Welfare Effects of Consumption Taxes (Job Market Paper)

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Abstract

Driven by high government deficits and an unevenly distributed tax burden, recent debates on economic policy have revolved mostly around reforms in the American tax codes. Consumption tax reforms are considered to circumvent the efficiency-equity tradeoff that other reforms might encounter. This paper studies long run consequences of changing to a consumption tax regime, as well as short run welfare effects evaluated in transitional dynamics. Switching from labor income taxes to consumption taxes stimulates stronger precautionary motives, leading to a substantial increase in aggregate capital and labor supply under a balanced government budget. Furthermore, consumption tax reforms favor households with a low wealth-to-earnings ratio. Therefore, given that the wealth distribution is more concentrated than the distribution of earnings, consumption tax reforms effectively reduce the welfare inequality. Another novel aspect of this paper is to quantify the effects of progressive consumption tax reforms. The tax scheme I adopt is clean and easy to implement. It allows for tax exemptions in consumption, while imposing a constant marginal tax rate on the additional amounts. I find that households with low earnings benefit most from the reform.

Keywords: Incomplete markets, Flat consumption taxes, Progressive lat consumption taxes, Welfare inequality
JEL: E2 , D52, H21

1. INTRODUCTION

Given the current government deficit coupled with a highly unequally distributed tax burden, tax reforms receive the most consideration. However, most of the populated reforms aiming to adjust income tax codes are at the cost of either efficiency or equity. Therefore, many political and business commentators have argued that consumption tax reforms might be the solution to the efficiency-equity trade-off.

Most literature regarding consumption tax reforms either focus on the long run consequences or the short run effects with a representative agent. For example, Summers (1981) and Weidenbaum (1995) advocate consumption taxes by showing a long run improvement in the aggregate output and the aggregate welfare. Ventura (1999) studies the steady state inequality in terms of income and wealth of a flat tax reform. Krusell et al. (1996) finds that a change from income taxes to consumption taxes can make almost everybody worse

off in the long run. In addition, Coleman (2000) takes into account the transition processes and shows that a flat consumption tax reform can generate considerable welfare gain by examining a representative agent.

However, the volume of work that studies welfare inequality in a dynamic setup is limited. One such work is Correia (2010), which assumes that households differ in their initial wealth and earnings. With a complete market setting and a certain class of utility, Gorman aggregation can be satisfied. Correia proves that changing from a labor income tax regime to a consumption tax regime favors households with a lower than average wealth-to-earnings ratio. Moreover, with an exogenous distribution over wealth and earnings, welfare inequality reduces with consumption tax reforms.

The discussion of welfare inequality in a complete market setting with an exogenous distribution lacks full characterization of the general equilibrium. Thus, this paper extends Correia (2010) to an incomplete market setting. By introducing an idiosyncratic shock to labor efficiency, I am able to examine the welfare effects by taking into account the redistributions of resources. In comparison to the removal of labor income taxes under a complete market, eliminating labor income taxes under an incomplete market amplifies the volatility of labor income and stimulates stronger precautionary motives. As a result, higher capital is accumulated and market prices are adjusted accordingly. Hence, besides the impact of a change in the tax code, households are also subject to changes in wages and interest rates. Therefore, the threshold of the wealth-to-earnings ratio that determines who benefits from the reform differs in incomplete markets and in complete markets.

Another highlight of this paper is to study the welfare effects of progressive consumption tax reforms, which are acknowledged to be fairer than the current tax system. Because of the obstacle of implementation, progressive consumption tax reforms are solely of theoretical interest. In this paper we adopt a progressive consumption tax form that is clean and easy to implement. The tax scheme allows for a deduction in consumption and imposes a constant in marginal tax rate on the extra amounts. An increasing average tax rate captures the progressivity of consumption taxes. A fixed marginal tax rate guarantees the execution of consumption tax reforms. This idea originates from Correia (2010), where a government transfer is used. Due to the absence of discussion on the optimal progressivity [1], I experimented on different levels of deductions and their associated marginal tax rates. The numerical results show that the aggregate capital and labor are higher after progressive consumption tax reforms, but are decreasing in the progressivity of consumption taxes. From a welfare point of view, households with low earnings benefit most from the reform.

