**	3.57
Net Interest Rate	0.88	**Capital**	12.93

4.3 Distributional Effects

Our main results concern the distributional effects of the tax policy. Figure 3 displays the change in the wealth level of each quintile of the wealth distribution following this tax policy. The tax change leads to a short run distributional pain and a long run distributional gain. In the short run, the wealth level decreases for individuals at the bottom of the distribution (for the 1^{st} and 2^{nd} quintile) and increases for individuals at the top of the distribution (from the 3^{rd} to the 5^{th} quintile). In the long run, the tax policy is regressive because the wealth gain of the poor is higher than the wealth gain of the wealthy.

4.3.1 Mechanisms

In the short run, the wealth of individuals at the bottom of the distribution decreases because individuals reduce their precautionary savings in reaction to a lower potential income loss. In the long run, the wealth increases more for the poor than for the wealthy because the income gain for the poor represents a higher share of initial wealth than for the wealthier.

Three elements help to understand the wealth change over time: an income elements (IE), an intertemporal elasticity of substitution elements (SE) and a precautionary saving elements (PS).

The income, the intertemporal elasticity of substitution and the precautionary saving

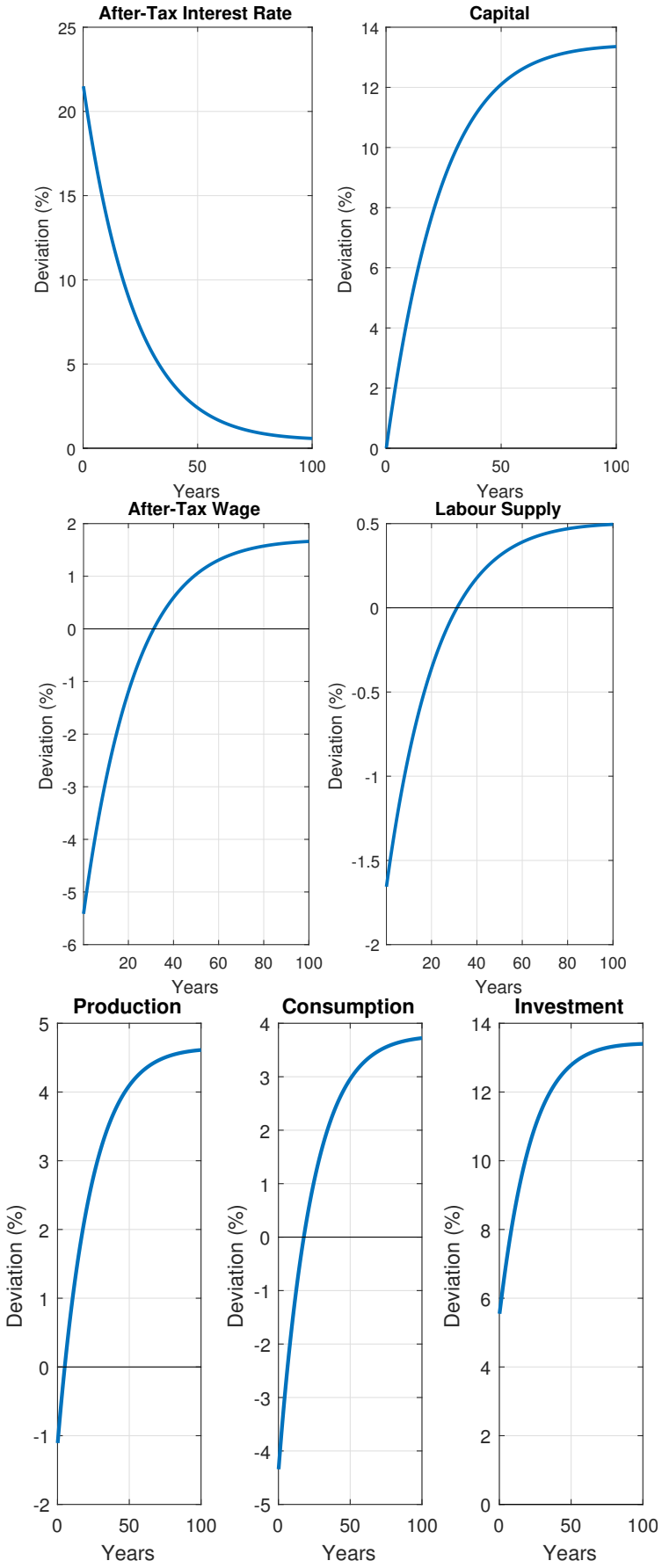

Figure 2: Change w.r.t Initial SS - IRF

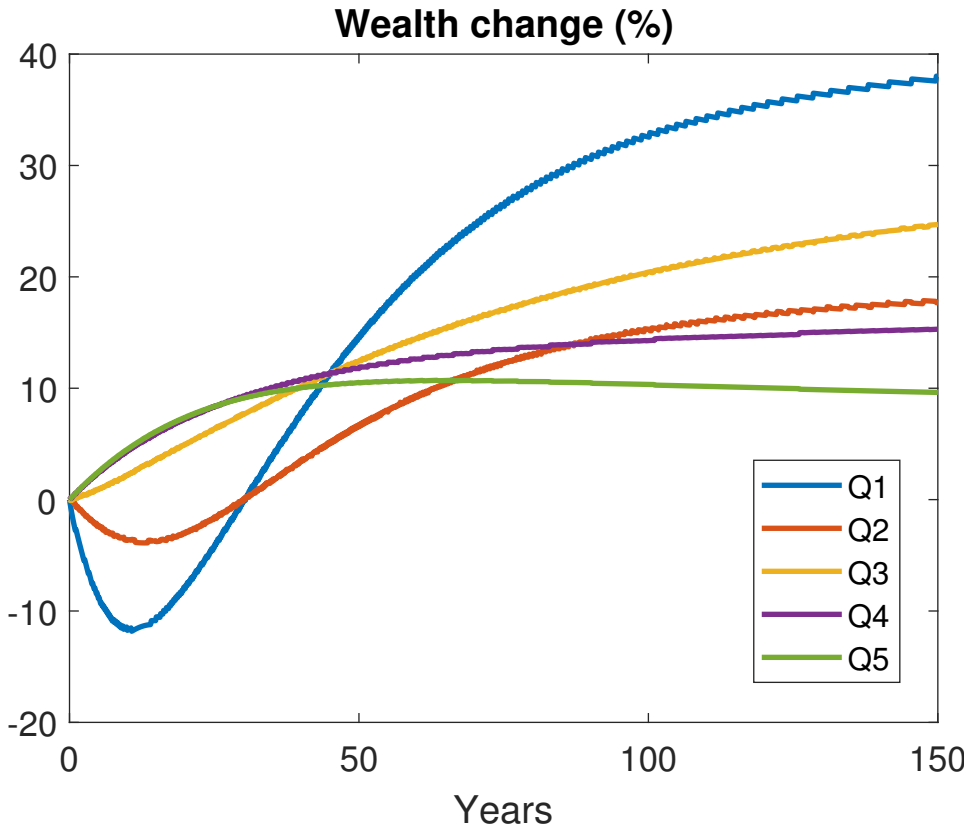

Figure 3: Change in the wealth level, by quintile

elements, which determine the individual consumption choice, are heterogeneous across the wealth distribution and across labour market status. Figure 4 shows the amount of each of these elements as a percentage of the income for individuals at the upper bound values of the 1^{st} to the 4^{th} quintile for each labour market category. We consider these elements as contributions to the consumption since the sum of these elements equals consumption.

