Working Papers / Documents de travail

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WP 2021 - Nr 43

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June 30, 2021

Abstract

We revisit the canonical policy of eliminating capital taxation by increasing labor taxation in a endogenous-labor, heterogeneous-agent model with income and wealth heterogeneity, when the government is subject to a strict (per-period) balanced-budget constraint. By contrast with its non-budget neutral equivalent - associated with a constant tax rate over time and a permanent increase in the level of public debt - we show that the obtained endogenous path for the labor tax rate is sharply *increasing* in the initial period and decreasing over time. The policy then generates a deeper recession in the short-run and a greater expansion in the long-run, as well as a smaller decline in wealth inequality associated with a reduced incentive to save for precautionary motives. Overall, the policy still generates significant losses in average welfare.

Keywords : Fiscal Policy, Capital Tax Cut, Tax Composition, Heterogeneous Agents, Wealth Redistribution

JEL Code : E21, E6, D31, H23

*This work was supported by French National Research Agency Grants ANR-20-CE26-0013-04 and ANR-17-EURE-0020 and by the Excellence Initiative of Aix-Marseille University - A*MIDEX. We wish to thank Sushant Acharya, Jess Benhabib, Antoine Devulder, Aurélien Eyquem, Julien Matheron, Céline Poilly, Jean-Christophe Poutineau, Ludwig Straub and Fabien Tripier for very useful comments and suggestions. This paper also benefited from presentations at various workshops and conferences: ASSET 2018, PET 2019, AFSE 2019, the *Worskhop on Real and Financial Interdependencies* 2019, and T2M 2020.

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1 Introduction

Since the 2007-2009 financial crisis and the general worsening of the world economic situation, many industrialized countries have experienced a sharp degradation in their public finance and a strong increase in their debt-to-GDP ratio. Meanwhile, wealth and income distribution have continued to widen in these countries, placing the issues of inequality and redistribution at the heart of recent academic and public policy discussions. This new context has drastically constrained the way "structural reforms" - designed to improve economic efficiency - could be adopted and implemented in these countries. These reforms are now typically required to avoid any further deterioration in public finance and to be consistent with some degree of "fairness" at the macroeconomic level, i.e. to not deteriorate further the level of economic inequality. [1]

In this paper, we reconsider a canonical reform analyzed in the literature, namely the policy of decreasing permanently the capital tax rate financed by increasing labor taxation. We differ from the previous literature by considering a key novel ingredient, namely that the government must balance its budget *at each point in time* over the course of the reform, so that the reform does not lead to any short-run and long-run changes in the level of public debt. We argue that introducing this new ingredient is important not only for "real-world" considerations, as described above, but also from a more theoretical perspective. Previous papers in the literature have typically considered "non-budget neutral" capital tax cuts, i.e. policies associated with short-run and long-run variations in public debt levels (see in particular Domeij and Heathcote [2004] and related references in our discussion of the literature below). Thus, it is difficult in these papers to disentangle the effects of the policy that are due to the tax composition change *per se* (i.e., changes within the set of capital and labor tax rates consistent with the financing of a given amount of public spending) from those that result from the variations in the public debt level. According to recent results in the literature, the long-run and distributional effects

[1] The research program underlying this paper was prepared, for the most part, before the outburst of the COVID-19 crisis. Of course, the balance-budget perspective for the government has been largely put aside over the course of this crisis. Still, we believe that balanced-budget considerations for the government will become even more important in the future as soon as the sanitary crisis is over, due to the dramatic additional increase in the debt-to-GDP ratios that all industrialized countries have experienced in the last two years.

of public debt variations are significant (see e.g. Floden [2001], Bilbiie et al. [2013] and Röhrs and Winter [2017]). Our "budget-neutral" policy (hereafter BN policy) is immune to this criticism since it focuses on the direct effects of a tax composition change only. We explicitly consider both the short-run and the long-run effects of this policy, not only in terms of aggregate macroeconomic variables but also in terms of inequality and redistribution.

The framework we consider to analyze this issue is a standard heterogeneous agent model with incomplete markets, uninsured idiosyncratic labor income risk and endogenous labor choices, in line with the canonical setups of Bewley [1986], Huggett [1993], Aiyagari [1994] and Domeij and Heathcote [2004]. At each point in time, households make labor, consumption and saving choices depending on their current wealth and labor productivity levels, while firms decide on output and production inputs. The levels of macroeconomic variables are determined at equilibrium by the distributions of wealth and labor-income/productivity levels and the aggregation of individual consumption, labor and production choices. Our model is calibrated on the US economy and replicates quite well the US wealth distribution, except for the very top of this distribution. We can then consider the permanent capital tax cut policy described above. Namely, for a given initial stationary distribution associated with a particular capital-labor tax composition, we analyze the effects of a permanent elimination of capital taxation associated with a (perfectly anticipated) *sequence* of future labor tax rates enabling the government to balance its budget at every period in time, taking all general equilibrium effects into account. In order to find this sequence of equilibrium labor tax rates, we use and adapt recent numerical techniques for solving heterogeneous agent models developed by Achdou et al. [2017]. For comparison purposes, we also consider a non-budget neutral policy (hereafter NBN policy) similar to the one considered in Domeij and Heathcote [2004] in which the tight balanced-budget condition is not imposed and the labor tax rate is constant. In this case, the only requirement is that the public debt level associated with the new labor tax rate remains bounded in the long-run.

Our main results can be summarized as follows. First, we show that in the BN policy the obtained endogenous path for the labor tax rate implies a sharp *increase* in the initial period and is then decreasing over time. Thus, the labor tax is higher in the short run than the constant labor tax rat in the NBN environment, and it becomes eventually smaller than this constant labor tax rate only after several years. These different paths for the two labor tax rates, and the corresponding different paths for the public debt level, then generate significant differences in terms of macroeconomic outcomes between the two capital tax cut policies.

Elaborating on these results and starting with the long run effects of the policy, in the long run, the smaller labor tax combined with the elimination of capital taxation implies that the BN policy favors capital accumulation to a greater extent than its NBN equivalent. Thus, it also leads to a greater output expansion. The long-run response of hours worked is *a priori* ambiguous since a greater capital stock and a larger labor income tax have opposite effects on the net marginal productivity of labor and on net wages. In our calibration, the positive effect of capital accumulation dominates and hours worked (and net wages) rise in the new stationary state. Aggregate consumption also increases in the long-run, but very moderately since the change in tax composition affects capital income and labor income in opposite directions. Finally, one of the most striking difference between the two policy scenarios concerns the public debt level. While by definition the public debt level remains constant in the BN policy, it more than doubles in the NBN scenario. This implies that a significant fraction of the reform in the latter case is actually financed by public debt accumulation, so that the results obtained in this case cannot be interpreted as resulting only from the tax composition change *per se*, as emphasized above.

Turning to the short-run, the effects of the policies are quite different. Since the aggregate capital stock is fixed in the implementation period and capital takes time to accumulate, the positive effect of capital accumulation on the marginal productivity of labor (and on net wages) is not yet operative, so that most effects are driven by the increase in labor taxation. The latter implies a substantial decrease in aggregate hours worked, net wages, consumption and output, thus generating a recession. Since the increase in the labor tax rate is higher in the BN policy than in the NBN policy, these contractionary effects are magnified in the BN case. Over time, as capital accumulation increases the marginal productivity of labor, the labor tax rate required to balance the budget gradually decreases and hours worked, consumption and output all gradually increase, eventually exceeding their pre-reform levels. Therefore, the policy generates a deeper immediate recession which progressively translates into a larger long-run expansion.

Finally, the two policy scenarios have different distributional and welfare effects. In this model in which wealth inequality results from labor income heterogeneity and the correspondingly different "histories" of households in terms of individual labor productivity, the complete elimination of capital taxation actually leads to a *decline* in wealth inequality, as measured for example by the Gini coefficient. We provide a detailed analysis of the sources of this decline, tracing it back into the heterogeneous saving behaviors of households at different wealth and labor productivity levels. Across the entire distribution, the *intertemporal substitution effect* implies that agents consume less and save more when the net interest-rate increases. However, the extent of this additional saving is influenced by both *permanent income* and *precautionary savings* motives which, by contrast, are significantly different across households. With a decrease in capital taxation and an increase in labor taxation, capital income becomes a proportionately greater component of total income. As a result, the richest households can rely on this extra capital income to "self-insure" against future income losses associated with becoming less productive, so that they do not have to save much for precautionary reasons. Similarly, poor, low-income agents associated with the lowest productivity types "only" have the prospect of improving their labor income by becoming more productive, and thus they have no reason to save much for precautionary purposes. On the contrary, in spite of the capital tax cut, moderately productive agents that do not belong to the upper part of the wealth distribution do not have enough assets to significantly self-insure against future labor income losses associated with becoming less productive, and thus they tend to save more for precautionary savings motives. Since these "middle class" workers represent a significant share of the total population, their proportionately greater saving generates a higher concentration of wealth at the middle of the wealth distribution. This explains why the level of wealth inequality decreases.

