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# Consumption taxes and the efficiency-equity tradeoff

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# Consumption taxes and the efficiency-equity tradeoff

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**Abstract:** We study the aggregate and distributional implications of introducing consumption taxes into a model with income taxes. The setup is a neoclassical growth model, where agents differ in earnings and second-best policy is chosen by a Ramsey government. Our main result is that the introduction of consumption taxes by the Ramsey government increases aggregate efficiency and benefits all income groups, but it also increases inequality in net income. To put it differently, a switch to income taxes reduces inequality, but it also hurts all groups including the poor.

**Key words:** Ramsey taxation, efficiency, inequality.
**JEL classification:** H4, H2, D6.

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## 1. Introduction

It is widely believed that consumption taxes are good on the grounds of aggregate efficiency. Nevertheless, they are unpopular because they are also believed to increase inequality and so hurt the poor. Is this so?

To answer this question, we study the aggregate and distributional implications of consumption taxes. Our main result is that, when second-best policy is optimally chosen (by a benevolent Ramsey government), the introduction of consumption taxes into a model with income taxes is Pareto improving (i.e. it benefits all income groups) but at the cost of higher inequality. Reversing the result, a switch to income taxes would reduce inequality, but it would also hurt all groups including the poor. Thus, there is a genuine tradeoff between efficiency and equality. This confirms the common belief mentioned above.

We deliberately work within a simple and recognizable setup. To study distributional implications, we naturally need a model with heterogeneous agents and a potential conflict of interests. We choose to work with Judd's (1985) neoclassical growth model, in which agents are divided into two groups, called capitalists and workers, where workers do not participate in capital markets.[1] The government is allowed to finance the provision of public goods by a mix of income and consumption taxes, which are both proportional to their own tax base. The paths of tax-spending policy instruments are chosen by a Ramsey government.

Following most of the Ramsey literature, we focus on the long run. Our results are as follows. First, when we compare an economy with income taxes to the same economy that also makes use of consumption taxes, the latter is more efficient. Both social groups, capitalists and workers, get better in terms of net income and welfare. Second, net income inequality is increased by the introduction of consumption taxes. In other words, the larger pie, as we switch to a more efficient economy with consumption taxes, benefits the capitalist more than the worker. These results are robust to a number of extensions, like the inclusion of an explicitly progressive tax code as in Atkinson and Stiglitz (1980).

The rest of the paper is as follows. Section 2 presents a Judd-type model with consumption and income taxes. Section 4 solves for Ramsey policy. Section 5 discusses robustness. Section 5 closes the paper.

[1] This has been one of the most commonly used models with heterogeneity in the literature on optimal taxation. In addition to Judd (1985), see also Lansing (1999), Krusell (2002), Fowler and Young (2006), Angelopoulos et al. (2011) and many others. As Fowler and Young (2006) argue, the assumptions of this model are not unreasonable in terms of wealth concentration.

## 2. A model with income and consumption taxes and heterogeneous agents

The setup is the standard neoclassical growth model extended to allow for heterogeneity across agents. Following Judd (1985) and many others, we assume that agents differ in capital ownership. That is, capital is in the hands of a small group called capitalists, while workers cannot save or borrow. Subject to this setup, the Ramsey government will maximize a weighted average of capitalists' and workers' welfare by choosing income taxes, consumption taxes, as well as the associated amount of the public good. For simplicity, the model is deterministic.

*Capitalists*

There are $k = 1, 2, ..., N^k$ identical capitalists. Each $k$ maximizes:

$$\sum_{t=0}^{\infty} \beta^t u(c_{k,t}, l_{k,t}, g_t) \tag{1}$$

where $c_{k,t}$ and $l_{k,t}$ are respectively $k$'s consumption and work hours, $g_t$ is per capita public spending and $0 < \beta < 1$ is the time preference rate.

In our numerical solutions, we will use a simple period utility function of the form:

$$u(c_{k,t}, l_{k,t}, g_t) = \mu_1 \log(c_{k,t}) + \mu_2 \log(1 - l_{k,t}) + \mu_3 \log(g_t) \tag{2}$$

where the parameters $\mu_1, \mu_2, \mu_3 > 0$ are preference weights.

The period budget constraint of each $k$ is:

$$(1 + \tau_t^c) c_{k,t} + k_{k,t+1} - (1 - \delta) k_{k,t} = (1 - \tau_t^y)(r_t k_{k,t} + w_t l_{k,t}) \tag{3}$$

where $k_{k,t+1}$ is $k$'s end-of-period capital, $r_t$ is the return to beginning-of-period capital, $k_{k,t}$, $w_t$ is the return to labor, $l_{k,t}$, $0 < \tau_t^c, \tau_t^y < 1$ are proportional consumption and income tax rates respectively, and the parameter $0 < \delta < 1$ is the capital depreciation rate.