Figure 4 shows that unemployed consume more than their income through precautionary saving mechanisms (in grey) and intertemporal elasticity of substitution (in black). Precautionary saving occurs in response to the probability to get employment opportunity shocks. Unemployed can only face positive income shocks by getting a job and know that their future potential income is higher. Therefore, they use their wealth in order to consume more than the income they earn today. Besides, the intertemporal elasticity of element leads them to consume more because of preference for consumption today.

The unemployed at the 20^{th}, 40^{th}, 60^{th}, and 80^{th} percentiles consume respectively 139 %, 142 %, 145 % and 137 % of their net income. The PS element depends on the wealth level as it is determined by the marginal propensity to consume and the potential

income gain. The marginal propensity to consume is higher for individuals close to the borrowing constraint. The amount of consumption increases highly with the wealth level when individuals move off the borrowing constraint and, therefore, the PS element increases with wealth. For individuals above the 60^{th} percentile, the marginal propensity to consume is lower and the potential income gain has a higher weight in the consumption choice. The potential income gain decreases with wealth. Therefore, for individuals above the 60^{th} percentile, the PS element decreases with wealth.

At the 20^{th}, 40^{th}, 60^{th}, and 80^{th} percentiles, individuals with a bad job consume respectively 98 %, 99 %, 103 % and 104 % of their net income and individuals with a good job consume respectively 82,7 %, 83.2 %, 85,0 % and 88,4 % of their net income. Through the precautionary saving element, some individuals consume less than the income they earn because they face a potential income loss. As explained above, this element decreases with wealth. For individuals above the median, those with a bad job consume more than the income they earn because the precautionary element is small compared to the substitution element. All individuals with a good job consume less than their income because they all face a potential income loss.

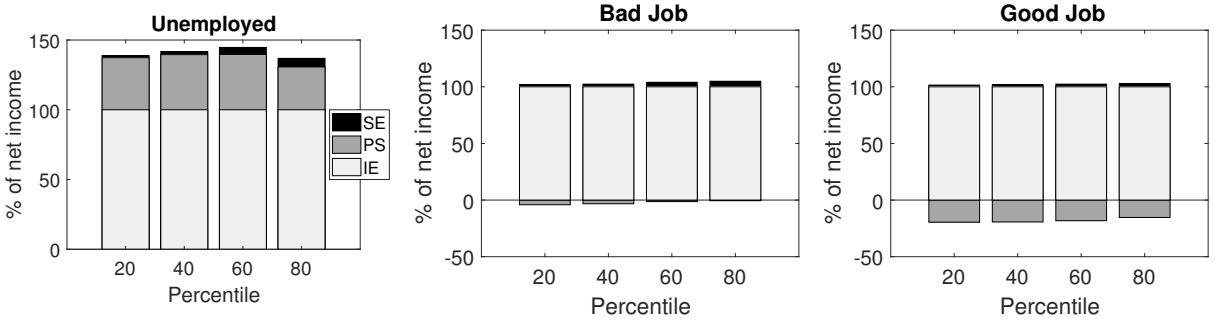

Figure 4: Decomposition of consumption

The Euler equation allows us to decompose the consumption change into those three elements and to explain theoretically the figure 4. For an individual of type j who can switch to a state j+ or j-, the Euler equation is:

$$\begin{aligned}(\rho - r)\, u'((c_j(a)) &= u''(c_j(a))\, c_j'(a)\,(y + ra - c_j(a)) \\ &+\lambda_{jj+}\,(u'(c_{j+}) - u'(c_j)) + \lambda_{jj-}\,(u'(c_{j-}) - u'(c_j))\end{aligned} \tag{21}$$

Therefore, the consumption can be written as:

$$c_j(a) = (y + ra) - \frac{(\rho - r)\, u'((c_j(a))}{u''(c_j(a))\, c_j'(a)} + \frac{\lambda_{jj+}\,(u'(c_{j+}) - u'(c_j)) + \lambda_{jj-}\,(u'(c_{j-}) - u'(c_j))}{u''(c_j(a))\, c_j'(a)} \tag{22}$$

This equation helps to anticipate the effect of the tax policy on the consumption and the saving behaviour. Through the income element, if the income from labour y and the income from capital ra increase everything else being equal, the consumption increases.

However, though a intertemporal elasticity of substitution element, when the interest rate increases, the individual saves more and consumes less. This intertemporal elasticity of substitution element is described by the following element of the equation: $\frac{(\rho-r)u'((c_j(a))}{u''(c_j(a))c'_j(a)}$. The intertemporal elasticity of substitution element is higher for the wealthy because they have a lower relative risk aversion.

Then, through a precautionary saving element, $\frac{\lambda_{jj+}(u'(c_{j+})-u'(c_j))+\lambda_{jj-}(u'(c_{j-})-u'(c_j))}{u''(c_j(a))c'_j(a)}$, individuals consume more when the income of the other labour market status increases relative to their actual income. This element is amplified if the marginal propensity to consume is lower because individuals are further to the liquidity constraint.

4.3.2 The short run pain for the bottom of distribution

In order to understand the effect on the bottom of the wealth distribution in the short run, we identify the type of workers who are in the first quintile (Q1) and the second quintile (Q2). Figure 5 shows the contribution of each type of labour market status to the wealth change of each quintile. The main contributors to the short run negative effect on the wealth of the first and second quintile are the individuals with a bad job.

Figure 6 to 9 shed light on the mechanisms explaining the consumption and the saving change over time. At a particular percentile, the left hand side figure shows the consumption and saving change relative to their initial value. The right hand side figure shows the income, substitution and precautionary effect contributions to consumption change over time.

In the short run, the wealth of Q1 and Q2 for individuals with a bad job decreases (figure 5). Indeed, as shown in figures 6 and 7, in the first period, the consumption of individuals with a bad job in Q1 and Q2 decreases more than their net income. Therefore, savings of individuals with a bad job in Q1 and in Q2 decrease. Consumption decreases more than their net income because of the precautionary saving effect. The precautionary saving helps to increase consumption in the short run because the potential future consumption loss decreases. Indeed, the potential income shock is to become unemployed and the unemployed income does not decrease after the policy change while the net wage