Comparing the results obtained under the BN and the NBN scenarios, we show that the latter effect is less pronounced when the government takes balanced budget considerations into account. Facing a higher labor tax increase in the short-run compared to the NBN case, middle class households are exposed to a smaller loss of labor income if they become less productive. As a result, their precautionary saving increases proportionately less than in the NBN case. The reduction of inequality is still present, but it is less important in the BN policy than in its NBN counterpart.

Finally, in spite of these "favorable" outcomes of the capital tax cut policy in terms of wealth inequality, we show that this policy remains largely detrimental for the average welfare, for two reasons: first, for the vast majority of households, consumption after the reform is significantly lower than its pre-reform level for a very long time-span. Second, as we show below, the tax reform implies an increase in the riskiness of equilibrium consumption-labor profiles, both across households and over time. These short-term and risk-related utility losses are not compensated by the longer-term utility gains associated with an increased consumption level in the long-run, nor by the reduction of wealth inequality across households. We also show that the deterioration in average welfare is slightly smaller in the BN policy than in the NBN policy, due to the smaller increase in the riskiness of equilibrium consumption profiles.

Related Literature

Our paper belongs to a wide literature analyzing the effects of tax composition changes in dynamic macroeconomic models. This literature was strongly influenced by the seminal contributions of Judd [1985] and Chamley [1986], who showed that in standard infinitely-lived agent models with complete markets, the long-run optimal tax rate is zero. This result was extended by Atkeson et al. [1999] and Chari and Kehoe [1999], who showed that the result held in various other contexts, including in particular the presence of heterogeneous agents. However, Chamley's result was shown not to be robust to the introduction of idiosyncratic income risk in incomplete market models of the type developed by Bewley [1986], Huggett [1993] and Aiyagari [1994]. Aiyagari [1995] showed that in these setups, the optimal long-run capital tax rate is typically positive.

This literature led many researchers to assess what would be the macroeconomic and welfare implications of eliminating capital taxation, compensating the income losses for the government by adjusting the labor tax rate (or the consumption tax rate) to a new constant level. The seminal contribution is Lucas [1990] who showed that, in a standard representative agent framework, the welfare effects of eliminating capital taxation are significant. Nonetheless, the result does not hold in heterogeneous agent models. For example, Garcia-Milà et al. [2009] show that in such setups abolishing capital taxation has large distributional effects and benefits only to the richest agents. Correia [2010] considers the effect of suppressing capital taxation and financing the loss in revenue with various combinations of labor and consumption taxes. In contrast with Garcia-Milà et al.

[2009], she shows that under realistic wealth and income distributions, an elimination of capital taxation financed by a flat consumption tax can reduce inequality and be welfare improving for the poorest households.

The previous papers, however, do not display idiosyncratic income uncertainty. As such they do not leave a role for precautionary savings, which is known to be important and to play a significant role in incomplete market heterogeneous agent models. For this reason, Domeij and Heathcote [2004] analyze the effect of abolishing capital taxation in a Aiyagari-type model, comparing the effects with those obtained in a standard representative-agent model. Despite the consideration of precautionary saving motives, their results are consistent with those of Garcia-Milà et al. [2009]: a capital tax cut financed by a permanent labor tax increase is welfare-improving in a representative-agent economy, but is welfare-reducing for the majority of households except the richest ones in a heterogeneous agent model with idiosyncratic income uncertainty.

All the previous papers share in common that the tax composition changes imply short-run and/or long-run variations in the level of public debt. This is not innocuous, since public debt *per se* also has significant distributional and welfare effects. Aiyagari and McGrattan [1998] first analyzed this issue in a heterogeneous agent model with idiosyncratic uncertainty and identified the relevant tradeoffs. They concluded that the (at the time) US level of public debt was close to the optimum quantity of debt from the utilitarian welfare point of view. Floden [2001] extended the analysis to take into account the role of transfers, and showed that the welfare gains or losses for an utilitarian social planner are the combination of complex and sometime contrasting effects involving a level effect, a risk-sharing effect and an inequality effects. Bilbiie et al. [2013] compare the effects of budget-neutral and debt-financed lump-sump tax cuts in a simple borrower-saver model with or without sticky prices and they show that the two policies have drastically different macroeconomic and distributional effects. Röhrs and Winter [2017] analyze the effects of debt reduction in a heterogeneous agent model targeting realistic skewed wealth and income distributions.

A recent literature then developed to analyze what is the optimal debt - tax composition dynamics in these heterogeneous agent models. For example, Dyrda and Pedroni [2018] analyze in a quantitative model what should be the optimal paths for capital and labor taxation and the corresponding optimal government debt dynamics when the social planner cares for redistribution and inequality. Acikgöz et al. [2018] study the optimal long-run Ramsey solution to such a problem and conclude that, with respect to their respective actual levels in the US, the optimal long-run capital tax should be lower while the debt level and the labor income tax should be higher.

The closest papers to our work are thus Domeij and Heathcote [2004], Garcia-Milà et al. [2009] and, to a lesser extent, Dyrda and Pedroni [2018]. Compared to Garcia-Milà et al. [2009] but similarly to Domeij and Heathcote [2004], we explicitly consider uninsured labor income uncertainty, allowing us to generate a motive for precautionary savings. As it turns out, this motive plays a crucial role in the evaluation of the aggregate and distributional consequences of tax composition changes. Compared to Domeij and Heathcote [2004], and compared to all other previously mentioned papers in the literature, our paper is, as far as we know, the first one to consider the implications of a *strictly budget-neutral* change in the capital-labor tax composition in heterogeneous agent models with uninsured idiosyncratic income risk (without relying on exogenous lump-sum transfers to compensate the government for the potential revenue losses). Thus, compared to, e.g., Domeij and Heathcote [2004], when analyzing the policy of abolishing capital taxation, we are able to differentiate the effects that result from the tax composition change *per se* to those that are associated with a permanent increase in the level of public debt. By considering, as an alternative to our budget-neutral policy, a non-budget-neutral policy similar to the one considered by Domeij and Heathcote [2004], we are then able to *quantify* these different effects, and we show that they are quantitatively significant. Finally, we undertake in this paper a thorough analysis of the saving behavior of agents, both along the time dimension and across segments of the wealth distribution. This allows us, among other things, to identify how the intertemporal substitution effect, the life cycle/permanent income effect and the precautionary savings motives evolve and interact with each other in reaction to changes in the capital-labor tax composition, and thus how they respond to induced variations in the net interest rate.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 describes the calibration and assesses the ability of the model to match key moments of the US economy, in particular the wealth distribution. In Section 4, we analyse the effects of the capital tax cut policy described above, taking transition and distributional effects into account. We compare the results with an alternative policy inspired from

Domeij and Heathcote [2004] in which the government budget is not balanced in every period in time. We also derive the welfare implications of these policies and we analyze and quantify the differences. Finally, we assess the sensitivity of our results to alternative calibrations of structural parameters. Section 5 concludes.

2 Model

We consider a simple heterogeneous agent model with endogenous labor choices in the line of Aiyagari [1994], Domeij and Heathcote [2004] and Heathcote [2005]. The economy is composed of heterogeneous consumers that differ in terms of wealth (asset levels) and idiosyncratic labor productivity. Markets are incomplete because agents cannot insure against the income variations associated with switches in labor productivity levels. The economy also features firms, producing the unique final good using labor and capital, and a government, financing its public spending and debt service using labor income and capital income taxation. Although we consider, for empirical consistency, that there is a positive amount of public debt in the pre-reform period, we assume that the government is subject to a tight budget constraint, in the sense that any new reform must be conducted under a strict (period per period) balanced-budget condition.

2.1 Households

The economy is composed of a continuum of unit mass of infinitely-lived heterogeneous agents. These agents differ in terms of their wealth (accumulated assets levels a_{it}) and labor productivity level z_j. The latter is assumed to take three values: $z_j \in (z_L, z_M, z_H)$ standing for "low-skilled", "medium-skilled" and "high-skilled", respectively, with $z_H > z_M > z_L$. Agents switch stochastically between these skill levels over time according to a three-state Poisson process and choose their individual working hours n_{jt} accordingly.