The rest of the paper is organized as follows. Section 2 describes the model. Parameters are calibrated in section 3. Section 4 presents the effects of consumption taxes reforms at the steady state and along the transition processes. Section 5 concludes the paper.

2. The Model

I consider an infinite horizon economy with endogenous production and idiosyncratic income shocks. The economy is populated by a continuum (measure 1) of infinitely lived

[1] Gentry (1997) states that consumption taxes should be at least as progressive as the current labor income tax.

households, a representative firm and a government.

Households

The preference over sequences of consumption and leisure takes the form

$$U = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, h_t)$$

where $\beta \in (0,1)$ is the subjective discount factor. The period utility function $u(\cdot)$ satisfies the following conditions: $u(0,h) = 0$; $u(c,0) = 0$; $u(\cdot,\cdot)$ is continuously differentiable; $u_1(\cdot,h)$ is positive and a strictly decreasing function; $u_2(c,\cdot)$ is positive and a strictly decreasing function; $\lim_{x\to\infty} u(x,h) = 0$; $\lim_{x\to\infty} u(c,x) = 0$; $\lim_{x\to 0} u(x,h) = \infty$; $\lim_{x\to 0} u(c,x) = \infty$.

Each period, households receive capital income. We assume that the capital income tax is proportional with rate τ_a, so the after-tax capital income is $(1 + (1-\tau_a)r_t)a_t$, where a_t is the current asset holding. In addition to capital income, households is endowed with 1 unit of time each period to be divided between labor and leisure. Thus, households also receive labor income, which takes into account the labor supply and a stochastic labor efficiency ϵ. The shock of labor efficiency is *i.i.d.* across households and follows a Markov process with a transition matrix $\Pi(\epsilon_t|\epsilon_{t-1})$. The labor income tax T_w is a function of the labor income y_t, thus the after-tax labor income becomes $y_t - T_w(y_t)$.

Households divide after-tax income into consumption and next period's asset holdings. We assume that a consumption tax T_c is levied, which depends on the amount of consumption. Therefore, households period budget constraint becomes

$$\begin{aligned} c_t + T_c(c_t) + a_{t+1} &= (1 + r_t^\tau)a_t + y_t - T_w(y_t) \\ y_t &= \epsilon_t w_t h_t \\ r_t^\tau &= (1-\tau_a)r_t \\ \text{where } \epsilon_t &\sim AR(1). \end{aligned}$$

Production

The representative firm maximizes profits according to

$$\max_{K_t, L_t} AF(K_t, L_t) - (r_t + \delta)K_t - wL_t$$

where δ is the capital depreciation rate, K_t and L_t denote the aggregate capital and labor at period t. The first order conditions of this maximization problem gives

$$\begin{aligned} r_t &= AF_K(K_t, L_t) - \delta; \\ w_t &= AF_L(K_t, L_t). \end{aligned}$$

in which F_K and F_L are first order derivatives with respect to capital and labor respectively.

The government and market clearing

The government collects its revenue from taxes on consumption, capital income and labor income to finance its spending G, which is constant and exogenously given.

$$G = \int_{A\times E} T_c(c_t) + T_w(y_t) d\Gamma_t(a,\epsilon) + \tau_a r_t K_t$$

The asset and labor markets clearing requires that the aggregate capital and the aggregate labor provided by the households are equal to the capital and labor required by the firm. The output market clearing condition equates the output to the aggregate investment, consumption of households and the government.

$$
\begin{aligned}
K_t &= \int_{A\times E} a_t d\Gamma_t(a,\epsilon) \\
L_t &= \int_{A\times E} \epsilon_t h_t d\Gamma_t(a,\epsilon) \\
C_t &= \int_{A\times E} c_t d\Gamma_t(a,\epsilon) \\
C_t + K_{t+1} - (1-\delta)K_t + G &= AF(K_t, L_t)
\end{aligned}
$$

where $\Gamma_t(a,\epsilon)$ is period-t distribution over assets and efficiency.

