## Distributional Effects of Tax Composition Changes

Frédéric Dufourt<sup>\*</sup>, Lisa Kerdelhué<sup>†</sup>, Océane Piétri<sup>\*</sup>

February 1, 2019

#### Abstract

In this paper, we evaluate the consequences of tax composition changes on macroeconomic variables, wealth distribution and inequality. While the macroeconomic effects of these reforms are generally well understood, their distributional impacts, on wealth shares and wealth distribution, are mostly overlooked. We use a heterogeneous agents model with incomplete market and idiosyncratic employment shocks. Following a recent policy experiment in France, we examine the macroeconomic and distributional effects of a budget neutral reduction in labour income tax financed with an increase in capital income tax. The results suggest that impact on individual across the wealth distribution can be very different than the average impact and depends on time horizon. While we have negative long-run and positive short-run effects for macroeconomic variables, the middle class loses the most in the long-run, the richest are suffering the less both in short-run and long-run and that effects on the poorest depend on time-horizon and labour situation.

**Keywords** : Fiscal Policy, Heterogeneous Agents, Wealth Redistribution **JEL Code** : E21, E62, D3, H23

<sup>\*</sup>Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE

<sup>&</sup>lt;sup>†</sup>Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE and Banque de France

## 1 Introduction

Since the euro crisis, many countries have seen an increase in their unemployment rate while the sustainability of their public debt has been questioned. Many developed economies have engaged many structural reforms in order to improve economic efficiency and stabilize or decrease public indebtedness. In this context, budget neutral tax composition change has been suggested as a fair tool to improve economic efficiency.

Such policies, and their implementations, have been the hard-core of recent events in France. In 2018, the French government decreased the labour income tax and financed it with an increase in capital income tax in order to avoid increasing public debt. The main justification was described as following :

"We will eliminate the health and unemployment insurance premiums for private sector employees, which will instantly increase the net salary of these employees [...]. We will finance it by increasing the General Social Contribution (CSG) tax rate [...] which will also affect capital income. Like VAT financing, such a financing scheme allows to alleviate labor taxation, but it is fairer and more redistributive than a VAT increase since the latter reduces the purchasing power of the poor."

#### Election program - Emmanuel Macron - 2017

While aggregate effects of these reforms are quite well known, the dynamic effects on the distribution of wealth is not yet well understood. This paper contributes to fill this gap by asking what are the effect of a reduction in labour income tax financed with an increase in capital income tax on wealth distribution and inequality not only in a steady state analysis, but also in transition dynamics. This notions of transition dynamics and redistribution are critical for acceptability of such policy. Our model allows to disentangle between short run and long run macroeconomic, and more importantly, effects on wealth share and wealth distribution induced by the reform. To the best of our knowledge, it has not be shown in the literature. To analyze this policy, we use as a baseline model, a heterogeneous agents framework, matching french economy, with incomplete markets, uninsured idiosyncratic labour income risk as in Bewley [1986], Huggett [1993], Aiyagari [1994] and endogenous labour supply. The use of heterogeneity and labour income risk to analyze such questions allows the presence of precautionary savings and distributional effect leading us to disentangle direct and indirect effects, evaluating general equilibrium effects. Moreover, we are able to assess the results' evolution with respect to labour income risk. We use the method developed recently by Achdou et al. [2017] allowing us to solve this model faster and more efficiently than in a discrete time framework.

Our main results are, firstly, that we do obtain opposite results depending on the time horizon (short-run and long-run effects), but also of the labour-market situation and wealth categories. In the short-run, the change in tax composition has positive effects on consumption and production, while in the final steady state, we obtain an overall negative macroeconomic impact.

The dynamics of the wealth redistribution and the evolution of wealth shares are also time-dependent. While for the richest households (Top 10 %) are the less affected both on long-run and short-run, this not the case for the main part of the distribution. In the long-run, the middle class suffers the most of this policy, this result does not hold anymore when we consider short-run results, where the poorest households (bottom 50 %) are the greatest losers of the reform.

**Related Literature** A wide range of papers in the literature has analyzed 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] has 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 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

#### 1. INTRODUCTION

introduction of heterogeneity, this tax rate almost reach 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] shows that budget neutral reforms can be growth enhancing but can have adverse effect on redistribution. 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 deviation from the Ricardian Equivalence and large impact of temporary fiscal changes on aggregate variables. Closest papers to our work are Domeij and Heathcote [2004], Correia [2010] and Dyrda et al. [2016]. Domeij and Heathcote [2004] investigates the welfare gain of capital tax reduction. Indeed, their main finding is that while 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, and especially at the evolution of wealth shares detained by the agents with respect to the evolution of assets in the economy. Similarly, the paper by Dyrda et al. [2016] investigates what should be the optimal path for capital and labour taxation when a social planner care for redistribution and equality. Finally, the paper by Correia [2010] finds that an increase in consumption taxes simultaneous to a decrease in labor taxes has positive distributional effects compared to an equivalent system with capital taxes and labour taxes. More recently, Kaymak and Poschke [2016] investigates macroeconomic and distributional impacts of progressive wealth taxes introduction.