Each $k$ acts competitively by choosing $\{c_{k,t}, l_{k,t}, k_{k,t+1}\}_{t=0}^{\infty}$. The first-order conditions include the budget constraint above and:

$$\frac{1}{(1+\tau_t^c)c_{k,t}} = \frac{\beta[1-\delta+(1-\tau_{t+1}^y)r_{t+1}]}{(1+\tau_{t+1}^c)c_{k,t+1}} \tag{4a}$$

$$\frac{\mu_1(1-\tau_t^y)w_t}{(1+\tau_t^c)c_{k,t}} = \frac{\mu_2}{1-l_{k,t}} \tag{4b}$$

*Workers*

There are $w = 1,2,...,N^w = N - N^k$ identical workers. Each $w$ maximizes:

$$\sum_{t=0}^{\infty} \beta^t u(c_{w,t}, l_{w,t}, g_t) \tag{5}$$

where, as above, we use:

$$u(c_{w,t}, l_{w,t}, g_t) = \mu_1 \log(c_{w,t}) + \mu_2 \log(1-l_{w,t}) + \mu_3 \log(g_t) \tag{6}$$

The period budget constraint of each $w$ is:

$$(1+\tau_t^c)c_{w,t} = (1-\tau_t^y)w_t l_{w,t} \tag{7}$$

This is a simple static problem. Each $w$ acts competitively by choosing $c_{w,t}$ and $l_{w,t}$. The first-order conditions include the budget constraint above and:

$$\frac{\mu_1(1-\tau_t^y)w_t}{(1+\tau_t^c)c_{w,t}} = \frac{\mu_2}{1-l_{w,t}} \tag{8}$$

*Firms*

There are $f = 1,2,...,N^f$ firms owned by capitalists. Thus, each capitalist owns one firm, or $N^k = N^f$. Each firm maximizes profits given by:

$$\pi_{f,t} = y_{f,t} - r_t k_{f,t} - w_t l_{f,t} \qquad (9)$$

subject to the production function:

$$y_{f,t} = A(k_{f,t})^{\alpha}(l_{f,t})^{1-\alpha} \qquad (10)$$

where $k_{f,t}$ and $l_{f,t}$ are capital and labor inputs respectively, while $A > 0$ and $0 < \alpha < 1$ are usual technology parameters.

The familiar first-order conditions for the two inputs are:

$$r_t = \frac{\alpha y_{f,t}}{k_{f,t}} \qquad (11a)$$

$$w_t = \frac{(1-\alpha) y_{f,t}}{l_{f,t}} \qquad (11b)$$

*Government budget constraint*

The period government budget constraint is (written in aggregate terms):[2]

$$G_t = N^k[\tau_t^y(r_t k_{k,t} + w_t l_{k,t}) + \tau_t^c c_{k,t}] + N^w[\tau_t^y w_t l_{w,t} + \tau_t^c c_{w,t}] \qquad (12)$$

where $G_t$ is total provision of the public good (i.e. $g_t \equiv G_t / N$ is per capita provision).

*Decentralized competitive equilibrium (for any feasible policy)*

In the decentralized competitive equilibrium (DCE), both types of households maximize utility, firms maximize profits, constraints are satisfied and markets clear.[3] It is convenient to

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[2] We use a single income tax, rather than separate taxes on capital income and labour income, because, if a Ramsey government has access to capital income, labour income and consumption taxes, it can implement the first-best (see e.g. Lansing, 1999, Coleman, 2000, and Correia, 2010). We get similar results in our model (available upon request). We also do not include public debt because, as is known, in a Ramsey equilibrium, long-run debt cannot be pinned down by long-run conditions only (see e.g. Chamley, 1986), except if we add some friction. Since the presence of public debt is not expected to matter to our main results, we assume it away.

define the population shares of the two groups, $n^k \equiv N^k / N$ and $n^w \equiv N^w / N = 1 - n^k$. Then, the DCE is summarized by the following equations (quantities are in per capita terms):

$$\frac{1}{(1+\tau_t^c)c_{k,t}} = \frac{\beta[1-\delta+(1-\tau_{t+1}^y)r_{t+1}]}{(1+\tau_{t+1}^c)c_{k,t+1}} \quad (13a)$$

$$\frac{\mu_1(1-\tau_t^y)w_t}{(1+\tau_t^c)c_{k,t}} = \frac{\mu_2}{1-l_{k,t}} \quad (13b)$$

$$\frac{\mu_1(1-\tau_t^y)w_t}{(1+\tau_t^c)c_{w,t}} = \frac{\mu_2}{1-l_{w,t}} \quad (13c)$$