Definition of *Competitive Equilibrium*: Given a tax scheme (τ_a, T_c, T_w), a transition matrix Π, initial distribution $\Gamma(a,\epsilon)$ over a Borel set consist of shocks and asset holding $\{A\times E\}$, where $A=[b,\infty)$ is the asset domain and E is the set of shock, competitive equilibrium is consist of a value function $V(a,\epsilon;\Gamma)$, policy functions $g_c(a,\epsilon;\Gamma)$, $g_h(a,\epsilon;\Gamma)$ and $g_a(a,\epsilon;\Gamma)$, an evolution in probability distribution $T(\Gamma)$, a vector of aggregate capital and labor (K,L), factor prices $\big(r(a,\epsilon), w(a,\epsilon)\big)$, such that,

1. The value function and policy functions solve households utility maximization problem:

$$
\begin{aligned}
V(a,\epsilon;\Gamma) = \max_{c,a',h} u(c,h) + \beta \sum_{\epsilon'} \pi(\epsilon'|\epsilon) V(a',\epsilon';\Gamma') \\
\text{s.t. } c + T_c(c) + a' &= (1+(1-\tau_a)r)a + y - T_a(a) - T_w(y) \\
y &= w\epsilon h \\
c &= g_c(a,\epsilon;\Gamma) \\
h &= g_h(a,\epsilon;\Gamma) \\
a' &= g_a(a,\epsilon;\Gamma) \\
\epsilon' &= \Pi(\epsilon'|\epsilon)\epsilon \\
\Gamma' &= T(\Gamma) \\
a' &\geq 0
\end{aligned}
$$

2. Factor prices satisfy the firm profit maximization conditions,

$$
\begin{aligned}
r(K,L) &= AF_K(K,L) - \delta \\
w(K,L) &= AF_L(K,L)
\end{aligned}
$$

3.The government budget constraint satisfies

$$
G = \int_S T_c + T_w d\Gamma + \tau_a r K
$$

4. *Market clearing*:

$$K' = \int_{A\times E} g_a(a,\epsilon;\cdot)d\Gamma$$
$$L = \int_{A\times E} \epsilon g_h(a,\epsilon;\cdot)d\Gamma$$
$$C = \int_{A\times E} g_c(a,\epsilon;\cdot)d\Gamma$$
$$C + K' - (1-\delta)K + G = AF(K,L)$$

5. *Consistency*: Γ is consistent with the agents' optimal decisions, in the sense that it is generated by the optimal decision rules and by the law of motion of the shock.

3. Calibration

For preferences, we assume a CRRA utility $u(c,h) = \frac{(c^\gamma h^{1-\gamma})^{1-\sigma}-1}{1-\sigma}$ with a relative risk aversion parameter $\sigma = 2$ and $\gamma = 0.38$ to match the average hour worked of 0.3. The production function is Cobb-Douglas, $F(K,L) = AK^\alpha L^{1-\alpha}$, with $\alpha = 0.36$ matching the capital's share in output. A is normalized so that output is equal to 1 in the deterministic steady state of the benchmark economy. We calibrate β to be 0.91 to target the capital to output ratio of 3 at the stationary equilibrium of the benchmark economy. The depreciation rate δ is set to be 0.06, such that the investment to output ratio is around 2. We follow Domeij and Heathcote (2004) by setting the flat capital tax to be 0.396.