The rest of the paper is organized as follows. In the next section, we give a description of the model, along with the calibration of the different parameters values and how do our simulation perform to reproduce the French economy. Section 3 presents the main results and discusses them and Section 4 concludes.

## 2 Model

#### 2.1 The economy

We describe our baseline economy by the following framework.

**Households** The economy is composed of a continuum of heterogeneous agents, maximizing a utility function discounted at rate  $\rho$ ,

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

 $c_{ijt}$  represents the individual consumption (with the indices i and j being respectively, the individual wealth and labour situation). We assume that the period individual utility function is:

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

$$\tag{2}$$

Its utility is increasing with consumption  $c_t$  and decreasing with working hours  $n_t$ ,  $\sigma$  is the coefficient of relative risk aversion,  $\psi$  disutility from labour and  $\epsilon$  the Frisch elasticity of labor supply.

Individuals face two levels of heterogeneity, on their labour market situation and in their assets holdings. Labour market's heterogeneity comes from idiosyncratic uncertainty of labour income across time. Labour market status j follows a three-state Poisson process with  $j \in \{B, U, G\}$ , where U is unemployment, B is "bad-job" and G is "good-job" as described in Algan et al.(2003). Therefore, the proportion of individuals in each category remains fixed in both steady states (before and after tax change) and during the transition as well. Unemployed individuals receive unemployment benefit (denoted RR later on) and spend fixed amount of time looking for a job ( $n_{jt} = e$ ) and employed individuals supply labour endogenously and receive an hourly wage  $w_t$ .

Individual facing idiosyncratic income risk uses precautionary savings in assets to smooth consumption. Therefore, individuals are heterogeneous in their assets holdings,  $a_{ijt}$  paid at  $r_t$ , generating a distribution of wealth in the economy. Each individual's wealth evolves depending on its labour situation such that : For employed individuals (j=B,G), we have :

$$da_{ijt} = (1 - \tau_W)w_t z_j n_{jt} + (1 - \tau_K) a_{it} r_t - c_{ijt},$$
  

$$n_{jt} = \left[\frac{z_j w_t (1 - \tau_W)}{\psi}\right]^{\epsilon}$$
(3)

For unemployed individuals :

$$\begin{cases} da_{ijt} = (1 - \tau_{W1})RR + (1 - \tau_K) a_{it} r_t - c_{ijt} \\ \text{where } RR = \mu w_1 \bar{n} \end{cases}$$
(4)

The individual having a good-job is granted with a productivity  $z_G$ , while a agent having a bad-job have a productivity  $z_B$ , where  $z_G > z_B$  (as explained later,  $z_B$  is normalized to 1).

Finally, an unemployed agent receives unemployment benefit, calculated as the proportion  $\mu$  of the weighted average of the net wage of individuals with good and bad jobs (before the fiscal policy change). This unemployment benefit remains entirely fixed in both steady state and transition.

Each household is subjected to a set of taxes, both on capital income at rate  $\tau_K$  and labour income at rate  $\tau_W$ .

**Firms** There is a representative firm with Cobb-Douglas production function and maximizes its profit with respect to aggregate capital  $K_t$  and labour  $N_t$ 

$$AK_t^{\alpha}N_t^{1-\alpha} - w_t N_t - (\delta + r_t)K_t, \tag{5}$$

with  $\delta$ , the quarterly capital depreciation rate.

**Government** The government taxes assets  $A_t$  at rate  $\tau_k$  and labour at rate  $\tau_w$  to finance public spending G,  $(G = \xi Y_0, \text{ with } Y_0 = \text{initial output})$ , debt  $B_t$  and unemployment benefit. Therefore, government budget constraint satisfies

$$\dot{B}_t = G + r_t B_t + (1 - \tau_{W1}) RR \, \bar{U} - \tau_K r_t A_t - \tau_W w_t [\bar{B} \, n_{Bt} \, z_B + \bar{G} \, n_{Gt} \, z_G], \qquad (6)$$

with  $\overline{U}$ ,  $\overline{B}$ ,  $\overline{G}$  are respectively the proportion of unemployed and individuals with bad and good jobs in the economy (fixed over time). **Equilibrium** An equilibrium is a sequence of wage  $w_t$  and interest rate  $r_t$ , optimality conditions holdings, boundary conditions holdings, budget constraint holdings and bonds and labour markets clearing such that:

$$B_t + K_t = \int_{\underline{a}}^{\infty} ag_B(a, t)da + \int_{\underline{a}}^{\infty} ag_U(a, t)da + \int_{\underline{a}}^{\infty} ag_G(a, t)da$$
(7)

$$N_t = \bar{B} n_{Bt} z_B + \bar{G} n_{Gt} z_g \tag{8}$$

$$Y_t = C_t + I_t + G_t \tag{9}$$

In equilibrium, the evolution of the distribution determines equilibrium interest rate which affects individual's savings decisions and the evolution of the distribution next period.

## 2.2 Transition dynamic

The household's decisions and the evolution of the saving's decisions follow respectively a Hamilton - Jacobi - Bellman equation (HJB) and a Kolmogorov-Forward KF) equations. The HJB equation can be written as:

$$\rho V(a,t) = \max_{c,n} u(c,n) + \frac{\partial V(a,t)}{\partial a} \left[ y(t) + (1-\tau_K) a r(t) - c \right] + \Lambda V(a,t) + \frac{\partial V(a,t)}{\partial t}$$
(10)

with

$$V(a,t) = \begin{bmatrix} v_B(a,t) \\ v_U(a,t) \\ v_G(a,t) \end{bmatrix}, y(t) = \begin{bmatrix} (1-\tau_W)z_B n_B w(t) \\ (1-\tau_W)\mu w_1 \bar{n} \\ (1-\tau_W)z_G n_G w(t) \end{bmatrix}$$
(11)

and

$$\Lambda = \begin{bmatrix} -\lambda_{BU} & \lambda_{BU} & 0\\ \lambda_{UB} & -(\lambda_{UG} + \lambda_{UB}) & \lambda_{UG}\\ 0 & \lambda_{GU} & -\lambda_{GU} \end{bmatrix}$$
(12)

with  $\lambda_{zz'}$  the probability to switch from state z to state  $z'^{1}$ .

It gives us the first-order conditions:

$$u'_c(c(a,t),n(t)) = \partial_a V(a,t)$$
(13)

<sup>&</sup>lt;sup>1</sup>For simplicity,  $\lambda_{BG} = \lambda_{GB} = 0$ , see Algan et al.

$$u'_{n}(c(a,t),n(t)) = -u'_{c}(c(a,t),n(t))w(t)z_{j}, \ j = B,G$$
(14)

The KF equation describes the evolution of wealth distribution:

$$\frac{\partial g(a,t)}{\partial t} = -\frac{\partial [s(a,t)g(a,t)]}{\partial a} + \Lambda^T g(a,t)$$
(15)

with

$$g(a_t) = \begin{bmatrix} g_B(a) \\ g_U(a) \\ g_G(a) \end{bmatrix}$$
(16)

Here, the distribution of wealth evolved depending of the amount of savings s(a, t) in time t and labour income risk which probability is described in matrix  $\Lambda$ . The function V satisfies the state constraint (see Achdou et al. [2017] for more details):

$$\partial_a V(\underline{a}, t) \ge u'(y(t) + (1 - \tau_K) \underline{a} r(t)) \tag{17}$$

The density  $g_j$  satisfies the initial condition:

$$g(a,0) = g_0(a) \tag{18}$$

The value function satisfies a terminal condition corresponding to the final steady state value function  $v_{Fss}(a)$ . T is the last time period for T "large".

$$V(a,T) = V_{Fss}(a) \tag{19}$$

#### 2.3 Calibration

To examine the impact of change in tax composition, we will calibrate our model to match key moments for French economy. Some parameters (capital share, rate of time preference, capital depreciation) are calibrated as commonly admitted in the literature. We calibrate the model for quarterly data for the period 1995Q1-2017Q4.

**Preferences** The rate of time preference  $\rho$  is set to 0.01 targeting a yearly subjective discount rate of 4%. As the empirical literature (see Attanasio [1999]) has estimated risk-aversion coefficient between one and three, we set  $\gamma = 2$ .

Estimates of Frisch elasticities for male labor supply range between 0 and 0.5 (Domeij and Floden [2006]). Following Heathcote [2005], we set the Frisch labour supply elasticity to 0.3. However, this elasticity may be higher because the borrowing constraint is forgiven in standard estimation (Domeij and Floden [2006]).

**Production**  $1 - \alpha$  is set to match the labour share in France. Total labor's share is roughly around two-thirds of total value added. We normalize A to 1 because we can always choose the measurement unit of output. The depreciation rate  $\delta$  is set to match a yearly 10% depreciation.