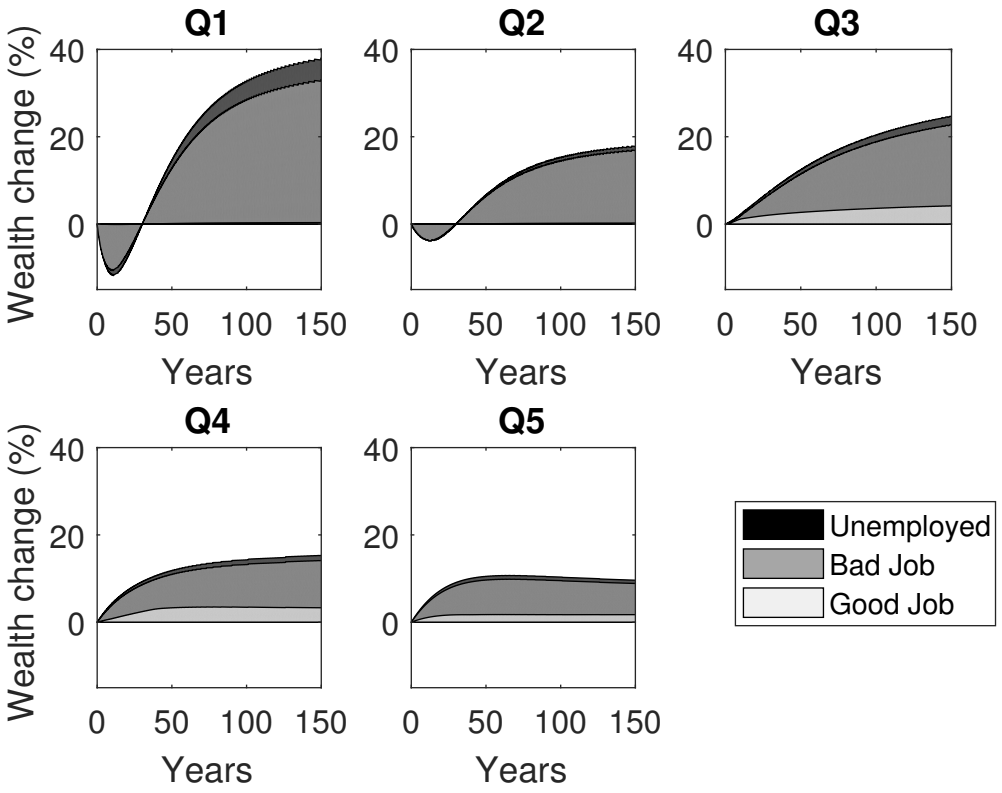

Figure 5: Change in the wealth level, by quintile

decreases.

In the short run, the wealth of Q3 and Q4 for individuals with a bad job decreases. In the first period, for individuals with a bad job at the upper bound of these quintiles, the consumption decreases less than the net income (see figure 8 and 9). Therefore, savings and wealth of individuals with a bad job in Q3 and Q4 increase. The intertemporal elasticity of substitution effect through which consumption is reduced to save more dominates the precautionary saving effect. The difference between Q4 and Q5 is also explained by a higher substitution than precautionary saving effects.

Therefore, in the short run, the wealth of Q1 and Q2 decrease because the precautionary saving effect dominates while the wealth of Q3 to Q5 increase because the intertemporal elasticity of substitution effect dominates.

4.3.3 Towards a long run gain for the bottom of the distribution

Figure 5 shows that, in the long run, the wealth increases the most for the bottom (Q1) and the middle of the distribution (Q3). Because the contribution to the wealth change is mainly driven by individuals with a bad job (see figure 5), we focus on the wealth

change for the individuals with a bad job. For individuals with a bad job, Q1 and Q2 wealth decreases in the short run but increases after 40 years. 40 years after the reform corresponds to the period when the wage becomes higher than initially. The long run increase in wealth is higher for Q1 than Q2 (Figure 5), because the precautionary saving effect is higher for Q1 than for Q2 (figures 6 and 7).

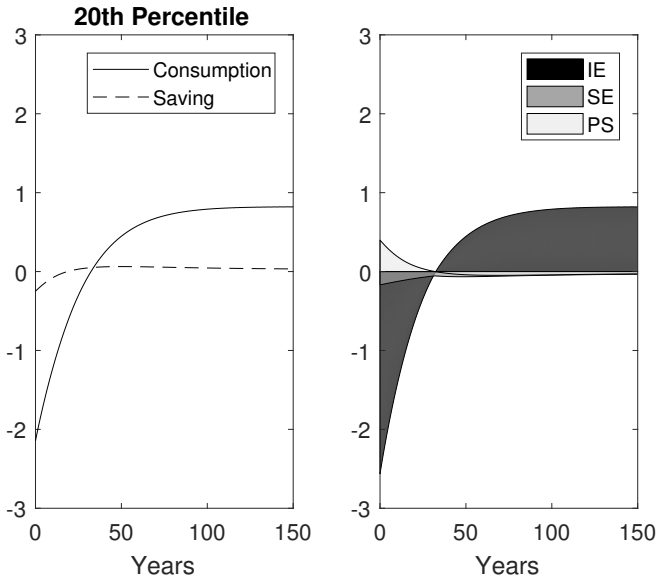

Figure 6: Mechanisms, 20th percentile

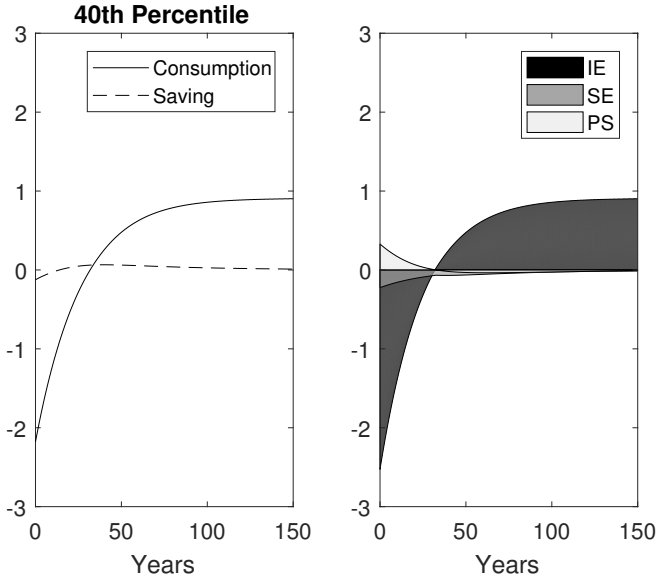

Figure 7: Mechanisms, 40th percentile

Then, the long run increase in wealth is higher for Q3 than for Q2 because Q3 accumulates more wealth from the first period while Q2 begins by loosing wealth and only

accumulates more wealth after 40 years (see figure 5). Then, the total accumulation of wealth in the long run is higher for Q3 than for Q2.

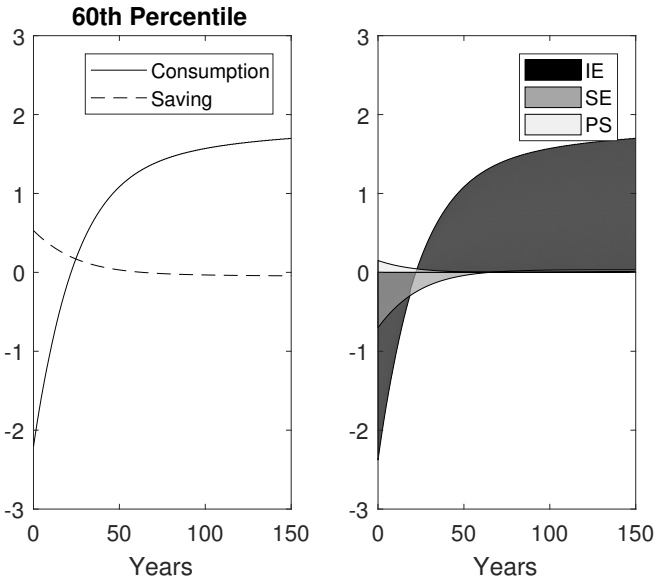

Figure 8: Mechanisms, 60th percentile

Then, the increase for Q4 is lower than the increase for Q3 (see figure 5). We can explain this by the following equation:

$$\frac{a_{t+1} - a_t}{a_t} = \frac{\Delta y}{a_t} + \Delta r - \frac{\Delta c}{a_t} \tag{23}$$

At each period, the wealth change increases less for higher level of wealth because the labour income change and the consumption change between t and t+1 represent a lower share of initial wealth. The labour income change on initial wealth $\frac{\Delta y}{a_t}$ decreases with the level of wealth, Δr is independent of the level of wealth and the consumption change on wealth $\frac{\Delta c}{a_t}$ also decreases with the level of wealth since the marginal propensity to consume decreases with wealth and $c'(a) < 1$. In the long run, savings increase for all but this change in the saving is relatively lower if the wealth is higher.