Table 1 describes the seven states earning process, which is calibrated in Abraham and Carceles-Poveda (2010). The method The process, which is similar to the ones used by Diaz et. al (2003) and Davila et. al (2007), is calibrated so that it generates a Gini coefficient for earnings of 0.6.

Table 1: Earning process

Earning Process							
$\epsilon \in \{\epsilon_1,\epsilon_2,\epsilon_3\}$	0.1805	0.3625	0.8127	1.8098	3.8989	8.4002	18.0980
	0.9687	0.0313	0	0	0	0	0
	0.0445	0.8620	0.0935	0	0	0	0
	0	0.0667	0.9180	0.0153	0	0	0
$\Pi_{\epsilon'\|\epsilon}$	0	0	0.0666	0.8669	0.0665	0	0
	0	0	0	0.1054	0.8280	0.0666	0
	0	0	0	0	0.1235	0.8320	0.0445
	0	0	0	0	0	0.2113	0.7887
Stationary Distribution							
$\epsilon*$	0.3173	0.2231	0.3128	0.0719	0.0453	0.0245	0.0051

4. Numerical Results

In this section, I start with a tax reform that replaces a flat labor income tax with a flat consumption tax. The purpose of doing so is to compare the results under incomplete markets with the results derived by Correia (2010) under a complete market setting. Then I move on to illustrate the additional benefits of progressive consumption taxes by replacing the current progressive labor income tax system.

4.1. Flat labor taxes to flat consumption taxes

Shifting from labor income taxes to consumption taxes distorts both the intertemporal and the intratemporal margins. Thus, in this section, I first focus on the intertemporal decision of savings by assuming that the labor supply is fixed at the average level of 0.3. Later on, I incorporate an elastic labor supply in analyzing the intratemporal tradeoff between leisure and consumption. The labor tax rate in the benchmark economy is 0.269, following Domeij and Heathcote (2004).

4.1.1. With inelastic labor

Table 2 displays the aggregate results of changing from a flat labor income tax to a flat consumption tax under a balanced government budget. First notice that the aggregate capital increases after the reform. Anagnostopoulos and Li (2012) proves that under an incomplete market and with an inelastic labor supply, a flat consumption tax does not distort the capital formation. Therefore, the change in capital is a result of eliminating the labor income tax. Without the labor tax, the stochastic labor income becomes more volatile, thus more precautionary savings are stimulated. A lower interest rate and a higher wage ensue. The aggregate consumption increases following the aggregate capital because the aggregate capital is below the golden rule level.[2]

Table 2: SS of Replacing a flat labor tax with a flat consumption tax, with inelastic labor

					Aggregates					
Eco	τ_c	τ_w	r	w	w^τ	K	L	K/Y	C	We
Pre	0	0.269	6.00	0.551	0.403	4.32	1.67	3.00	0.830	100
FCT	0.290	0	4.37	0.599	0.599	5.43	1.67	3.47	0.886	106.
	(29%)	(36.8%)	(-27.17%)	(8.71%)	(48.71%)	(25.59%)	(0.0%)	(15.67%)	(6.75%)	

In our calibration, the share of consumption in the total output is lower than the share of labor income, [3] so the post-reform consumption tax is slightly higher than the pre-reform labor tax because of a narrower tax base. The after-tax wage increases more than the consumption tax by approximately 20%. This conclusion is the key to understanding that who benefit from the reform. For a given level of assets, the reform benefits households with higher labor efficiency. Facing the same change in capital income, households with higher

[2]The golden rule capital satisfies $MPK = \delta$, which requires $\frac{K}{Y} = \frac{\alpha}{\delta} = 6$.