The labour disutility  $\psi$  is set to 55 targeting for 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.

**Labour Market** Labour Market's inflows and outflows characterising idiosyncratic uncertainty, job separation and finding rate determine the proportion of agents in each labour market situation (bad-jobs, unemployment and good-jobs). We use partly the calibration as describe in Algan et al.. Indeed, based on European Panel Data for the French economy, they compute several values. Firstly, let's define  $\phi = 0.2$ , the job finding rate (Insee) and  $\xi = 0.054$ , the probability that the job offered is a good one, we can compute the job finding rate of a "good-employed" job and "bad-employed" job, which are respectively

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

The destruction rates for good-jobs  $\lambda_{GU}$ , is set at 0.0069 as done in Algan et al..  $\lambda_{BU}$  is set at 0.02 to reach an unemployment rate close to french data.

Good-job is defined as a labour situation with labour income 1.6 times higher than the median wage. So, we normalize  $z_B = 1$  and set  $z_G = 1.6$ .

The unemployed productivity,  $\mu = 0.7$ , is set as described in Hairault et al. [2012]. Finally, the time devoted to search activity e when an individual is unemployed is equal to 0.3317 as in Algan et al..

**Fiscal policy** To calibrate the labour income tax rate  $\tau_W$ , we use the average implicit

tax rate on the period 2000-2017 computed by Eurostat. The capital tax rate is set as described in Artus et al. [2013]. So, we have

$$\tau_W = 39\% \text{ and } \tau_K = 44\%$$
 (20)

Definition & Parameters	Values	Sources
Capital Share $\alpha$	0.33	Insee
TFP scale parameter A	1	-
Rate of Time Preference $\rho$	0.01	Prescott [1986]
Capital Depreciation $\delta$	0.025	Prescott [1986]
Frisch Labour supply elasticity $\epsilon$	0.3	Heathcote [2005]
Labour disutility $\psi$	55	Calibrated
Coefficient of Relative Risk Aversion $\sigma$	2	Attanasio [1999]
Unemployment Insurance Replacement Rate $\mu$	0.7	Hairault et al. [2012]
Share of Output for Public Spending $\xi$	0.2867	Calibrated
Time for search activity $e$	0.3317	Algan et al.
Job destruction rate "good-employed" job $\lambda_{gu}$	0.0069	Algan et al.
Job destruction rate "bad-employed" job $\lambda_{bu}$	0.020	Calibrated
Job finding rate $\phi$	0,2	Insee
Probability of "good-job" offer $\xi$	0,054	Algan et al.
Tax rate of labour income $\tau_w$	39%	Eurostat
Tax rate of Capital before policy $\tau_{K1}$	44%	Eurostat

Table 1: Parameters calibration for quarterly period

We follow the recent fiscal change implemented in France in 2018, where a social contribution (General Social Contribution - CSG) on capital and labour was increased. This increase of social contribution was, for labour income only, more than compensated by a decrease of other social contribution, especially health and unemployment insurance for private workers, implying a decrease of labour income tax of 0.5 percentage point.

We calibrate the capital tax change and compute the labour tax change in order to avoid an increase in public debt in our model. We get the following tax rate: :

Tax Rates (%)	Capital Tax $\tau_K$	Labour Tax $\tau_W$	
Initial Steady State	44	39	
Final Steady State	45.7	38.691	

Table 2: Change in Fiscal Policy

To answer the question of redistribution of tax policy changes, we have implemented this policy to maintain public spending stable, set a new tax rate for labour income and let the public debt adjust at each period.

### 2.4 Model performance

We compare our initial steady state simulation with different key values for France on the period 1995-2017.

**Aggregate Variables** Our model match the data quite well. The ratios of consumption, investment, debt and public spending relatives to output are close to the French data.

Statistics	Data	HA model	Sources
Investment/Output	0.21	0.20	Eurostat
Debt/Output	0.75	0.75	Eurostat
Consumption/Output	0.54	0.51	Eurostat
Net marginal revenue from capital	0.009	0.0088	OECD
Hours Worked	37.7	35.21~(B) / 40.54~(G)	Eurostat
Unemployment Rate	9.3~%	8.31~%	Eurostat

Table 3: Model vs. Data - Aggregate Values

Distribution The question of wealth distribution and its evolution is quite central in

our paper, we targeted some key moments to reproduce to match the french economy. Our simulations managed to reproduce the main part of the wealth distribution of the french economy. Indeed, as show in Table 4, we reach a Gini index very close to the value observed in France and the proportion of wealth held by the different decile of the population.