Specifically, let z_j be the productivity level of an individual, with $j \in (L, M, H)$. The corresponding net wage income is $(1-\tau_t^w)w_t z_j n_{jt}$, where w_t is the base wage, and τ_t^w is the wage income tax rate. This agent also receives capital income $(1-\tau_t^k)\, a_{it}\, r_t$, based on its individual wealth a_{it}, the capital income tax rate τ^k and the real interest rate r_t. Thus, the budget constraint of this agent is

$$\dot{a}_{ijt} = (1-\tau_t^w)w_t z_j n_{jt} + (1-\tau_t^k)\, a_{it}\, r_t - c_{ijt}, \tag{1}$$

with c_{ijt} its consumption level.

Households are free to borrow or save but they are exposed to a borrowing limit $a \geq \underline{a}$, with $-\infty < \underline{a} < 0$. Households aim to maximize their intertemporal utility function

$$\mathbb{E}_0 \int_0^\infty e^{-\rho_t} u\left(c_{ijt}, n_{jt}\right) dt, \tag{2}$$

where $\rho > 0$ is the subjective discount rate, and $u(c, n)$ is a standard ("well behaved") instantaneous utility function. This maximization is made subject to (1), the borrowing limit $a \geq \underline{a}$, and the exogenous Poisson process governing transitions between productivity levels.

We denote by $V(a, t)$ the vector of value functions for each productivity types, by n the vector of individual labor supplies multiplied by their corresponding individual productivity levels,[2] and by Λ the transition matrix between skills. The optimal decisions are then described by the following Hamilton-Jacobi-Bellman (HJB) equation

$$\rho V\left(a,t\right) = \max_{c,n} u\left(c,n\right) + \partial_a V(a,t)\ \left[(1-\tau_t^w) w_t n\ + (1-\tau_t^k)\, a\, r_t\ - c\right] + \Lambda^T V(a,t) + \partial_t V\left(a,t\right) \tag{3}$$

and the state-constraint boundary condition

$$\partial_a V(\underline{a}, t) \geq u_c'\left((1-\tau_t^w) w_t n\ + (1-\tau_t^k)\, \underline{a}\, r_t\right). \tag{4}$$

The first-order conditions are

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

$$u_n'\left(c_t, n_t\right) = -\partial_a V(a,t)\left(1-\tau_t^w\right) w_t z_j. \tag{6}$$

These conditions can be simplified to obtain a standard labor supply equation

$$-\frac{u_n'\left(c_t, n_t\right)}{u_c'\left(c_t, n_t\right)} = \left(1-\tau_t^w\right) w_t z_j \tag{7}$$

As usually done in the literature, we consider that the instantaneous utility function belongs to the class suggested by Greenwood, Hercowitz and Huffman [1988] , namely:

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

[2] i.e. $V(a,t) = \begin{bmatrix} V_L(a,t) \\ V_M(a,t) \\ V_H(a,t) \end{bmatrix}$ and $n = \begin{bmatrix} n^L z_L \\ n^M z_M \\ n^H z_H \end{bmatrix}$

with $\sigma > 0$, the parameter driving the coefficient of relative risk aversion, ψ the labor disutility and $\epsilon > 0$, the Frisch elasticity of labor supply. As is well known, this specification eliminates any wealth effect on the labor supply curve, which in this case simplifies to

$$n_{jt} = \left[\frac{z_j w_t \left(1 - \tau_t^w\right)}{\psi}\right]^\epsilon . \tag{8}$$

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 labor N_t

$$\Pi_t = K_t^\alpha N_t^{1-\alpha} - w_t N_t - (\delta + r_t) K_t, \tag{9}$$

with $\delta \in [0,1]$ the quarterly capital depreciation rate and $\alpha \in [0,1]$. Firm's first-order conditions are given by :

$$r_t = \alpha K_t^{\alpha-1} N_t^{1-\alpha} - \delta \text{ and } w_t = (1-\alpha) K_t^\alpha N_t^{-\alpha} \tag{10}$$

2.3 Government

The government uses taxes on capital and labor income to finance its spending and the service on public debt. The government budget constraint is

$$\dot{B}_t = G + r_t B_t - \tau_t^k r_t A_t - \tau_t^w w_t N_t, \tag{11}$$

with A_t the aggregate wealth in the economy, G the constant amount public spending and B_t the level of government debt. However, in our benchmark policy, we consider a strict budget-neutral policy associated with a constant level of public debt, $\dot{B}_t = 0$. In this context, any change in the tax composition must be associated with the following balanced-budget constraint:

$$G + r_t B = \tau_t^k r_t A_t + \tau_t^w w_t N_t \tag{12}$$

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 $\left(\tau_t^k, \tau_t^w, G_t, B_t\right)$, distribution functions $(g_L(a,t), g_M(a,t), g_H(a,t))$, with $(G_L(a,t), G_M(a,t), G_H(a,t))$ the corresponding cumulative functions, and aggregate variables (K_t, N_t, C_t, Y_t), such that, for t $\in [0,\infty]$:

- Households choose a, c and n to solve their maximization program such that the borrowing and boundary constraints hold,
- The representative firm choose K and N to solve its profit maximization program,
- Given the solution of the household's maximization program, the distribution functions satisfy

$$\frac{\partial \tilde{g}(a,t)}{\partial t} = -\frac{\partial [s(a,t)\tilde{g}(a,t)]}{\partial a} + \Lambda^T \tilde{g}(a,t), \text{ with } \tilde{g}\,(a,t) = \begin{bmatrix} g_L(a,t) \\ g_M(a,t) \\ g_H(a,t) \end{bmatrix}, \tag{13}$$

$g_L(a,t), g_M(a,t), g_H(a,t)$ being the distributions over the wealth grid of "low-skilled", "medium-skilled" and "high-skilled" workers, respectively (with $\iint_{\underline{a}}^{\infty} g_j(a,t)dadj = 1$), and Λ is the transition matrix between skill levels. We further denote by $\bar{L}$, $\bar{M}$ and $\bar{H}$ the fixed proportion of individuals in each productivity level, i.e.

$$\bar{L} = \int_{\underline{a}}^{\infty} g_L(a)da,\ \bar{M} = \int_{\underline{a}}^{\infty} g_M(a)da \text{ and } \bar{H} = \int_{\underline{a}}^{\infty} g_H(a)da.$$

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

$$A_t = \int_{\underline{a}}^{\infty} adG_L(a,t) + \int_{\underline{a}}^{\infty} adG_M(a,t) + \int_{\underline{a}}^{\infty} adG_H(a,t) \tag{14}$$

$$C_t = \int_{\underline{a}}^{\infty} c_t^L dG_L(a,t) + \int_{\underline{a}}^{\infty} c_t^M dG_M(a,t) + \int_{\underline{a}}^{\infty} c_t^H dG_H(a,t) \tag{15}$$

- The government budget constraint (Eq. 11) or (Eq. 12) holds ,
- and all market clearing conditions are satisfied, so that

$$A_t = B_t + K_t \tag{16}$$

$$N_t = \bar{L}\, n_t^L z_L + \bar{M}\, n_t^M z_M + \bar{H}\, n_t^H z_H \tag{17}$$

$$Y_t = C_t + I_t + G_t \tag{18}$$

3 Model properties

3.1 Calibration

Our model is calibrated on a quarterly basis to match key features of the US economy over the period 1995 - 2017. Table 1 summarizes the calibration.

Definition & Parameters	Values	Sources
Rate of Time Preference ρ	0.01	Prescott [1986]
Coefficient of Relative Risk Aversion σ	1	Kaplan et al. [2018]
labor disutility ψ	300	Calibrated
Frisch labor supply elasticity ϵ	0.3	Heathcote [2005]
Capital Share α	0.36	Heathcote [2005]
Capital Depreciation δ	0.025	Prescott [1986]
Productivity for Low-skilled z_L	0.4	Calibrated
Productivity for Medium-skilled z_H	1.4	Calibrated
Productivity for High-skilled z_H	4.74	Domeij and Heathcote [2004]
Exit rate from Low-skilled state λ_{LM}	0.02	Calibrated
Exit rate from Medium-skilled state $\lambda_{ML} = \lambda_{MH}$	0.0015	Calibrated
Exit rate from High-skilled state λ_{HM}	0.025	Domeij and Heathcote [2004]
Share of Output for Public Debt ξ	67%	Domeij and Heathcote [2004]
Initial Tax rate of labor income τ^w	29.6%	Domeij and Heathcote [2004]
Initial Tax rate of Capital τ^k	39.7%	Domeij and Heathcote [2004]

Table 1: Summary of calibration

3.1.1 Preferences and technology

The 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 empirical literature (cf Attanasio [1999]) has typically estimated the degree of relative risk-aversion between 1 and 3. We thus set the parameter governing the coefficient of relative risk aversion to $\sigma = 1$, as in Kaplan et al. [2018], leading to a logarithmic GHH utility function. Following Heathcote [2005], the Frisch labor supply elasticity is set to

0.3, in accordance with estimates of this elasticity for the male labor supply ranging between 0 and 0.5 (Domeij and Floden [2006]). The labor disutility parameter ψ is set to 300 in order to target an aggregate labor supply of 0.35 at steady-state. The borrowing constraint $\underline{a}$ is exogenously set at -0.052.