[3]By the resource constraint, we have $\frac{C}{Y} + \delta\frac{K}{Y} + \frac{G}{Y} = 1$. The capital-to-output ratio is 3, meaning the second term is 0.18. The third term $\frac{G}{Y} = 0.2$ in our calibration. Thus $\frac{C}{Y} = 0.62$.

labor efficiency experience a larger increase in their labor income. Since the labor income increases by a larger percentage than the consumption tax, households with higher labor efficiency is more likely to enjoy higher consumption. For the same labor efficiency, households with lower asset holdings are better off. Because their labor income dominates their capital income, the increase in their after tax wage delivers a higher disposable income. It follows that their consumption has a greater chance to go beyond the pre-reform level. Since we assume a fixed labor supply, consumption becomes the sole determinant of welfare. As a result, households with low wealth-to-earnings ratios benefit from the reform, while households with relatively higher wealth and relatively lower earnings are worse off. Because the distribution of wealth is more concentrated than the distribution of earnings, the aggregate welfare increases, measured by the consumption equivalent as shown in the last column of Table 2.

Table 3 gives the distributions of wealth and consumption over different asset quintiles. First notice that the Gini index of wealth increases with the reform. Eliminating the labor income tax stimulates stronger precautionary motives, especially for households with high labor efficiency. Since these households are more likely to be at the higher end of the assets distribution, their tremendous increase in savings contributes to the larger inequality in wealth. However, by shifting from a flat labor tax to a flat consumption tax, the Gini index of consumption decreases. From the previous analysis we know that households with low wealth-to-earnings ratios are more likely end up with higher consumption. As a result, households in the first four asset quintiles who mainly obtain their income from labor increase their share in the aggregate consumption. In contrast, the top quintile households' shares in the aggregate consumption decrease due to their high wealth-to-earnings ratios. If we take a closer look at the top 5% group, these households also show an increase in the share of the aggregate consumption. This is because most of them also possess high labor efficiency, such that their wealth-to-earnings ratios are sufficiently low.

Table 3: Distribution from a flat labor tax to a flat consumption tax, with inelastic labor

Distribution of Wealth									
	Gini	Quintile					Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Pre	0.834	2.80E-03	2.81E-03	2.17	5.86	91.97	47.7	24.0	13.4
FCT	0.855	2.88E-03	2.88E-03	1.76	4.09	94.14	51.25	25.82	14.36
Distribution of Consumption									
	Gini	Quintile					Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Pre	0.789	3.00	3.00	13.00	16.64	64.35	29.17	14.19	7.81
FCT	0.810	3.24	3.24	13.08	17.14	63.29	29.21	14.16	7.75

4.1.2. With elastic labor

Since a change from a labor income tax scheme to a consumption tax scheme also distorts the intratemporal margin between consumption and leisure, in this section I incorporate an

elastic labor supply to discuss the impact of the tax change on the consumption-leisure trade-off. Table 4 and 5 exhibit the steady state aggregate variables and distributions. With the presence of an elastic labor supply, all the previous results hold: the tax reform results in higher capital and consumption, larger inequality in wealth, but also more evenly distributed consumption. Thus in this section, we focus on the additional effects of the consumption tax reform: the aggregate labor supply increases and the Gini index of labor decreases.

Table 4: Steady state aggregate variables of FLT → FCT, with elastic labor

	Variables										
Eco	τ_c	τ_w	r	w	w^τ	K	H	L	K/Y	C	Wel
Ben	0	0.269	6.00	0.558	0.407	5.09	0.30	1.88	3.00	0.975	100
FCT	0.272	0	4.25	0.631	0.631	6.74	0.31	1.94	3.51	1.10	109.3

Table 4 shows that the aggregate labor increases more than the average hour worked, implying that the increase in labor supply comes from households with high labor efficiency. The change in tax schemes distorts relative prices and inspires income effects and substitution effects. With CRRA class of utility, the substitution effect is captured by the Frisch elasticity, namely $(1-l)/l$ (where $l = 1-h$), a decreasing function of labor. For a given level of labor efficiency, households with more assets are inclined to provide less labor, thus a stronger substitution effect dominates the income effect, resulting in an increase in their labor supply. Since households with larger amounts of assets are more likely to possess high labor efficiency, their increase in labor supply leads to a higher level aggregate effective labor. In contrast, households at the lower end of the wealth distribution have a stronger income effect than a substitution effect, thus their labor supply reduces. As a result, the Gini index of labor decreases.