Statistics	Data	HA Model	Sources (Data)
top 10 $\%$	$49.5 \ \%$	44.49~%	Carroll et al. [2014]
top 20 $\%$	67.7~%	68.03~%	-
top 40 $\%$	89.2~%	89.82%	-
top 60 $\%$	98.5~%	95.18~%	-
top 80 $\%$	100.2~%	98.33~%	-
Share with no assets	6 %	3.06~%	Insee
Gini Coefficient	0.65	0.6469	Insee

Proportion of Wealth Held by Percentile of Hh

Table 4: Model vs. Data - Wealth Share

## 3 Results

In this section, we present the main results of this work. Firstly, we present the effects of a change in tax composition for aggregate variables on both the long-run (steady state analysis) and during the transition. Then, in a second time, we investigate the distributional effects on wealth shares, wealth distribution and inequality.

## 3.1 Aggregate Effects

#### 3.1.1 Long-run Effects

Firstly, in a steady state analysis, we obtain the following results :

Change w.r.t Initial Steady State (%) Variables Impact Prices Wage -0.550Interest Rate 2.86After-tax Wage -0.054-0.2655After-tax Interest Rate Production Output -0.5659Capital -1.6562Labour -0.0163Consumption -0.4479Asset -2.2615Gini Coefficient 0.2817

Table 5: Steady State Analysis - Aggregates

At first sight, considering only a long-run analysis (steady-state analysis), the implementation of this policy have a negative impact on the economy. Indeed, we observe a decrease with respect to the initial steady state, of almost all aggregate variables as shown in Table 5, except for interest rate. Especially, we have a increase of global inequality (Gini Index + 0.28 %), or global consumption decreasing of -0.48 %.

Moreover, as we assess the impact of a change of tax composition in an heterogeneous agents framework, we observe a separate impact for the several labour class of agents (unemployed, bad-jobs, good-jobs).

Table 6: Steady State Analysis - Aggregates- Labour Status

Variables	Total	Bad-Jobs	Unemployed	Good-jobs
Labour	-0.0163	-0.0163	D.N.A	-0.0163
Consumption	-0.4479	-0.467	-0.5391	-0.3495
Asset	-2.2615	-2.7238	-2.6677	-1.2575
Gini Coefficient	0.2817	0.1634	0.3534	0.0324

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

As shown in Table 6, depending of the labour situation we can see various reaction of aggregate variables to a tax composition change. Especially, the individuals in a good-job situation seem to be the less affected by a change in fiscal policy. Indeed, compared to Bad-Jobs and unemployed agents, the increase of the Gini index (0.16/0.35 % vs 0.0324 %) and the decrease of asset are much smaller for the good-jobs households than for the two other categories. Although, the Unemployed and the Good-Jobs categories are the less affected by the decrease of aggregate consumption.

#### 3.1.2 Transitional Effects

As shown in the previous subsection, the change of tax composition seems to have a negative impact on the economy, on the aggregates. However, a steady state analysis is not sufficient. Firstly, we observe very different impacts for some aggregates variables.

As shown in Figure 1, we have on the short-run, an increase of the after-tax wage, labour, consumption and to a lesser extent of the production. We also have a brutal



Figure 1: Change w.r.t Initial SS - Aggregates

drop of the after-tax interest rate, much more important than in the stead-state analysis. Also, the changes occurring for the different labour situation, we observe that the Badjobs individuals are those benefiting the most of the policy (more than 0.4 % increase of consumption) compared to unemployed and Good-jobs individuals.

For aggregate wealth, we observe the same results than in the long-run analysis, i.e the unemployed and the Bad-jobs individuals are more impacted negatively by the change in fiscal policy than the Good-jobs.

### 3.2 Impact on Wealth Distribution and Inequality

#### 3.2.1 Long-Run Effects

#### Mechanisms

Here, we explain the main mechanisms that affect the distribution change between the two tax scenarios. As Figure 3 shows, the saving rate and wealth accumulation depend on labour market conditions and wealth level. Individuals with good jobs accumulate precautionary savings since they are expecting bad income shocks, contrary to unemployed. Besides, individuals close to the liquidity constraint have more incentives to accumulate savings.



Figure 2: Change w.r.t Initial SS - Aggregates by Labour Category

Carrying out the discretisation of equation (15), following Achdou et al. [2017], gives this useful equation to understand the mechanism:

$$g_j(a_i) = \frac{\frac{-g_j(a_{i-1})(s_j(a_{i-1}))^+}{\Delta a} + \frac{g_j(a_{i+1})(s_j(a_{i+1}))^-}{\Delta a} - g_{j-1}(a_i)\lambda_{j-1} - g_{j+1}(a_i)\lambda_{j+1}}{\frac{-(s_j(a_i))^+}{\Delta a} + \frac{(s_j(a_i))^-}{\Delta a} - \lambda_j}$$
(21)

When savings are negative,  $s_j(a_i)$ )<sup>-</sup>, the density of individuals with wealth  $a_i$  increases if the saving rate of wealthier individuals dominates the saving rate of individuals with wealth  $a_i$ .