4.4 Comparison with a non budgetary neutral reduction in the capital tax

Domeij and Floden [2006] study the effect of a reduction in the capital tax financed by the increase in the labour tax at the period of implementation in order that the public debt converges in the long run. If we want to reduce the capital tax to 30 %, this policy

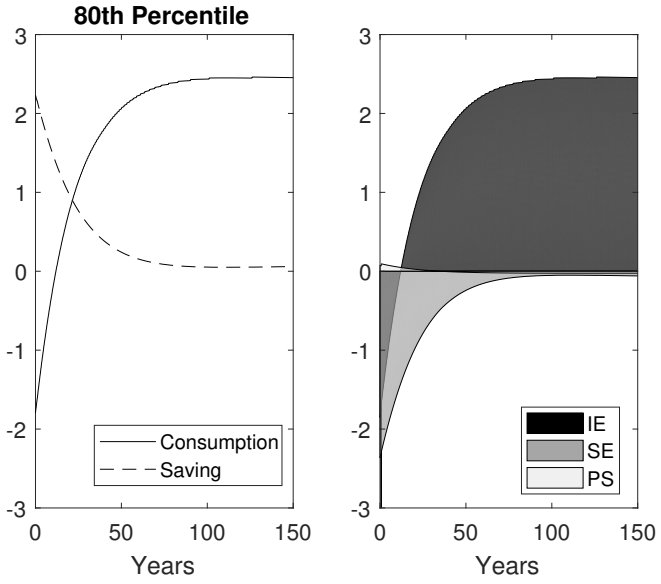

Figure 9: Mechanisms, 80th percentile

change leads to an increase in the labour tax to 41 % for the rest of the period (see figure 10) and this leads to an increase in the public debt in the long run (see figure 11). Indeed, the after tax wage and the labour supply are reduced in the long run. The government needs to increase its public debt in order to finance government and social expenditure while the fiscal base of the labour tax is reduced. At the aggregate level, production and consumption decrease less in the short run and increase more in the long run when the reform is budget neutral.

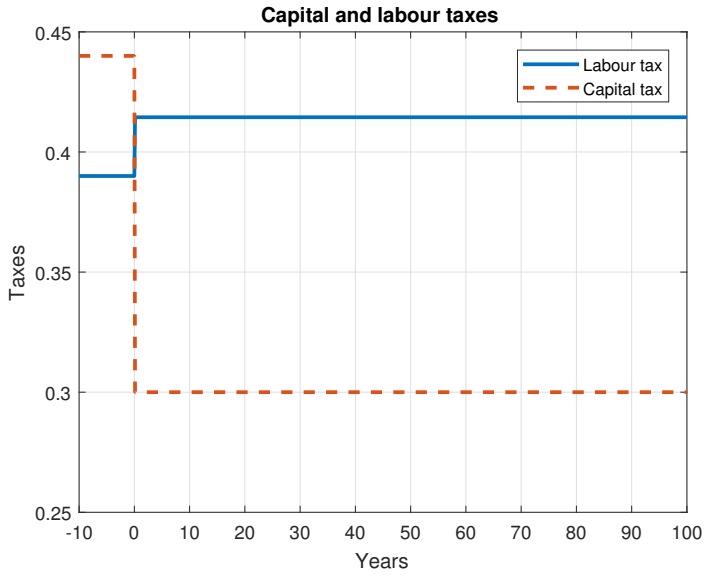

Figure 10: Change in capital and labour tax - Not budgetary neutral

Considering the distributional effects, there is no short run distributional pain when

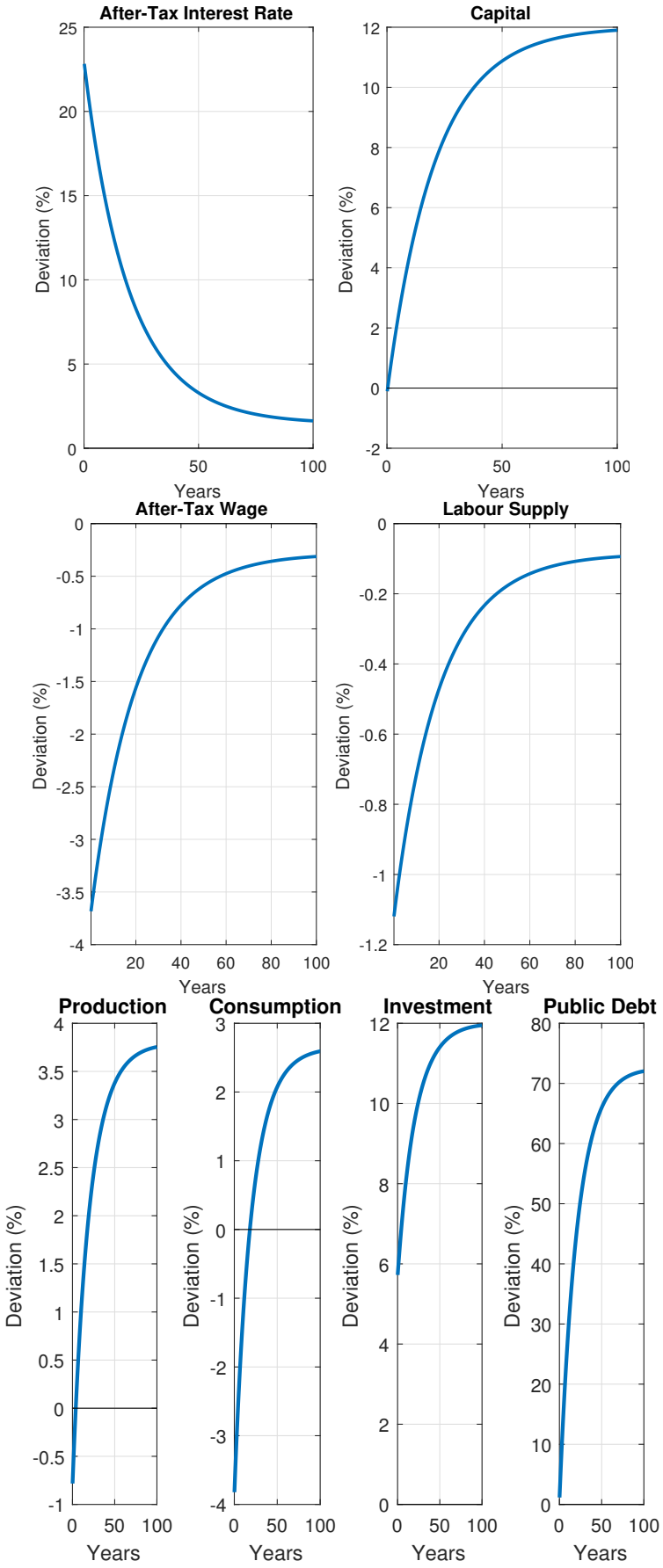

Figure 11: Change w.r.t Initial SS - IRF - Not Budgetary Neutral

the reform is not budget neutral. The wealth of the first quintile increases the most in relative in the short run (see figure 12) . In the short run, the net interest rate increases as much as in the budget neutral case while the net income decreases less. Consequently, the net income decreases less than consumption for the poor in the not budget neutral case and the saving of the poor increases (see figure 13). The public debt has distributional effects on income because the increase in public debt leads to a higher income than in the case without public debt.