Table 5: Steady state distribution of FLT → FCT, with elastic labor

				Distribution of Wealth					
	Gini			Quintile			Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.828	0	0	2.46	5.71	91.81	43.32	19.95	10.48
FCT	0.847	0	0	1.95	3.95	94.08	47.29	21.88	11.49
				Distribution of Labor					
	Gini			Quintile			Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.186	24.18	24.18	22.71	20.14	8.77	3.40	1.63	0.875
FCT	0.158	23.28	23.28	22.42	21.26	9.73	3.64	1.72	0.916
				Distribution of Consumption					
	Gini			Quintile			Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.790	3.23	3.23	13.95	16.69	62.88	29.23	13.83	7.35
FCT	0.803	3.36	3.3699	13.73	17.53	61.99	30.02	14.15	7.51

4.1.3. The comparison between an incomplete market and a complete market

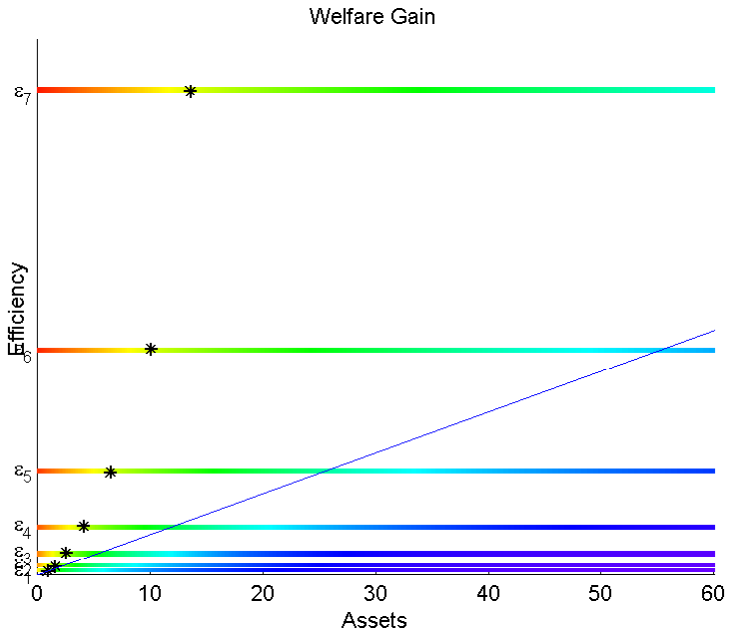

Figure 1: Welfare gain by assets and labor efficiency

Figure 1 displays the the welfare gain under an incomplete market as well as the welfare gain under a complete market of Correia (2010). I quantify the welfare gain by evaluating the welfare along the transition paths. Following the approach by Heathcote et al. (2004), I define an individual welfare gain in terms of consumption equivalent: a percentage that the non-reform consumption needs to increase in each period in order to catch up with the post-reform welfare. Let c_t^{NR} denote the consumption at period t without a reform and c_t^R be the consumption after the reform, then the welfare gain λ_x of type $x = (a, \epsilon)$ is obtained from:

$$\sum_{t=0}^{\infty} \beta^t Eu(c_t^R) = \sum_{t=0}^{\infty} \beta^t Eu((1+\lambda_x)c_t^{NR}).$$