When savings are positive,  $s_j(a_i)$ )<sup>-</sup>, the density of individuals with wealth  $a_i$  increases if the saving reduction of wealthier individuals dominates saving change of individuals with wealth  $a_i$ .

#### Unemployed

Unemployed can only face positive income shock (getting a job) and always have negative saving. In the new tax scenario, unemployed only face a lower capital income (and no change in labour income). After the increase in capital tax, the interest rate has increased since investment is lower. However, in the new steady-state, the rise in interest rate is not offsetting the capital tax increase. Therefore, capital income  $(1 - \tau_K)ra$  is



Figure 3: Saving rate by labour market category

lower in the new tax scenario.

Since the tax is proportional, the increase in capital tax implies a higher fall of capital income for wealthier unemployed. Besides, wealthier unemployed have a higher marginal propensity to save. Since their income decreases, they decrease savings by a higher amount than poorer unemployed. As explained above, this leads to an increase in density at low level of wealth.

Therefore, in the new tax scenario, the probability to have a low level of wealth is higher. The probability density function (PdF) for low level of wealth (corresponding to below initial median wealth) increases (see Figure 4).

This leads to an accumulated increase in the cumulative distribution function (CdF). For high level of wealth (above median), the CdF decreased slightly implying a lower accumulated increase in the CdF (see Figure 5).

The wealth change in euros increases with the level of wealth (see Table 7)). This change represents an increasing share of wealth for those who hold a wealth lower or equal to the  $60^{th}$  percentile.

For wealthier individuals (above the  $60^{th}$  percentile), the change is less important relative to the initial level of wealth (see Table 7).



Figure 4: PdF for low level of wealth (corresponding to below initial median wealth)



Figure 5: CdF for high level of wealth

Variables	U : Euros	U: Growth	B : Euros	B: Growth	G : Euros	G: Growth
P 20	-320.026	-2.222	-320.026	-1.176	-2240.179	-1.280
P 40	-640.051	-2.273	-640.051	-1.709	-4480.358	-1.318
P 60	-4480.358	-7.447	-3200.320	-5.556	-7040.563	-1.299
P 80	-10240.819	-3.252	-10240.819	-3.548	-10240.819	-1.226
P 90	-12801.024	-2.256	-13121.050	-2.461	-13441.075	-1.237
P 95	-15041.203	-1.888	-15361.229	-2.031	-16001.280	-1.224

Table 7: Steady State Analysis - Wealth change by labour market category

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

U, B and G correspond respectively to unemployed, individuals with bad and good jobs. In the column 'Euros', we see that the unemployed has lost 320 euros in the long run. Its wealth has decreased by 2.22 %.

To compute the wealth held by unemployed at the  $60^{th}$  percentile, we have found the level of wealth such that

$$G_0(a) = 60\% \tag{22}$$

and

$$G_N(a) = 60\% \tag{23}$$

Since many unemployed are moving below wealth initially hold by the unemployed at the  $60^{th}$  percentile, the level of wealth corresponding to  $60^{th}$  percentile fell sharply. Above the  $60^{th}$  percentile, the CdF increases slowly with wealth. Therefore, the level of wealth corresponding to percentile above 60 decreased less.

Unemployed in the top 10 lose relatively less than the average (see wealth growth in table 7). Therefore, the top 10 wealth share for unemployed increases (see Figure 6). Unemployed in the middle 40 are those for which the wealth variation is the higher. They are the most negatively affected by the reform. Unemployed in the bottom 50 lose on average less than the middle class. Indeed, their wealth decreases less since they



Figure 6: Wealth share change in the long run

reduce less their savings.

#### Individuals with bad jobs

For individuals with bad jobs, capital and labour income decreased. Total net income is reduced but those close to the liquidity constraint still use precautionary savings. There is a flow of individuals from above P40 to below P40 (see Figure 7). As for the unemployed, the top 10 wins while middle 40 and bottom 50 wealth share decreases and the middle 40 is the most negatively affected by the reform (see Figure 6).

## Individuals with good jobs

Those individuals always have positive precautionary savings since they can only face negative income shocks. Therefore, wealth of individuals with good jobs is decreasing less than for individuals in other labour market category. Therefore, their wealth share increased (see Figure 6).

#### Comparing between labour market category

As shown in Figure 6, individuals in the bottom 50 and the middle 40 unemployed or with bad jobs are relatively losing after the reform. Still, the most negatively affected are the middle 40 unemployed or with bad jobs.