The parameter α is set to one third in order to match the capital income share in the US economy. The depreciation rate δ is set to match a yearly 10% depreciation, as usually done in the literature.

3.1.2 Government

Capital and labor tax rates are respectively set to 39.7 % and 29.6 % in the pre-reform period, which is their implicit rates for the US economy according to Domeij and Heathcote [2004] . We calibrate the public debt ratio to 67 %, which is close to the average level of public debt in the US over the recent decades (see Table 2 below).

3.1.3 Labor productivity

In order to calibrate the Poisson process governing labor productivity switches, we considered as a starting point the calibration of Domeij and Heathcote [2004] and then slightly modify it in order to match as closely as possible the wealth distribution and the Gini coefficient of the US economy (except for the top 1 % as explained below). Denote by

$$\Lambda = \begin{bmatrix} -(\lambda_{LM} + \lambda_{MH}) & \lambda_{LM} & \lambda_{LH} \\ \lambda_{ML} & -(\lambda_{ML} + \lambda_{MH}) & \lambda_{MH} \\ \lambda_{HL} & \lambda_{HM} & -(\lambda_{HL} + \lambda_{HM}) \end{bmatrix} \tag{19}$$

the transition matrix. To reduce the number of parameters to consider, we prevent the possibility of direct switches between low-skill and high-skill productivity levels by setting $\lambda_{LH} = \lambda_{HL} = 0$. Likewise, we assume that the exit rates from medium-skill to low-skill and from medium-skill to high-skill are identical: $\lambda_{ML} = \lambda_{MH}$. The remaining probabilities are set in order to match as closely as possible the quintiles of the wealth distribution according to a Minimum Distance procedure. We obtain transition rates from low-skill to medium-skill and from high-skill to medium-skill of $\lambda_{LM} = 0.02$ and $\lambda_{HM} = 0.025$, respectively, and an exit rate from medium-skill to low-skill or high-skill productivity of $\lambda_{ML} = \lambda_{MH} = 0.0015$. The corresponding individual productivity levels are $z_L = 0.4$, $z_M = 1.4$ and $z_H = 4.74$.

3.2 Model performance

As shown in Table 2, our model manages to reproduce closely the investment/output, consumption/output and goverment spending/output ratios.

Statistics	Model	Data	Sources
Investment/Output (%)	24	27	Dyrda and Pedroni [2018]
Debt/Output (%)	67	67	Domeij and Heathcote [2004]
Consumption/Output (%)	53	52	Dyrda and Pedroni [2018]
Public Spending/Output (%)	23	21	Domeij and Heathcote [2004]

Table 2: Baseline model and data for US - Aggregates

Regarding the wealth distribution, Table 3 shows that the model also reproduces quite successfully the quintiles of the US wealth distribution and that it generates a realistic Gini coefficient. The calibration of the labor productivity process plays of course an important role in shaping a realistic wealth distribution, as shown in, e.g., Nirei and Aoki [2016]. Nonetheless, the table also shows that the model fails to match the top 1% of this wealth distribution. This is unsurprising in light of the discussions in Benhabib et al. [2011] and Benhabib and Bisin [2018], who show that bequests motives, stochastic returns, capital income shocks and a heterogeneous discount rate are all necessary ingredients to reproduce the right fat-tail of the US wealth distribution. Despite this limitation, our main focus in this paper is on the redistributive consequences of a tax composition change on the whole population, not precisely on the richest agents. This explains our focus on the quintiles as opposed to the top 1 %.

4 Effects of a budget-neutral capital tax cut

We now turn to the central part of our contribution, which is to investigate the effects of a budget-neutral (hereafter, BN) permanent cut in the capital tax rate financed by adjusting (per-period) the labor tax rate. After a brief description of our policy experiment, we first present the consequences of our benchmark policy on aggregate variables in both the long-run and along the transition. For comparison purposes, we compare the results with those obtained from an alternative policy, similar to the one analyzed by

Proportion of Wealth Held by each Quintile

	Model	Data	Sources (Data)
Statistics			
1^{st} Quintile	0.009 %	-1.56%	World and Inequality Database (WID)
2^{nd} Quintile	1.42 %	0.48%	WID
3^{rd} Quintile	2.31 %	3.81 %	WID
4^{th} Quintile	15.61 %	12.71%	WID
5^{th} Quintile	79.79 %	84.60 %	WID
Top 1 %	10.05 %	33.8 %	WID
Gini Coefficient	0.74	0.84	WID

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

Domeij and Heathcote [2004], in which the reduction in the capital tax rate is associated with a once-for-all (i.e., constant over time) increase in the labor tax rate. In the spirit of Domeij and Heathcote [2004], we compute in this case the unique labor tax rate consistent with a stable (but larger than initial) public debt level in the long-run. We call this experiment the "Non Budget Neutral" (NBN) policy. In a second step, we investigate the welfare consequences of these reforms and we discuss their implications for the dynamics of wealth distribution. We finally conduct some calibration sensitivity experiments.

4.1 Policy experiment

The policy we consider is a complete elimination of capital taxation from its pre-refom level of 39.7% to 0%. As explained above, in our benchmark experiment, the government adjusts the labor income tax rate at each point in time in order to balance its current budget (BN policy). Alternatively, we also consider the situation in which the capital tax rate is eliminated and the labor tax rate is adjusted on a once-for-all basis in order to maintain a stable level of public debt in the long-run (NBN policy). However, this means that the level of public debt changes (both in the long-run and during the transition) compared to the pre-reform situation.

In our view, considering a BN policy is a more consistent way of investigating the impacts of a tax composition change. Indeed, the recent literature has shown that public debt variations have significant level and distributional effects *per se* (see e.g. Röhrs and Winter [2017]). Thus, a NBN policy combines the effects that are due to the tax composition change with the effects that results from the underlying changes in the public debt levels. Our NBN policy is immune to this criticism since it isolates the level and distributional effects that result from the tax composition change only.

We assume that the policy change, when announced and implemented by the government on the initial date, is fully unexpected by agents. Moreover, once it is announced, we consider that agents are able to fully anticipate the equilibrium path of future labor tax rates consistent with the balanced-budget requirement (or the government announces this path and commits to it). There are no further changes in the institutional environment or in the technology of production.

4.2 Aggregate Effects

We start our analysis with the implications of the policy change for the main macroeconomic variables. The capital tax cut generates an immediate increase in the net interest rate and in net capital income, triggering an increase in investment and capital accumulation (see Figure 1). At the same time, the increase in the labor tax rate generates a decrease in the net wage, associated with a decrease in the aggregate supply of labor. Production and consumption also drop in the short run because of this decrease in labor income, which dominates the increase in capital income. Thus, the policy generates a recession in the short-run.

Over time, the accumulation of capital generates an increase in the marginal productivity of labor for any given labor tax level. As a result, the net wage starts to increase (i.e., becomes less negative compared to the initial steady-state) in spite of the increase in labor taxation. Hours worked, output and consumption follow the same increasing path. After a while, this expansionary effect of capital accumulation eventually dominates, and output, consumption, hours worked and investment all increase. The policy is expansionary in the long-run, in accordance with related papers in the literature (e.g. Domeij and Heathcote [2004] and Garcia-Milà et al. [2009]). The long-run effects on the macroeconomic variables (in percentage deviation points from the pre-reform situation) are summarized in Table 4.