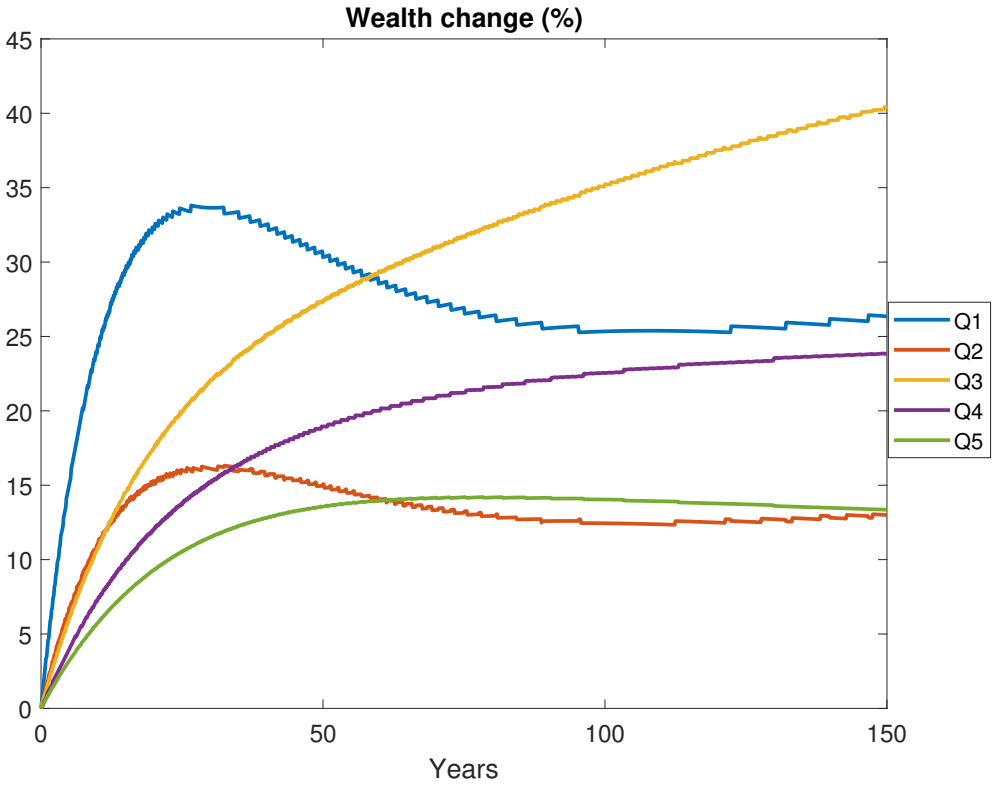

Figure 12: Change in the wealth level, by quintile - Not budgetary neutral

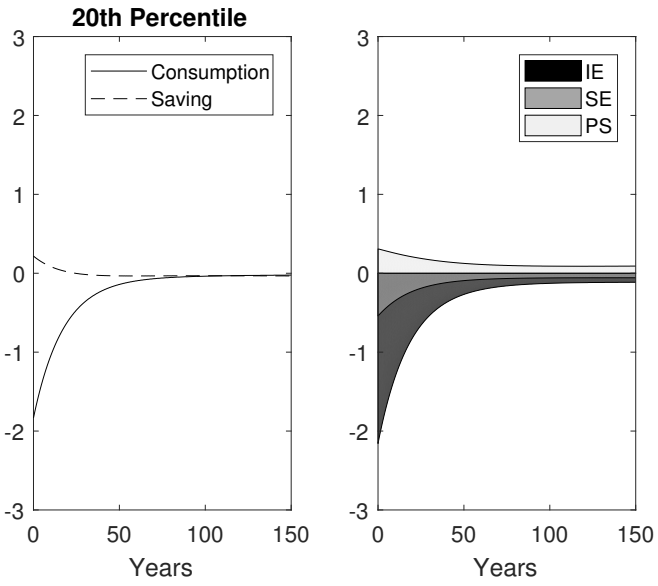

Figure 13: Mechanisms, 20th percentile - Not budgetary neutral

4.5 Welfare gain

To our knowledge, we are the first to analyse the wealth distributional effects of such a reform. However, Domeij and Floden [2006] study the effect of a reduction in the capital tax on welfare gain. Their measure of average welfare gain is the constant percentage increment in consumption in the no reform case (NR) that gives the same expected utility as when the reform (R) is implemented (see equation 24).

$$\int_{\underline{a}}^{\infty} u_t^R(c_t) dG(a,t) = \int_{\underline{a}}^{\infty} (1+\Delta) u_t^{NR}(c_t) dG(a,t) \tag{24}$$

They decompose this welfare in an aggregate component which is the welfare gain if households got to consume the same fraction of aggregate consumption as in the case of the no reform (see equation 24) and a distributional component which is the difference between the average welfare gain and the aggregate component.

$$\int_{\underline{a}}^{\infty} u_t^R(c_t^{NR} \frac{C_t^R}{C_t^{NR}}) dG(a,t) = \int_{\underline{a}}^{\infty} (1+\Delta) u_t^{NR}(c_t) dG(a,t) \tag{25}$$

Table 5 shows that as in Domeij and Floden [2006], the aggregate component is positive and the distributional component is negative. The aggregate component is 5%, a value close to Garcia-Milà et al. [2009] for homogeneous agent. The quantitative effects are different because our tax policy is different. We can also compare the not budgetary neutral tax policy which is closer to Domeij and Floden [2006]. With this not budgetary

neutral tax policy, the aggregate component of welfare is smaller and the distributional component higher. This is in line with the results of Röhrs and Winter [2017] who show that the change in government debt has an effect on welfare in the presence of inequality.

Table 5: Comparison of welfare gain

Variables	Average	Aggregate	Distributional
Domeij and Floden [2006]	-1.42 %	0.23 %	-1.65 %
Budgetary neutral	2.52 %	5.67 %	-2.99 %
Not budgetary neutral	1.60 %	5.18 %	-3.39 %

With our method, we can also show the welfare effects over time (see figure 14). The aggregate component of the welfare shows that if individuals would have kept the same share of total consumption the welfare effect would have been negative in the short run and positive in the long run as aggregate consumption decreases in the short run and increases in the long run. However, the individual consumption is redistributed across households and the consumption of the wealthier increases more than the consumption of the poor over time (see figures 6 to 9).

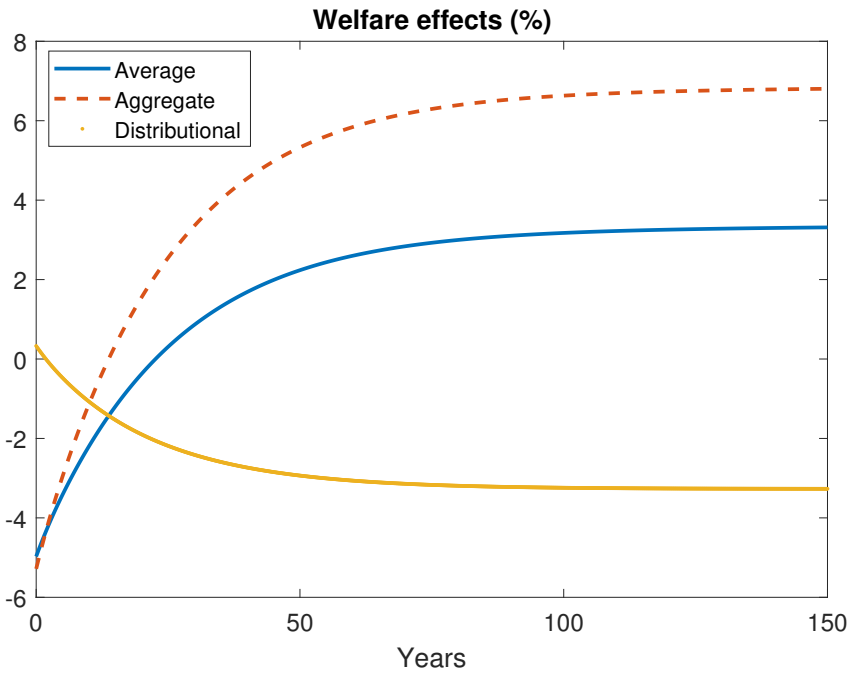

Figure 14: Welfare and its components - budget neutral reform

In order to understand the welfare change across the wealth distribution, we can compute the consumption change by quintile. As Garcia-Milà et al. [2009], we find that

the wealthy consumption increases more relative to the poor after a reduction in the capital tax (see figure 15). However, they only study the average consumption change relative to the first quintile. With our approach, we can analyse the effects during the transition. We find that the consumption decreases for all quintiles in the short run but more for the poor than the wealthy and that the first and second quintiles consumption stay lower than initially in the long run.