Figure 7: PdF for low level of wealth (corresponding to below initial median wealth)

#### Total distribution

As seen in previous section, the top 10 wealth share increased while the middle 40 wealth share decreased relatively more than the bottom 50 wealth share (see figure 12).

#### **3.2.2** Transitional Effects

#### Gini Index

When we compute a aggregate measure of inequality, as the Gini Index, we have an overall increase of inequality across for the all population as shown in Figure 10. However, this result has to be shaded when we consider the evolution of Gini index for each labour situation. Indeed, we observe globally that employed individuals suffer differently from this increase in inequality.

The Gini index for individuals with good-jobs starts to increase after the change in fiscal policy but very quickly, inequality decreases below the initial value of the Gini index, before starting again to increase on the very long-run (after 50 years). We observe the same kind of mechanism for the Bad-jobs households but the increase of inequality occurs on the longer period than for the Good-jobs and the inequality measure stays above its initial value. The unemployed agents do not face this behaviour. This results



Figure 8: Share of labour market category across the distribution



Figure 9: Wealth share change in the long run



Figure 10: Gini Index Across Time

can be explained by the distribution of each type of households on the wealth distribution. As shown in Appendix in Figure 18, we can see that the proportion of Good-jobs agents are more important in the right part of the distribution, benefiting the most of the decrease of labour income taxation, while at the same time, the unemployed individuals only suffer from the "bad-side" of the reform as they will only face the increase of capital taxation.

#### Wealth Share of Unemployed

As shown in Figure 11, in the short run, wealthier individuals are less negatively affected. Then, the wealth percentage reduction becomes quickly the highest for the individuals at  $60^{th}$  percentile.

Consider the share of wealth held by the bottom 50, the middle 40 and the top 10 among total wealth, the bottom 50 and the middle 40 are immediately the more negatively affected, while the top 10 wins in wealth share. Indeed, since the top 10 lose less than the average the top 10 wealth share increases.



This figure shows the % change relative to initial wealth for individuals at a particular percentile. We use a polynomial approximation since our results have been discretised (see appendix A.3)

Figure 11: Wealth change across time - Unemployed



Figure 12: Wealth share change across time - Unemployed



Figure 13: Wealth change across time

## Wealth Share of Individuals with Bad Jobs

In the short run, the individual  $60^{th}$  percentile is the most affected and the gap between individual is widening across time. In the first 10 years, the wealthier individuals are less negatively affected. Then, the middle 40 becomes more affected than the bottom 50 because the middle 40 wealth share is decreasing at a higher rate.



Figure 14: Wealth share change across time

#### Wealth Share of Individuals with Good Jobs

The middle 40 wealth is the most negatively affected in the very short run. After 20 years, wealthier becomes more affected than poorer. Indeed, wealth of for poorer individuals is decreasing at a lower rate. In the very short run, the top 10 is winning in



Wealth % Change across distribution - Good jobs

Figure 15: Wealth change across time

wealth share while the others are loosing. However, after 5 years, all individuals with good jobs have a higher wealth share than initially and after 10 years, the poorer have gained more since they are saving more.

## Wealth Share for All

Consider the full distribution, the top 10 is mostly composed of individuals with good jobs. Therefore, the wealth share of the top 10 is immediately higher and increases across time. Then, the middle 40 and the bottom 50 are mostly composed of individuals with bad jobs. In the short run, individual in the bottom 50 lose relatively more in wealth share than the middle 40. However, the opposite effects occurs after 10 years: the middle 40 becomes more negatively affected than the bottom 50 (see figure 17



Figure 16: Wealth share change across time



Figure 17: Wealth share change across time - All labour market categories

#### Conclusion 4

In this paper we have shown the importance of transitional dynamics to evaluate the impact of a change in tax composition. Indeed, while the aggregate effects are well know and well understood, our main contribution shows that distributional effects are inevitable to fully evaluate such policy. We observe that while in the short-run, the change in tax composition has positive effects on consumption and production, while in the final steady state, we obtain an overall negative macroeconomic impact. The impact on wealth shares and wealth distribution shows that when the richest households (Top 10 %) are the less affected both on long-run and short-run, this not the case for the main part of the distribution. Indeed, the rest of the distribution reacts differently depending on time-horizon, labour situation and position in wealth distribution. The middle class suffers the most of this policy, this result does not hold anymore when we consider short-run results, where the poorest households (bottom 50 %) seems to be the greatest losers of the new fiscal trade-off between capital and labour income taxation.