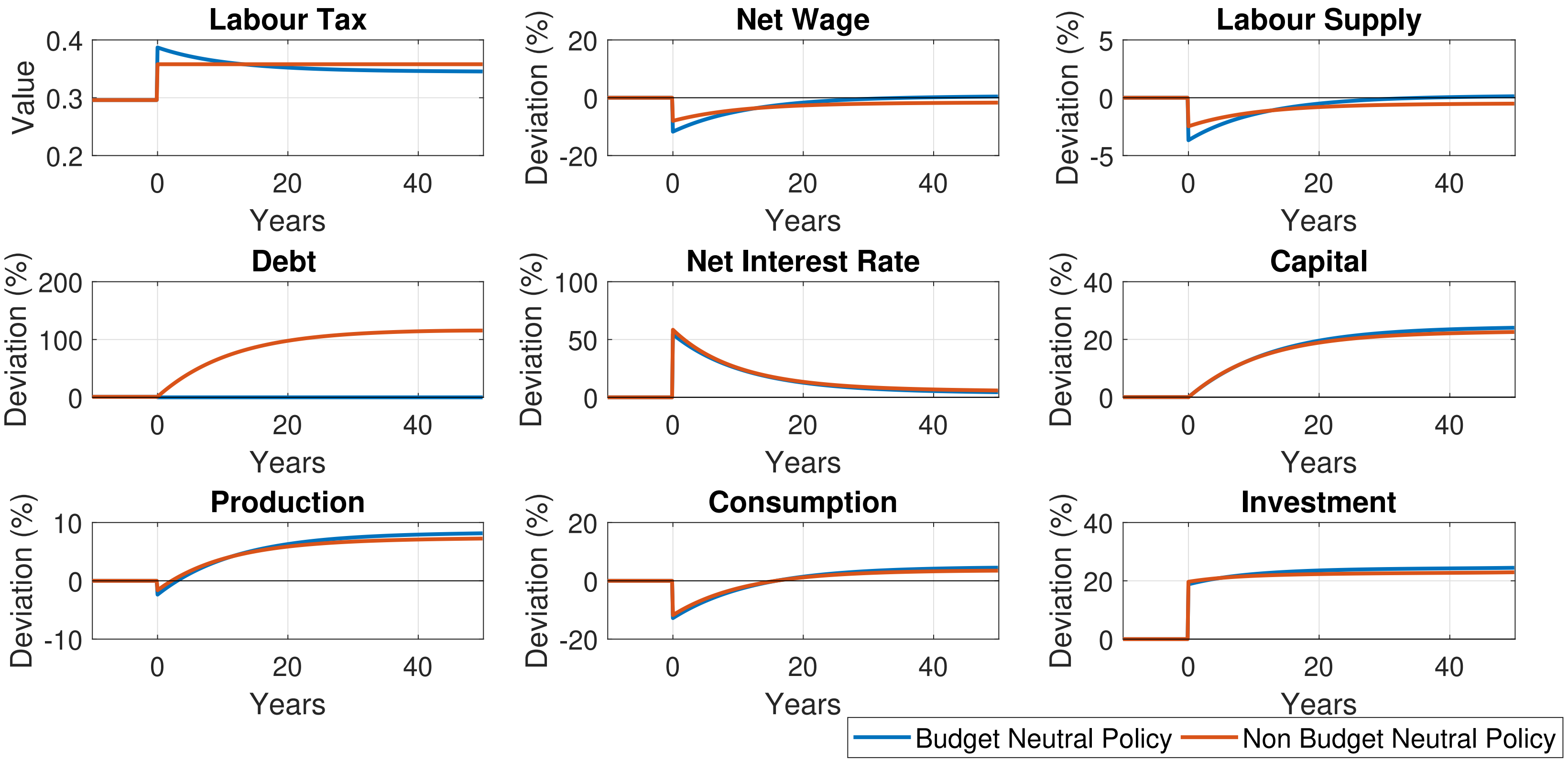

Figure 1: Change w.r.t. initial SS : Aggregate variables - Budget Neutral vs Non Budget Neutral

Prices		**Aggregates**	
Variables	Impact	Variables	Impact
Wage	8.02	**Output**	8.16
Net Wage	0.44	**Labor**	0.13
Interest Rate	-37.05	**Consumption**	4.70
Net Interest Rate	4.39	**Capital**	24.07

Table 4: Long-run variations (% deviations from initial steady state): Aggregates variables

In Figure 1, we also compare the results for the main macroeconomic variables to those that would be obtained if the capital tax cut was implemented while the strict balanced-budget condition is removed (NBN policy). By assumption, in this case, the labor tax rate is constant and is set to its unique value consistent with a bounded government debt in the long-run (similarly to Domeij and Heathcote, 2004). As can be seen, an important difference between these two experiments is that in the BN case, the government must impose a significantly higher labor tax rate in the short run than in the NBN case. It is only roughly 13 years after the implementation of the reform that the labor tax rate in the BN policy becomes smaller than its constant NBN counterpart

As shown in Figure 1, in spite of these different paths for the labor tax rate, the responses of most macroeconomic variables after the reform are qualitatively similar. However, quantitatively, there are significant differences. Among the most noticeable differences is that under the BN policy, the larger short-run increase in labor taxation implies a significantly greater drop in the net wage, the labor supply and output than in the NBN scenario. For example, in the initial period after the reform, the net wage drops by 11.74 % in the BN case, the labor supply drops by 3.68 % and output drops by 2.37 %. In the NBN case, the corresponding numbers are -8 %, -2.47 % and -1.62 %, respectively. Thus, the BN policy generates a much deeper recession in the short-run than the NBN policy. Of course, in the long-run, the opposite results hold. The smaller long-run labor tax rate in the BN scenario implies a greater expansionary effects of the capital tax cut policy. For example, the long-run increase in output is 8.16 % in the BN scenario, compared to 7.26 % in the NBN case. A summary of these contrasting results is presented in Table 5.

Short-Run		Long-Run		
BN	NBN	BN	NBN	
-11.74	-8.00	0.44	-1.68	**Net Wage**
-14.98	-10.28	0.56	-2.19	**Net Wage Income**
54.48	58.45	4.39	5.87	**Net Interest Rate**
54.48	58.45	27.88	36.37	**Net Capital Income**
-2.37	-1.62	8.16	7.26	**Output**
-3.68	-2.47	0.13	-0.51	**Labor**
-12.79	-11.77	4.70	3.65	**Consumption**
0	0	24.07	22.60	**Capital**

Table 5: Short-run and long-run variations (% deviation from initial steady state): BN versus NBN policy

However, the most striking difference in the two policy scenarios concerns, of course, the public debt level. While, by definition, the level of public debt remains constant in the BN case, Figure 1 shows that it more than doubles in the NBN cases compared to the pre-reform period. This implies that a very significant part of the reform in the NBN case is actually "financed" by public debt accumulation.

In our view, these contrasting effects of the capital tax cuts policies - attenuating or amplifying the initial recession and having very different implications for the long-run level of public debt - justify the consideration of the strict balanced-budget policy as an alternative to the NBN policy usually considered in the literature. Beyond the theoretical implications already mentioned in the introduction, these contrasting effects will also be of primary importance in terms of public policy discussions since they are likely to influence significantly the public acceptance of these reforms.[3] Of course, these considerations will also be relevant when we analyze the different distributional consequences of these two policy scenario, an issue to which we now turn in the following subsection.

[3]For example, a capital tax cut partially financed by public debt may raise the concern that the burden of the reform is unequally spread among generations. By contrast, a balanced-budget capital tax cut may be criticized for the large labor tax increase it imposes to workers and for the deep short run economic contraction

4.3 Distributional Effects

We now analyze the implications of the tax composition change on inequality and the wealth distribution. We show that the BN policy is less regressive than the NBN policy, but we start by investigating the common effects of the BN and NBN policies. One of the most striking results of our analysis is that the complete elimination of capital taxation actually leads to a *decline* in wealth inequality. To illustrate this claim, Figure 2 displays the evolution of the wealth Gini coefficient before and after the implementation of the reform (blue solid line for the BN scenario). The Gini coefficient drops from 0.74 in the initial date to roughly 0.71 in the new long-run wealth distribution.

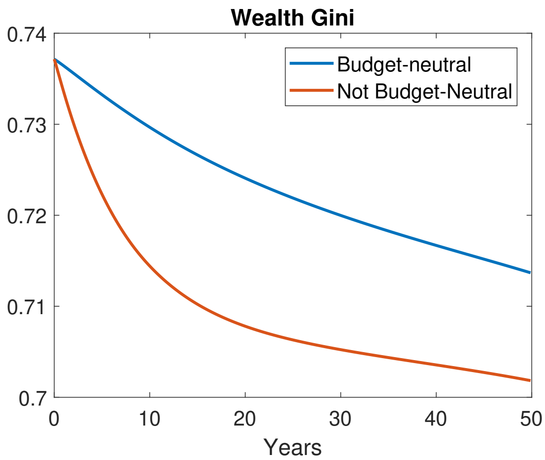

Figure 2: Wealth Gini coefficient - Budget Neutral vs Non Budget Neutral

How can we make sense of this result in spite of the fact that capital (and capital income), which is very unevenly distributed across agents, is taxed at a smaller rate? A preliminary answer can be found in Figure 3, which displays the evolution of wealth for agents at each quintile of the wealth distribution (blue solid line for the BN case). As can be observed, the capital tax cut implies that agents across all segments of the wealth distribution choose to accumulate more capital. However, the extent to which they do so is clearly not uniform. Figure 3 reveals that, on average, households in the bottom quintiles of the wealth distribution choose to accumulate proportionally more wealth than households in the upper quintiles. This generates a concentration of households at the intermediate levels of the wealth distribution, which in turn explains why the Gini coefficient decreases.