$$(1+\tau_t^c)c_{w,t} = (1-\tau_t^y)w_t l_{w,t} \quad (13d)$$

$$n^k c_{k,t} + n^k[k_{k,t+1} - (1-\delta)k_{k,t}] + n^w c_{w,t} + g_t = n^k y_{f,t} \quad (13e)$$

$$g_t = \tau_t^y n^k y_{f,t} + \tau_t^c(n^k c_{k,t} + n^w c_{w,t}) \quad (13f)$$

where, in the above, we use:

$$n^k y_{f,t} = A(n^k k_{k,t})^{\alpha}(n^k l_{k,t} + n^w l_{w,t})^{1-\alpha}, \ r_t = \frac{\alpha y_{f,t}}{k_{k,t}} \text{ and } w_t = \frac{(1-\alpha)n^k y_{f,t}}{(n^k l_{k,t} + n^w l_{w,t})}.$$

We thus have 6 equations in $\{c_{k,t}, l_{k,t}, k_{k,t+1}, c_{w,t}, l_{w,t}\}_{t=0}^{\infty}$ and one of the policy instruments, $\{\tau_t^c, \tau_t^y, g_t\}_{t=0}^{\infty}$, which adjusts to satisfy the government budget constraint. This is for any feasible policy. We now turn to optimal policy.

## 3. Second-best optimal policy (Ramsey)

Our aim is to compare an economy with and without consumption taxes, other things being equal. We choose to work as follows (we report that our results do not depend on the particular way we work). We first solve for Ramsey policy and the associated allocation when the government can use income taxes only. In other words, the government chooses $\{\tau_t^y, g_t\}_{t=0}^{\infty}$ to maximize a weighted average of capitalists' and workers' utility subject to the DCE equations, (13a-f), when we exogenously set $\{\tau_t^c\}_{t=0}^{\infty}$ at zero. This is called Regime A in

[3] The market-clearing conditions in the labour and capital markets are respectively $N^f l_{f,t} = N^k l_{k,t} + N^w l_{w,t}$ and $N^f k_{f,t} = N^k k_{k,t}$. Recall that $N^f = N^k$; namely, the number of capitalists equals the number of firms.

our Tables and serves as a benchmark. We then compare this economy to the same economy when the Ramsey government can use both income and consumption taxes. Actually, for reasons of completeness, we solve for two types of the latter. We first set $\{g_t\}_{t=0}^{\infty}$ as in Regime A. In other words, in Regime B, the government chooses $\{\tau_t^c, \tau_t^y\}_{t=0}^{\infty}$ to maximize the same objective subject to (13a-f) when we set $\{g_t\}_{t=0}^{\infty}$ as in Regime A. We also solve for the case in which all three policy instruments are chosen optimally. In other words, in Regime C, the government chooses $\{\tau_t^c, \tau_t^y, g_t\}_{t=0}^{\infty}$ to maximize the same objective subject to (13a-f).

*Ramsey policy and allocation*

Since the Ramsey equilibrium system cannot be solved analytically,[4] we present numerical solutions using common parameter values (see the notes in Table 1 for parameter values used). We report that our results are robust to changes in parameter values. Following most of the literature on Ramsey policy, we focus on the long-run solution. A numerical long-run solution for all three Regimes, A, B and C, is presented in Table 1.

Table 1 around here

A comparison of regimes A, B and C in Table 1 reveals the following: First, the economy with consumption taxes (see Regimes B and C) is more efficient than the economy without (see Regime A). For instance, per capita output and welfare, $y$ and $u$, are higher in B and C than in A.[5] More importantly, the same holds at individual level: both social groups are better off in B and C than in A. Intuitively, both workers and capitalists can benefit from a more efficient economy (this is as in Judd, 1985, although his celebrated result is driven by zero capital taxes). For instance, the net income and welfare of both capitalists and workers, $y_k$, $u_k$ and $y_w$, $u_w$, are higher in B and C than in A.[6] Notice also that, when consumption taxes are also available, the optimal long-run income tax rate is zero (see Regimes B and C). All this happens because consumption taxes are less distorting as public financing policy instruments than income taxes.

[4] We can get analytical results for the long run for some variables only. For instance, we can show that the income tax rate is zero in the long run. This is a reminiscent of zero capital income taxes in Chamley (1986) and Judd (1985).

[5] $u \equiv n^k u_k + n^w u_w$.

Second, the bad news is that the above efficiency gains come at the cost of higher inequality. In particular, the net income of capitalists relative to workers, $y_k / y_w$, rises as we move from Regime A (case without consumption taxes) to Regimes B and C (cases with consumption taxes).