# A Appendix

## A.1 Initial Wealth distribution



Figure 18: Initial Wealth Distribution

## A.2 Polynomial approximation

Since we discretise the continuous distribution on a grid, we use a polynomial approximation to compute the evolution of wealth at particular point of the distribution across time. Here we plot our discrete results and their polynomial approximation.



Figure 19: Wealth change (U)- Points simulated and polynomial approximation



Figure 20: Wealth share change (U) - Simulation and polynomial approximation



Figure 21: Wealth change (B) - Points simulated and polynomial approximation



Figure 22: Wealth share change (B) - Simulation and polynomial approximation



Figure 23: Wealth change (G) - Points simulated and polynomial approximation



Figure 24: Wealth share (G) - Simulation and polynomial approximation



Figure 25: Wealth share change (All) - Simulation and polynomial approximation

## References

- Yves Achdou, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll. Income and wealth distribution in macroeconomics: A continuous-time approach. Technical report, National Bureau of Economic Research, 2017.
- S Rao Aiyagari. Uninsured idiosyncratic risk and aggregate saving. The Quarterly Journal of Economics, 109(3):659–684, 1994.
- Yann Algan, François Chéron, Jean-Olivier Hairault, and François Langot. Wealth effect on labor market transitions. *Review of Economic Dynamics*.
- Patrick Artus, Antoine Bozio, and Cecilia García-Peñalosa. Taxation of capital income. Notes du conseil d'analyse économique, (9):1–12, 2013.
- Orazio P Attanasio. Consumption. Handbook of macroeconomics, 1:741-812, 1999.
- Robert J Barro. Are government bonds net wealth? Journal of political economy, 82 (6):1095–1117, 1974.
- Truman Bewley. Stationary monetary equilibrium with a continuum of independently fluctuating consumers. Contributions to mathematical economics in honor of Gérard Debreu, 79, 1986.
- Matthieu Bussière, Laurent Ferrara, Michel Juillard, and Daniele Siena. Can fiscal budget-neutral reforms stimulate growth? model-based results. 2017.
- Christopher D. Carroll, Jiri Slacalek, and Kiichi Tokuoka. The distribution of wealth and the mpc: Implications of new european data. *The American Economic Review*, 104 (5):107–111, 2014. ISSN 00028282. URL http://www.jstor.org/stable/42920919.
- Christophe Chamley. Optimal taxation of capital income in general equilibrium with infinite lives. *Econometrica: Journal of the Econometric Society*, pages 607–622, 1986.
- Juan Carlos Conesa, Sagiri Kitao, and Dirk Krueger. Taxing capital? not a bad idea after all! *American Economic Review*, 99(1):25–48, 2009.

- Isabel Correia. Consumption taxes and redistribution. American Economic Review, 100 (4):1673–94, 2010.
- David Domeij and Martin Floden. The labor-supply elasticity and borrowing constraints: Why estimates are biased. *Review of Economic dynamics*, 9(2):242–262, 2006.
- David Domeij and Jonathan Heathcote. On the distributional effects of reducing capital taxes. *International economic review*, 45(2):523–554, 2004.
- Sebastian Dyrda, Marcelo Pedroni, et al. Optimal fiscal policy in a model with uninsurable idiosyncratic shocks. In 2016 Meeting Papers, volume 1245, 2016.
- Antoine d'Autume. Comment imposer le capital? Revue économique, 58(3):499–533, 2007.
- Jean-Olivier Hairault, François Langot, Sébastien Ménard, and Thepthida Sopraseuth. Optimal Unemployment Insurance for Older Workers. *Journal of Public Economics*, 96(5-6):509–519, 2012.
- Jonathan Heathcote. Fiscal policy with heterogeneous agents and incomplete markets. The Review of Economic Studies, 72(1):161–188, 2005.
- Mark Huggett. The risk-free rate in heterogeneous-agent incomplete-insurance economies. Journal of economic Dynamics and Control, 17(5-6):953–969, 1993.
- Kenneth L Judd. Redistributive taxation in a simple perfect foresight model. *Journal* of public Economics, 28(1):59–83, 1985.
- Barış Kaymak and Markus Poschke. The evolution of wealth inequality over half a century: The role of taxes, transfers and technology. Journal of Monetary Economics, 77:1 25, 2016. ISSN 0304-3932. doi: https://doi.org/10.1016/j.jmoneco.2015.10.004. URL http://www.sciencedirect.com/science/article/pii/S0304393215001233. "Inequality, Institutions, and Redistribution" held at the Stern School of Business, New York University, April 24-25, 2015.

Edward C Prescott. Theory ahead of business-cycle measurement. In *Carnegie-Rochester* conference series on public policy, volume 25, pages 11–44. Elsevier, 1986.