Thus, an explanation of the decline in wealth inequality must clearly be found in the

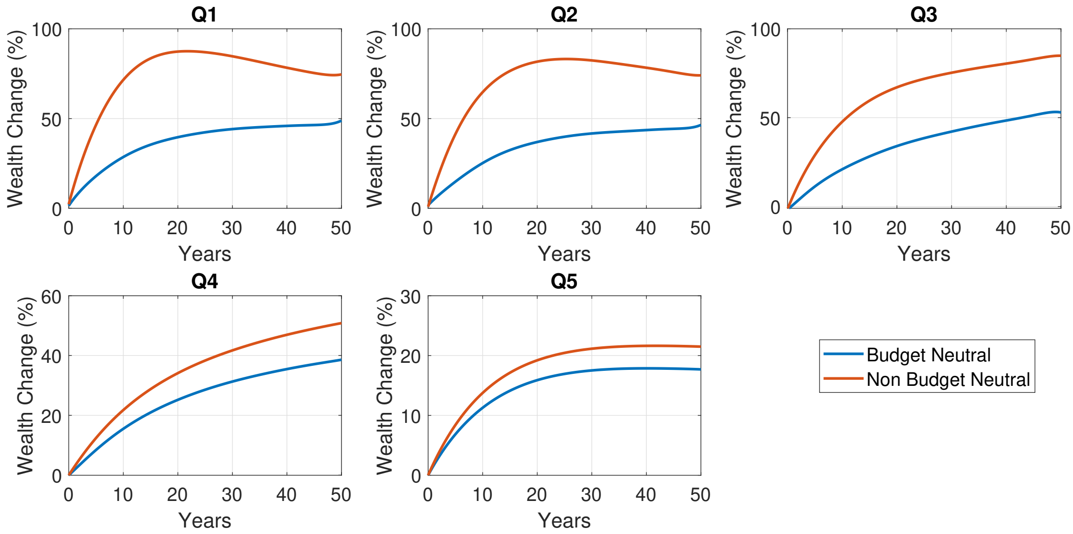

Figure 3: Wealth change w.r.t. initial steady state (percentage deviation points)

different saving behaviors of agents across the wealth distribution. This is not a trivial task, however, since the effects of an increase in the net interest rate on households' saving are notoriously complex to analyse - involving contrasting income and substitution effects and a *precautionary saving* component which is also likely influenced by the skill levels (whose distribution is expected to be non-uniform across the wealth distribution).

From an aggregate point of view, an increase in the net interest rate creates an incentive for all agents to substitute future consumption for current consumption, and thus to increase saving. This is the standard *intertemporal substitution effect*. Since the considered capital tax cut is massive (from 39.7% to 0), one clearly expects this effect to be first-order and to dominate the other effects. Figure 3 confirms this analysis, showing that capital accumulation is positive across the entire wealth distribution.

But the extent of this increased saving for intertemporal substitution motives can be amplified or mitigated at various segments of the wealth distribution for two reasons. The first reason connects with the permanent income model, which suggests that households with a current income lower than their permanent income should consume more and save less (or, equivalently, that saving should anticipate a decline in future income). Figure 4 displays the percentage changes in income after the reform. For the vast majority of households (i.e., those in the first four quintiles of the wealth distribution), the tax composition change implies a significant drop in current income, explained by the increased labor taxation and the corresponding drop in labor income. In addition, this labor income component is expected to be increasing over time since the labor tax rate follows a decreasing path (see Figure 1). Thus, for these households, the extra saving associated with the intertemporal substitution effect is expected to be *mitigated* by these permanent income considerations. By contrast, households in the top quintile of the wealth distribution benefit a lot from the capital tax cut and experience a strong increase in their current income, driven by the capital income component. Besides, this increase in capital income is greater in the current period than in the future, since the net interest rate is decreasing over time due to the negative effect of capital accumulation on the marginal productivity of capital (see Figure 1). Thus, for these households, the extra saving associated with the intertemporal substitution effect is expected to be *amplified* by these permanent income considerations.

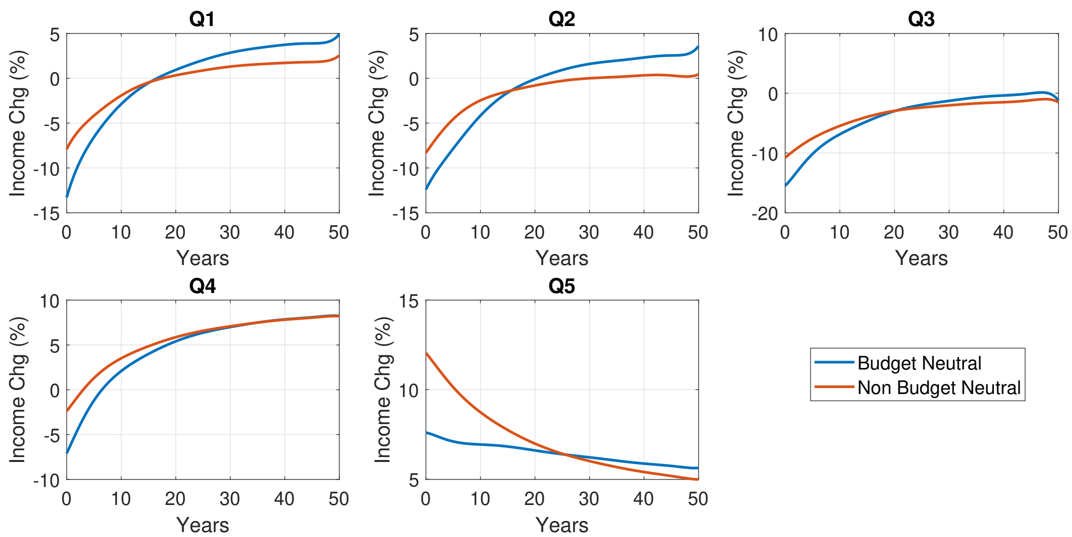

Figure 4: Income change w.r.t. initial steady state - percentage deviation points

The second reason why the additional saving associated with the intertemporal substitution effect can be attenuated or amplified is the *precautionary saving motive*, which is also expected to be different across skill and asset levels. Standard economic analysis suggests that precautionary saving should be the most significant when a combination of the following two factors is present : (i) the household is subject to significant income losses if "bad states" materialize in the future, and (ii) the household does not have sufficient assets to "self-insure" against this risk. In our economy, the richest households at the top of the wealth distribution (the 'upper class') do not meet the second criterion, and thus their saving for precautionary motives is likely small. Likewise, in our economy, low-skilled workers with typically low wealth (the 'lower class') do not meet the first criterion since they can only improve their labor income if good states materialize in the future. Thus, they have no reason to save a lot for precautionary reasons. By contrast, the analysis suggests that medium-skilled households who do not hold very important amounts of assets (the 'middle class') should be the ones mostly concerned by precautionary saving. Since the need to save for precautionary motives increases after the tax composition change, this increase is mostly concentrated on the medium-skilled households.[4]

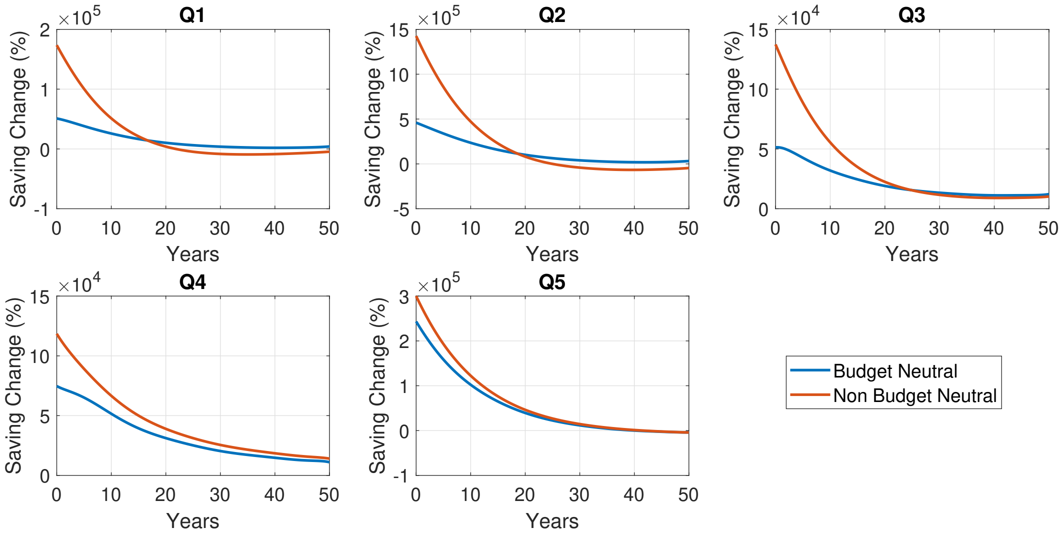

Figure 5: Saving change w.r.t. initial steady state (percentage deviation points)