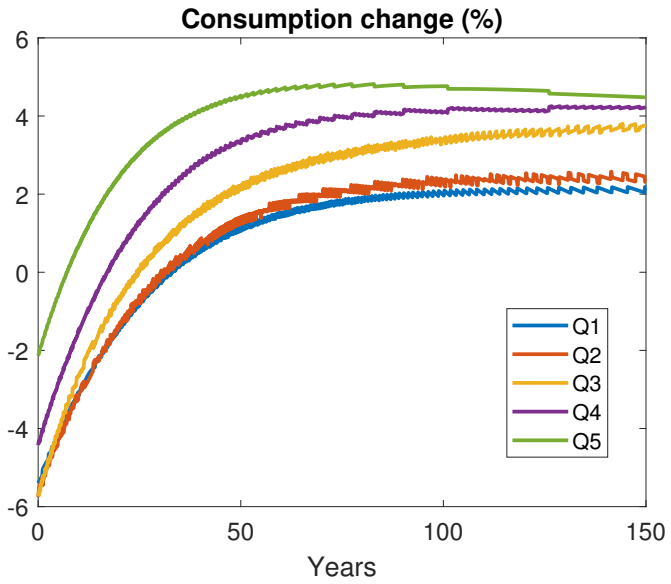

Figure 15: Welfare and its components - Budget neutral reform

4.6 Robustness Check

Our main results, presented in the last section, may depend on some assumptions or parameter calibration. In the following part, we present the main consequences of our fiscal reform under alternate situations.

4.6.1 Unemployment benefit depending on the previous wage

One important assumption in our model is a constant unemployment benefit. Indeed, in our baseline model, unemployed agents are not impacted by the increase in labour income taxation, and only benefit from the decrease in capital income taxation. Since they can only face a positive income shock, i.e become employed, relaxing this assumption might affect the results. As unemployed agents are mainly situated in the first and second quintiles of the distribution, the poorest individuals would be the most affected.

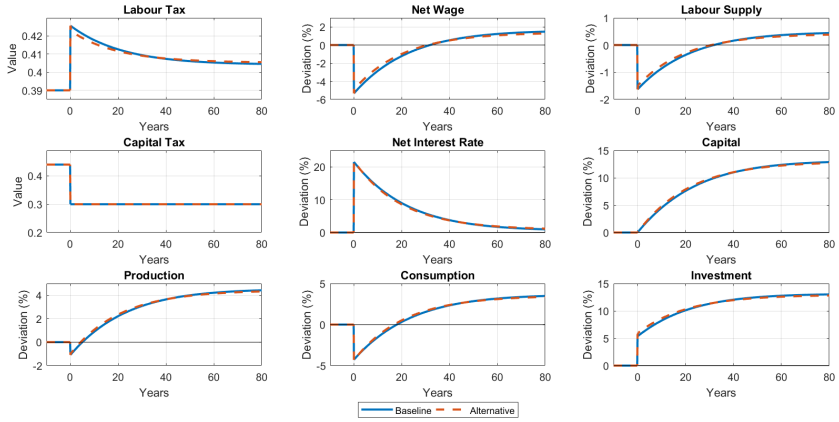

Figure 16: IRF - Baseline vs Fluctuating unemployment benefit

As shown in Figure 16, the absence of the constant unemployment benefit assumption leads to no differences between our baseline and the alternative model with benefit depending on the previous wage on the aggregate quantities.

However, the distributional consequences of this change are not neutral. Figure 17 shows the change in the wealth level of each quintile of the wealth distribution following this tax policy. In the short run, Q1 and Q2 wealth increases if the unemployment benefit depends on the previous wage while it decreased if the unemployment benefit stays constant. After the tax policy change, since the net wage falls in the short run, the potential income loss for individuals with a bad job is lower with constant unemployment benefit than with unemployment benefit depending on the previous wage. With constant unemployment benefit, the precautionary saving effect leads the consumption to decrease more than the net income (see figure 6) while with the unemployment benefit depending on the previous wage, the precautionary saving effect is very small (see figure 18). However, in both case, wealth inequality increases in the short run and decreases in the long run. Figure 19 shows that the wealth gini increases in the short run and decreases in the long run.

4.6.2 Calibration Sensitivity

In this section, we conduct a sensitivity analysis of our main results to changes in the values of different parameters. We will mainly focus on the Frisch elasticity, ϵ, the labour disutility ψ and the coefficient of relative risk aversion σ.

Sensitivity to the Frisch elasticity ϵ : The response to change in the labour tax

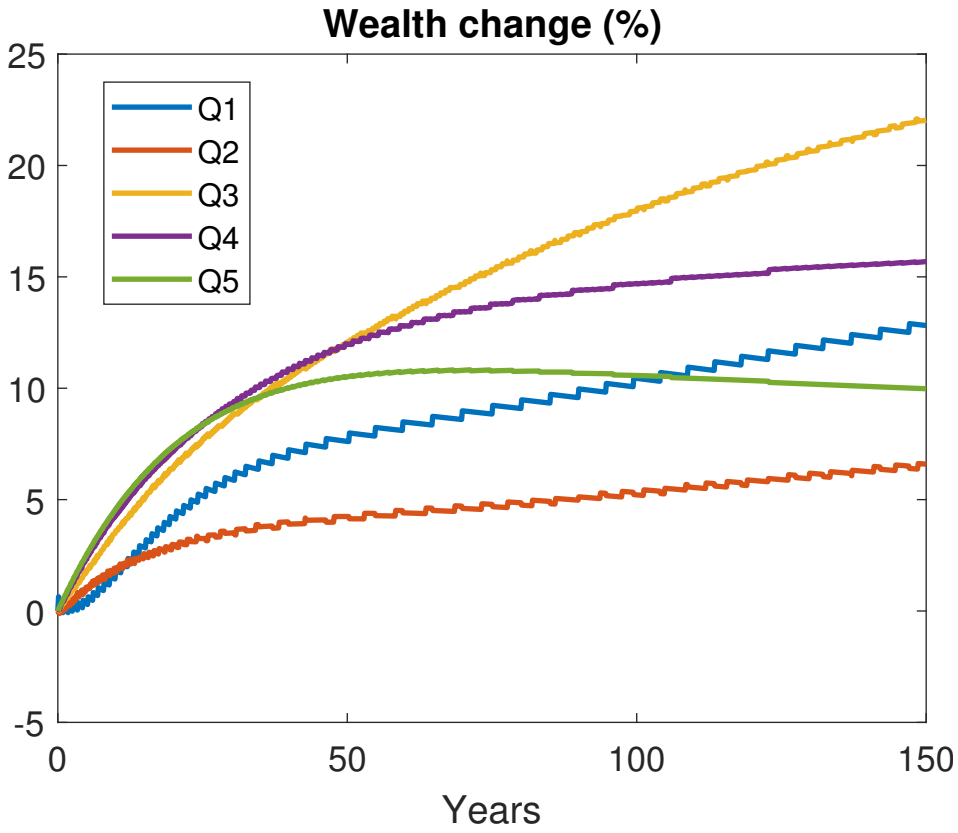

Figure 17: Change in the wealth level, by quintile - Unemployment benefit depending on previous wage