## 4. Robustness

Following e.g. Atkinson and Stiglitz (1980), we now add a lump-sum subsidy that makes the income tax code explicitly progressive in the sense that the average tax rate increases with pre-tax income. The results, reported in Table 2, do not change qualitatively.

Table 2 around here

## 5. Concluding remarks

In this short paper, we studied the aggregate and distributional implications of introducing consumption taxes. We showed that this results in a genuine tradeoff between efficiency and equity, since the introduction of consumption taxes comes at the expense of higher income inequality.

A paper related to ours is Correia (2010), who has shown that an exogenous policy reform that replaces the current US tax system with a flat consumption tax rate, accompanied by a lump-sum transfer that increases the progressivity of the tax system, can increase efficiency and also reduce inequality in a model calibrated to the US economy. But she assumes the availability of a lump-sum instrument and does not study optimal policy.

The paper can be extended in several ways. For instance, one can consider the implications of other "consumption-type" taxes like user fees on excludable public goods (see Economides and Philippopoulos, 2012). Second, one can solve for time-consistent policy (in addition to Ramsey policy). One can also add other types of heterogeneity (in addition to inequality in wealth). We leave these extensions for future work.

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[6] $y_k \equiv (1-\tau^y)(rk_k + wl_k) - \tau^c c_k$ and $y_w \equiv (1-\tau^y)wl_w - \tau^c c_w$.

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## Table 1: Long-run Ramsey solutions

| **Endogenous variables** | **Regime A: income taxes, and endogenous $g$** | **Regime B: income taxes, consumption taxes, and exogenous $g$** | **Model C: income taxes, consumption taxes, and endogenous $g$** |
|---|---|---|---|
| $c_k$ | 0.3356 | 0.3635 | 0.3504 |
| $l_k$ | 0.2069 | 0.2069 | 0.2069 |
| $k_k$ | 3.8525 | 5.3632 | 5.3632 |
| $c_w$ | 0.2821 | 0.3056 | 0.2945 |
| $l_w$ | 0.3333 | 0.3333 | 0.3333 |
| $y$ | 1.6091 | 1.8126 | 1.8126 |
| $g$ | 0.0921 | 0.0921 (set as in A) | 0.1038 |
| $\tau^y$ | 0.1908 | 0 | 0 |
| $\tau^c$ | - | 0.2852 | 0.3333 |
| $u_k$ | -0.7051 | -0.6811 | -0.6802 |
| $u_w$ | -0.8614 | -0.8374 | -0.8366 |
| $u$ | -0.8145 | -0.7905 | -0.7897 |
| $y_k / y_w$ | 2.2822 | 2.5938 | 2.6464 |
| $c_k / c_w$ | 1.1897 | 1.1897 | 1.1897 |
| $u_k / u_w$ | 0.8185 | 0.8134 | 0.8131 |

Notes: $\alpha = 0.36, \beta = 0.96, A = 1, \delta = 0.08, \mu_1 = 0.3, \mu_2 = 0.6, \mu_3 = 0.1, v^k = 0.3, v^w = 0.7, v = 0.3$ .

## Table 2: Long-run Ramsey solutions when the direct taxes are progressive

| **Endogenous variables** | **Regime A: income taxes, and endogenous $g$** | **Regime B: income taxes, consumption taxes, and exogenous $g$** | **Model C: income taxes, consumption taxes, and endogenous $g$** |
|---|---|---|---|
| $c_k$ | 0.3346 | 0.3632 | 0.3498 |
| $l_k$ | 0.2064 | 0.2065 | 0.2065 |
| $k_k$ | 3.8293 | 5.3643 | 5.3657 |
| $c_w$ | 0.2814 | 0.3054 | 0.2942 |
| $l_w$ | 0.3325 | 0.3328 | 0.3328 |
| $y$ | 1.6031 | 1.8107 | 1.8109 |
| $g$ | 0.0917 | 0.0917 (set as in A) | 0.1036 |
| $\tau^y$ | 0.1927 | -0.0012 | -0.0014 |
| $\tau^c$ | - | 0.2892 | 0.3390 |
| $u_k$ | -0.7061 | -0.6815 | -0.6806 |
| $u_w$ | -0.8619 | -0.8375 | -0.8365 |
| $u$ | -0.8152 | -0.7907 | -0.7898 |
| $y_k / y_w$ | 2.2777 | 2.5942 | 2.6484 |
| $c_k / c_w$ | 1.1890 | 1.1892 | 1.1892 |
| $u_k / u_w$ | 0.8192 | 0.8138 | 0.8136 |

Notes: $\alpha = 0.36, \beta = 0.96, A = 1, \delta = 0.08, \mu_1 = 0.3, \mu_2 = 0.6, \mu_3 = 0.1, v^k = 0.3, v^w = 0.7, v = 0.3$ and $s = 0.001$.