[4]It actually takes a rather complex argument to show that the need for precautionary saving indeed increases when the tax elimination policy is implemented. The income of households is composed of two components: labor income and capital income. It can be shown that even though idiosyncratic uncertainty comes in our model from labor income only, both a change in the labor tax rate and the capital tax rate influence the riskiness of income streams across the life cycle (and thus of equilibrium consumption profiles). Obviously, for a given capital tax rate, an increase in labor taxation reduces the riskiness of labor income and thus the need for precautionary savings. However, for a given labor tax rate, a change in the capital tax rate increases the importance of capital income in total income and increases the riskiness of income over the life cycle. It thus increases the need for precautionary savings. Overall, in our policy experiment which involves a massive reduction in the capital tax rate and a comparably smaller increase in the labor tax rate, the second effect dominates, so that the need for precautionary savings increases under the new tax regime. This result is proved more formally in the welfare decomposition undertaken below, in which we show that the "insurance component" of the utilitarian welfare is negatively affected by the reform. See the next section for details.

Figures 5 and 6 corroborate these analyses. In Figure 5, it can be seen that the households who increase the most their savings are located in the second quintile of the wealth distribution (see blue solid line). [5] In Figure 6 , it can be seen that this second quintile is almost exclusively composed of medium-skilled workers, while Table 4 indicates that households in this quintile hold negligible amounts of assets. In light of the discussion above, it is unsurprising that these households are the ones who save the most for precautionary reasons. Interestingly, Figure 5 also shows that the second highest saving rate variation is in the top quintile of the wealth distribution. As discussed above, households in this quintile are the most likely to save for permanent income considerations. In spite of this, overall, the proportionately greater saving in the intermediate quintiles of the wealth distributions explains why capital concentrates at these wealth levels and that wealth inequality eventually declines, as reflected by the decrease in the Gini coefficient.

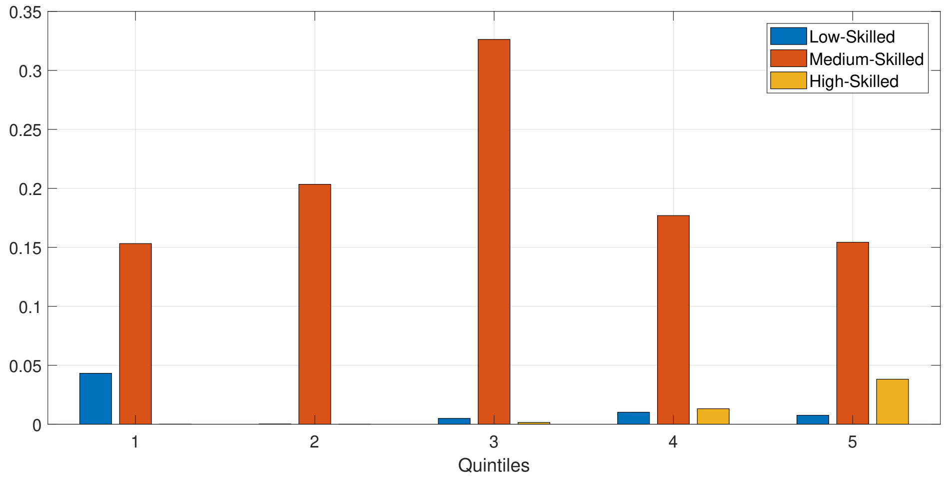

Figure 6: Distribution of skills per quintiles of the wealth distribution (percentage of the total population)

To conclude this analysis on inequality and redistribution, it is worthwhile to compare the results with those obtained when the strict balanced-budget condition is removed (NBN policy). Figure 2 shows that in the NBN case the Gini coefficient decreases even more than in the BN case, suggesting that the different timing for the labor tax rate

[5]One may be surprised by the very large percentage points displayed in Figure 5, but there is actually a simple explanation. At the initial stationary distribution, aggregate saving is by definition $\dot{A}_t = 0$. Although this is of course not true at each point of the wealth distribution, the "per quintile" initial average saving is already very close to 0. Any significant variation in saving will then translate into a very large percentage point deviation from this initial average saving level.

and the corresponding accumulation of public debt contribute to *reduce* even further wealth inequality. The positive effect on wealth accumulation is more important with the NBN policy and particularly for individuals at the bottom of the distribution (Figure 3). Besides, the short-run income reduction at the bottom of the distribution following the NBN policy is twice as small as following the BN policy. Of course, the aggregate outcome on the wealth gini is the result of the potentially contrasting implications of the alternative labor tax path on the different incentives to save. Without going too much into details, it is clear however that a main explanation for this greater reduction in wealth inequality is through the effect on precautionary savings. The reduction of inequality comes at the cost of higher income risk. As emphasized above, for a given capital tax rate (set to 0 in both policy experiments), the labor tax rate is significantly smaller in the NBN case than in the BN case for a very long time-span. For any given transition matrix governing switches in the individual productivity levels, a smaller labor tax rate implies a greater dispersion of net wages, and thus a greater riskiness in net labor income. Households need to self-insure against this increased risk. This explains why households - and particularly the medium-skilled households with few assets - increase their precautionary saving compared to the BN case, as clearly reflected in Figures 3 and 5.

4.4 Welfare

What are the implications of the considered tax composition change for household welfare, and for the various components influencing it? A simple intuitive answer can be obtained by looking at Figure 7, which displays the evolution of consumption over time for the different quintiles of the wealth distribution. Clearly, with a strong decrease in current income - and the strong incentive to save documented above - current consumption drops by a very significant amount for all households when the reform is implemented. Figure 7 reveals that the decrease is between 10 % and 15 % across the different quintiles of the wealth distribution. Moreover, in spite of the positive effect of capital accumulation on labor and capital income, it takes an extremely long time-span before consumption reaches, and eventually exceeds, its pre-reform level. The time-span is increasingly longer for households located at the lowest segments of the wealth distribution. Clearly, in the presence of time-discounting, it is very unlikely that the long-run welfare gains associated with an increased consumption more than outweigh the short-run welfare losses.

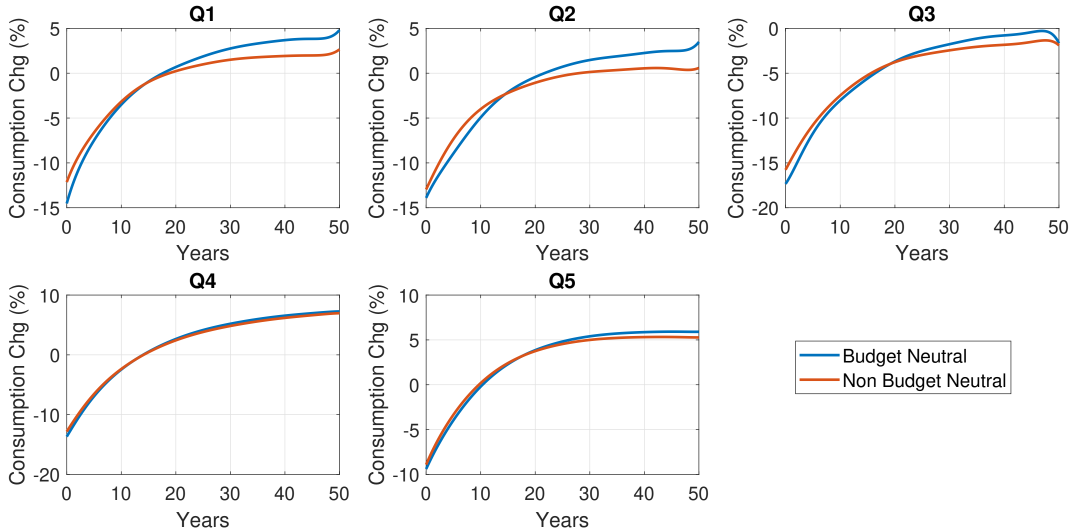

Figure 7: Consumption change w.r.t. initial steady state - percentage deviation points