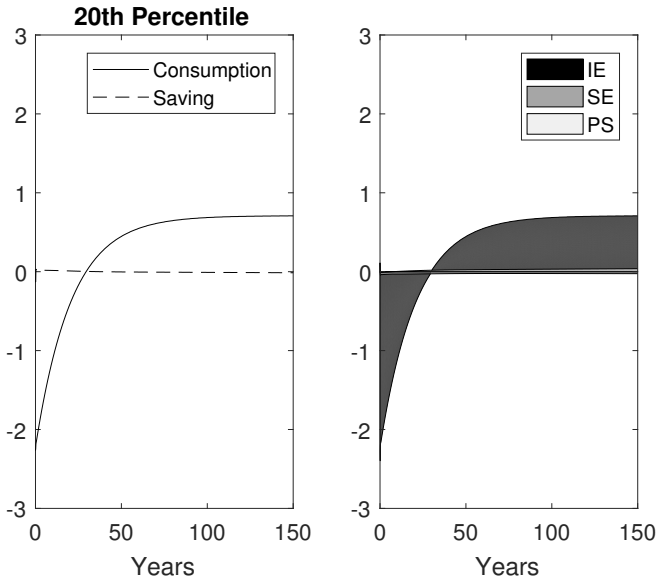

Figure 18: Mechanisms - Varying Unemployment Benefit, 20th percentile

is determined by ϵ. In our baseline model, this parameter is set 0.3. We investigate the consequences when ϵ is set to values around our baseline model. Indeed, as shown in Appendix (see Figure 20) any realistic change in its calibration leads to the same dynamic

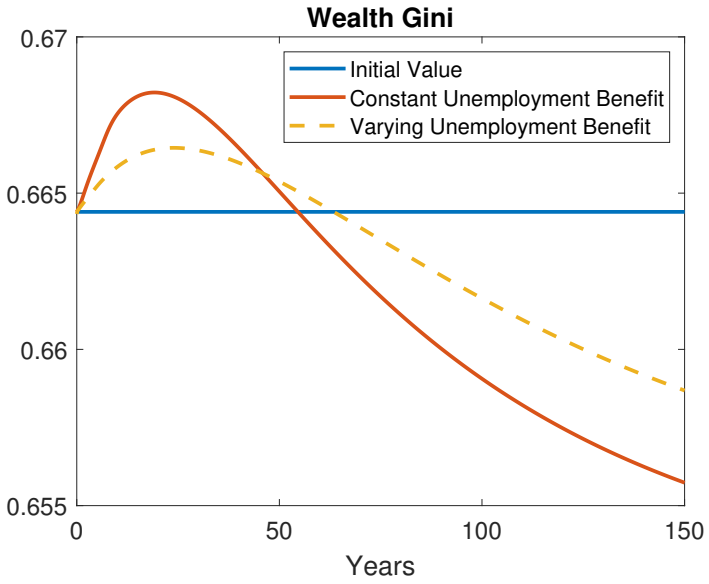

Figure 19: Wealth Gini, with different assumptions on unemployment benefit

than in our baseline model, with a short-run pain for the economy and an increase in consumption and production in the long run.

However, the wealth distribution response is slightly affected by the variation in ϵ. Indeed, a decrease in ϵ as shown in Figure 22 will, in the short-run, accentuate the wealth desacumulation for the two first quintile, while there are no real changes for the the rest of the distribution. On the long-run, we observe the same process with almost no changes for the richest individuals and an important increase in the wealth for the Q1 and Q2. When ϵ is set to 0.33, the poorest households (Q1, Q2 and Q3) seem less affected by the change in taxation while the forth and fifth quintiles are similarly affected compared to the baseline model.

These differences can be explained using Equation 7. Indeed, the derivative of $\frac{\partial n_{jt}}{\partial \epsilon}$ is always negative. So, an increase in ϵ lowers the individual labour supply and decreases the proportion of labour income in the total income (as the negative impact of τ_{Wt}'s increase is lowered when ϵ increases). This mechanism leads to a smaller wealth reduction for the poorest individuals. However, despite the important variations compared between alternate and baseline models for the first quintiles, these differences can be nuanced. Indeed, as Q1 and Q2 hold almost no wealth, any changes, even very small, provoke important variations with respect to the initial steady state.

Sensitivity to the labour disutility parameter ψ : The labour disutility parameter ψ is mainly used to calibrate the aggregate labour to match the French data. On the

aggregate level (Fig. 21), a change in the labour disutility ψ leads to no changes driven by a change in fiscal policy. On the distribution level (Fig. 23), the variation in ψ only affects the amplitude of the variation in wealth of the different quintiles compared to our baseline results, however the trend of the variation remains the same.

Sensitivity to IES calibration : Straub and Werning [2014] revisit the results of Judd [1985] explaining that the optimal capital tax in the long run depends on the intertemporal elasticity of substitution. This leads us to assess the effect of the change of the intertemporal elasticity of substitution on our results.

In our benchmarck model, $\sigma = 2$. The intertemporal elascity of substitution with our GHH utility is :

$$IES = \frac{-u'(c)}{u''(c)c} \tag{26}$$

In table 6, we assess if the IES has implications for the long run effect of the budget neutral reduction in the capital tax. The amplitude of the effects are higher with a higher IES. However, with both values, the reduction in the capital tax increases production and consumption and reduces inequality in the long run. Indeed, the wealth gini and the share of wealth held by the top 20 decrease.

Table 6: Steady State Analysis - Aggregates

Change w.r.t Initial Steady State (%)

Prices			**Aggregates**		
Variables	IES= 0.4	IES = 1.2	Variables	IES= 0.4	IES = 1.2
Wage	3.96	4.31	**Output**	4.41	4.90
Net Wage	5.33	1.91	**Labour**	0.44	0.57
Interest Rate	-19.23	-19.78	**Consumption**	3.52	4.10
Net Interest Rate	0.000243	0.27	**Capital**	12.84	14.14
Wealth Gini	- 2.15	-1.35	**Top 20 Share**	-2.65	-2.0873

5 Conclusion

In this paper, we have shown the importance of taking into account the differences between long-run (steady-state) and short-run (along the transition) distributional impacts to evaluate the consequences of a budget neutral reducing in capital taxation. Indeed,

while the aggregate effects (negative in the short-run and positive in the long-run) are well understood, our main contribution shows that distributional effects are inevitable to fully evaluate such policy and determine its acceptability. We show that the individuals reacts differently depending on time-horizon, labour situation and position in wealth distribution. Indeed, if in the long-run, the budget neutral reduction in capital taxation is redistributive towards the poorest individuals, it is not the case along the transition. The wealth of the first and second quintiles decreases and the rest of the distribution benefit from this policy. These results clearly shows the importance to fully consider the distributional component into policy evaluations and public debate.

A Appendix

A.1 Additional Figures

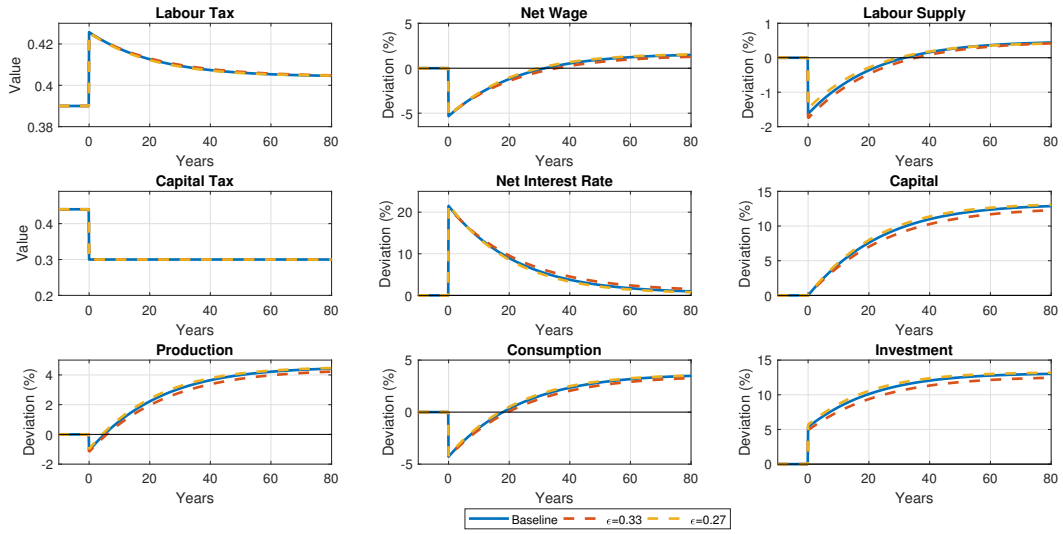

Figure 20: IRF - Baseline vs Alternate ϵ

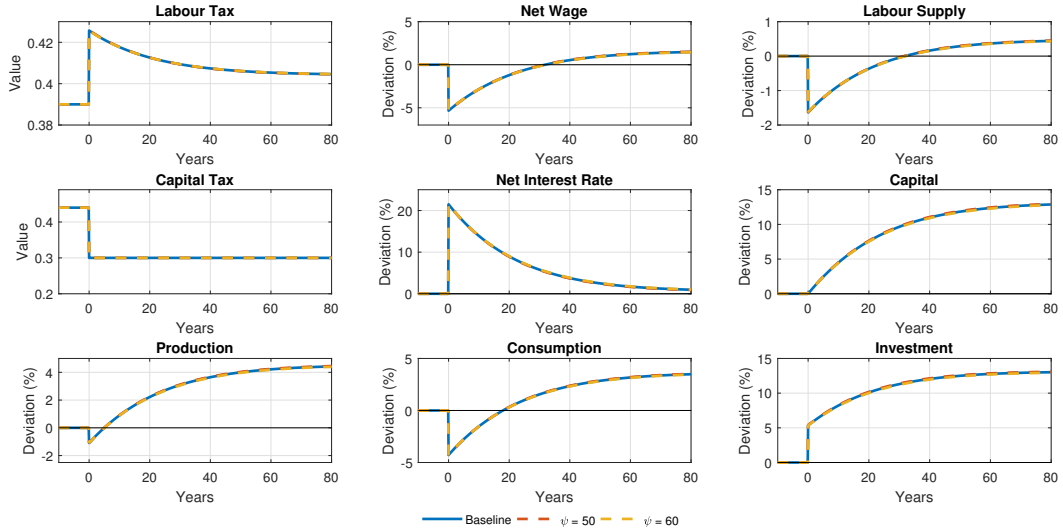

Figure 21: IRF - Baseline vs Alternate ψ

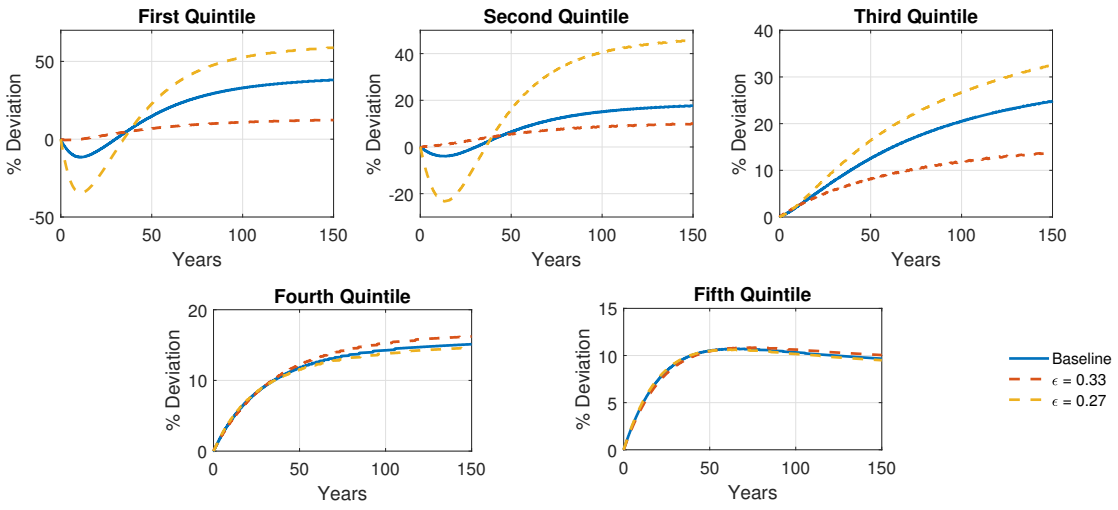

Figure 22: Change in the wealth level, by quintile - Change in ϵ

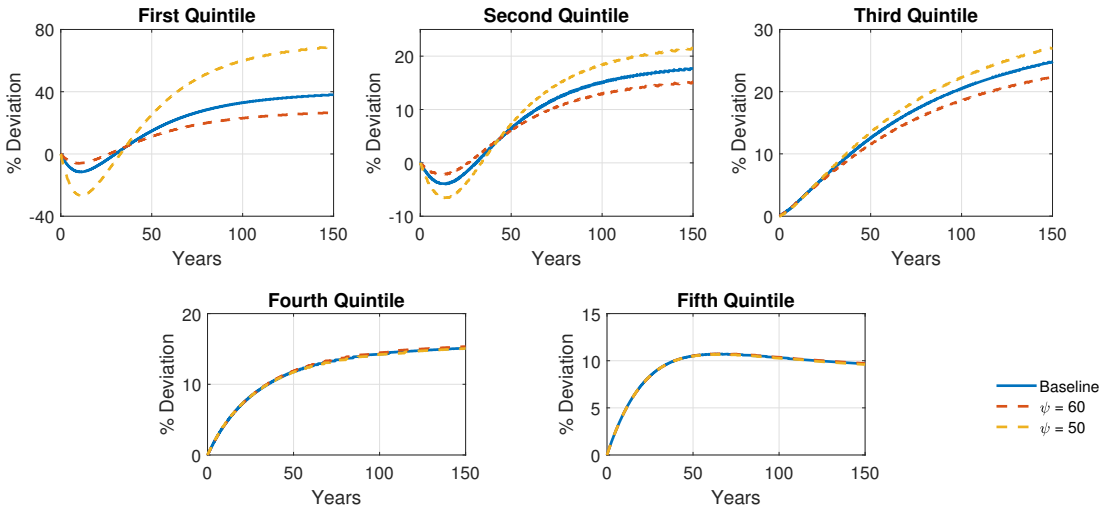

Figure 23: Change in the wealth level, by quintile - Change in ψ

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