However, the utilitarian welfare does not only depend on this "level" effect on individual consumption. As shown in the previous section, wealth inequality is also reduced by the reform, which may be welfare-improving for a social planner with inequality aversion. To make the discussion more precise, we follow the literature initiated by Benabou [2002] and Floden [2001] and decompose the utilitarian welfare gain Δ into three components (see also Dyrda and Pedroni, 2018): a *level effect*, denoted by Δ_L, an *insurance effect*, denoted by Δ_I, and a *redistribution effect*, denoted by Δ_R. The *level effect* is the welfare increase associated with an increased consumption for the average agent. It is the unique welfare component in a representative agent framework. The *insurance effect* is the welfare increase associated with a reduction of risk in equilibrium individual consumption and labor profiles. Since households are risk-averse, a reduction of risk implies an increase in welfare. Finally, the *redistribution effect* captures the welfare gains associated with a decrease in inequality for the inequality-averse social planner. Since this decomposition is well-known from the literature, we refer to the appendix for more formal details regarding the construction of these indices (see Appendix A). By construction, the utilitarian welfare gain satisfies:

$$1 + \Delta = (1 + \Delta_L)(1 + \Delta_I)(1 + \Delta_R) \tag{20}$$

Table 6 summarizes the implications of the capital tax cut policy for these various components of the utilitarian welfare. Unsurprising in light of the discussion above, both the BN and the NBN policies lead to a significant reduction in total welfare, dominated by a very significant decrease in the level component (for example, -7.17% and -4.79% respectively in the BN case). By contrast, the reduction in inequality documented above implies that the redistribution component is positive. What is perhaps the most striking result is that the insurance component also decreases by a very significant amount (for example, -4.40% in the BN case). This shows that a capital tax cut policy has a major negative influence on the riskiness of individual consumption profiles. This in turn explains why precautionary saving increases so much when the policy is implemented, as already discussed above.

Comparing the BN and the NBN policies, Table 6 shows that the utilitarian welfare is even more negatively affected when the government budget is not strictly balanced (NBN scenario). This is true in spite of the fact that income and individual consumption are less affected in the short-run because of the smaller labor tax increase, as confirmed by the slight improvement in the level component compared to the BN scenario. However, Table 6 also shows that both the insurance and the redistribution components are negatively affected by the policy. Indeed, as already discussed, the lower labor taxation is associated with an increase in the riskiness of individual labor income, which translates into a higher ex-post inequality in individual consumption profiles. Note that this latter observation is true in spite of the fact - also already documented above - that the NBN policy generates an even greater *reduction* in wealth inequality than the BN policy, as reflected in Table 6 by the decrease in the Gini coefficient.

Table 6: Welfare Decomposition (%)

Policy Change	Δ	Δ_L	Δ_I	Δ_R
Budget Neutral	-7.17	-4.79	-4.40	1.99
Non Budget Neutral	-8.11	-4.44	-5.14	1.37

4.5 Sensitivity analysis

To conclude our analysis, we conduct a short sensitivity analysis to assess how our main results change when we consider alternative calibrations for structural parameters. We mainly focus on the Frisch elasticity of the labor supply ϵ, the labor disutility parameter ψ and the coefficient governing the relative risk aversion (or the inverse of the intertemporal elasticity of substitution) σ, as these parameters are the most likely to have a significant influence on the result. To conduct this sensitivity analysis, we focus on two key elements: the utilitarian welfare measure (and its decomposition) and the Gini coefficient.

Specifically, starting with our initial calibration with $\epsilon = 0.3$, $\psi = 300$ and $\sigma = 1$, we consider the effects of increasing one by one the value of these parameters to $\epsilon = 0.5$, $\psi = 500$ and $\sigma = 1.5$, respectively. Results are collected in Table 7.

Table 7: Welfare components and Long-Run Gini coefficient

	Δ	Δ_L	Δ_I	Δ_R	ΔGini (%)
Benchmark	**-7.17**	**-4.79**	**-4.40**	**1.99**	**-3.18**
$\epsilon = 0.50$	-8.22	-6.11	-3.62	1.43	-2.37
$\psi = 500$	-7.12	-4.78	-4.40	2.04	-2.95
$\sigma = 1.5$	-6.73	-5.02	-2.35	0.56	-2.18

Overall, Table 7 confirms that our benchmark results are robust to these alternative parameter calibrations, and that the differences mostly concern the magnitudes in the different welfare effects and in the long-run Gini coefficient. An increase in the wage labor supply elasticity generates an even stronger decline in labor and labor income in the short run, thereby accentuating the initial recession. The drop in income implies that both consumption and saving are smaller in the short-run compared to the benchmark. For this reason, the welfare loss is greater, while the reduction in wealth inequality is smaller. An increase in the risk aversion coefficient reduces the desire to substitute future consumption for current consumption, thereby mitigating the initial decline in short-run consumption while reducing saving. For this reason, the welfare loss is smaller than in the benchmark, and the reduction in wealth inequality is also smaller. The desutility parameter has a negligible influence on both welfare and inequality.

5 Conclusion

In this paper, we have shown the importance of distinguishing between the long-run and the short-run effects of a capital tax cut policy, both for the levels of the macroeconomic variables and for redistribution and welfare issues. We have also shown that capital tax reforms conducted under a strict balanced-budget condition lead to significant differences compared with similar policies partly financed by public debt increases. The reason lies in the different saving behaviors of household, influenced by both intertemporal substitution considerations and precautionary savings motives, which are affected differently by the different paths for the net wage and the net interest rate.

A Appendix

A.1 Computation of Welfare Measures:

We define $v(x_t) \equiv u(c_t, n_t)$, where x_t is the consumption-labor composite such that:

$$x_t = c_t - \psi \frac{n_t^{1+\frac{1}{\epsilon}}}{1+\frac{1}{\epsilon}} \tag{21}$$

As in Dyrda and Pedroni [2018], our first measure of average welfare gain is the constant percentage increment in the consumption-labor composite x_t^{NR} in the no reform case (NR) giving the same expected utility as x_t^R when the reform (R) is implemented. The *average welfare gain* Δ solves the following equation:

$$\int_0^\infty \int_{\underline{a}}^\infty \exp(-\rho t) v_t^R(x_t(a_0, z_t)) dG_0(a_0, z_0) dt = \int_0^\infty \int_{\underline{a}}^\infty \exp(-\rho t)(1+\Delta) v_t^{NR}(x_t(a_0, z_t)) dG_0(a_0, z_0) dt \tag{22}$$

where G_0 is the initial cumulative distribution over states (a_0, z_0).

Welfare Decomposition

We define the aggregate level of x_t at each t, for $j = R, NR$ as:

$$X_t^j \equiv \int x_t^j(a_0, z_0) dG_t^j(a_0, z_t) \tag{23}$$

and the level effect Δ_L solves the following equations:

$$U\left((1+\Delta_L) X_t^{NR}\right) = U\left(X_t^R\right) \tag{24}$$

We define $\bar{x}_t^j(a_0, e_0$ the sequence of individual consumption-labor certainty equivalents:

$$U\left(\bar{x}_t^j(a_0, z_0)\right) = \mathbb{E}_0 U(x_t^j(a_0, z_0)) \tag{25}$$

with $\bar{X}_t^j$ the aggregate consumption-labor certainty equivalent such that:

$$\bar{X}_t^j \equiv \int \bar{x}_t^j(a_0, z_0) dG_0^j(a_0, z_t) \tag{26}$$

The *insurance effect* is defined by:

$$1 + \Delta_I \equiv \frac{1 - p_{risk}^{R}}{1 - p_{risk}^{NR}} \tag{27}$$

such that the cost of riskiness p_{risk}^{j} solves:

$$U\left(\left(1 - p_{risk}^{j}\right) X_t^j(a_0, z_0)\right) = U\left(\bar{X}_t^j\right) \tag{28}$$

The redistribution effect is defined by:

$$1 + \Delta_R \equiv \frac{1 - p_{ineq}^{R}}{1 - p_{ineq}^{NR}} \tag{29}$$

such that the cost of riskiness p_{ineq}^{j} solves:

$$U\left(\left(1 - p_{ineq}^{j}\right) \bar{X}_t^j\right) = \int U(\bar{x}_t^j) dG_0^j\left(a_0, z_t\right) \tag{30}$$

Our decomposition implies:

$$1 + \Delta = (1 + \Delta_L)(1 + \Delta_I)(1 + \Delta_R) \tag{31}$$

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