As shown in Correia (2010), when market is complete, households with lower-than-average wealth-to-earnings ratios experience a welfare gain from the reform. The threshold is represented by the straight line in the graph, where the upper left region denotes the winners. The welfare gain of different types of households under an incomplete market is expressed by the seven bars. Along each bar, the warmer the color the more substantial the welfare gain (red means the highest value and blue means the lowest). The seven dots on each bar give us the asset thresholds, below which the welfare gain is strictly positive. Clearly, in the presence of the market incompleteness, the consumption tax reform still favors households in the upper left region, where the wealth-to-earnings ratio is relatively low. However, the thresholds are somehow different from those derived from a complete market. For households with low labor efficiency, the difference in the thresholds of the welfare gain under the two markets

is barely noticeable. This is because with respect to low earnings households, the two markets share the same mechanism: households experience a decrease in the interest rate, an increase in the after-tax wage and that increase dominates the increase in the consumption tax. However, for households with high labor efficiency, the thresholds of the welfare gain are shifted to the left with an incomplete market. This means that certain households that could benefit from consumption tax reforms in a complete market are experiencing a welfare loss due to the market incompleteness. In addition to the above effects of market prices, households with high labor efficiency are affected by much stronger precautionary motives, which stimulate them to substitute consumption and leisure for more savings.

4.2. Progressive labor taxes to consumption taxes

Our previous analysis is based on the fact that different households face the same amount of change in the after-tax wage and the same amount change in the consumption tax, and that the after-tax wage increases more than the consumption tax. The results rely crucially on the initial tax system. In this section, we examine the effects of consumption tax reforms by asking what if the initial labor income tax is progressive. The functional form of labor tax is proposed by Gouveia and Strauss (1994).

$$T_w(y) = \kappa_0(y - (y^{-\kappa_1} + \kappa_2)^{-1/\kappa_1})$$

where y is the labor income. Parameters κ_0 and κ_1 govern the average tax rate and the progressivity respectively, and κ_2 is used to balanced government budget. Since the data used by Gouveia and Strauss (1994) was for period 1979 to 1989, I adopt the values of parameters estimated by Anagnostopoulos et al. (2010), who use the PSID data and cover a more recent time period from 1983 to 2003. In particular, $\kappa_0 = 0.414$, $\kappa_1 = 0.888$, and $\kappa_2 = 1.34$.

Though this progressive tax function matches medium to high income households very well, it does not do a good job at the lower end of the income distribution. Since our paper pays particular attention to households with low income, we modify the tax function by allowing for a deduction in income. The deduction is calculated as the weighted average of 2013's standard deduction for the following five types of the filing statues: single $\$5,950$, married filed separately $\$5,950$, married filed jointly $\$11,900$, head of the household $\$8,700$ and qualifying widower $\$11,900$. Therefore, the tax function becomes:

$$\begin{aligned} T_w(y) &= 0 \text{ if y} < \$10{,}800; \\ &= \kappa_0(y - (y^{-\kappa_1} + \kappa_2)^{-1/\kappa_1}) \text{if otherwise.} \end{aligned}$$

Intuitively, switching from a progressive labor income tax to a flat consumption shifts the tax burden from wealthy households to the poor, so the discrepancy of welfare enlarges. To reduce the welfare inequality, I consider progressive consumption tax reforms. The functional form of the progressive consumption tax was originally proposed by Correia (2010), who uses a non-discriminary government transfer and allows for a constant marginal tax rate on consumption. In our case, this is equivalent to have a deduction on consumption and impose the same tax rate on the extra amounts. The budget constraint becomes

$$\begin{aligned} c + a' &= (1 + r^\tau)a + y - T_w(y), \text{ if } c_t < \bar{c} \\ c + \tau_c(c - \bar{c}) + a' &= (1 + r^\tau)a + y - T_w(y), \text{ if otherwise} \end{aligned}$$

where $\bar{c}$ is the consumption deduction threshold and $y = wh\epsilon$ is labor income. Due to the absence of the discussion on the optimal level of the progressivity, I experimented on several levels of deductions and the associated marginal tax rates under a balanced government budget.

4.2.1. Steady State Analysis

Table 6: SS of moving from a progressive labor tax to a progressive consumption tax

			Aggregate Variables						
Eco	$\bar{c}$	τ_c	$(\kappa_{l0}, \kappa_{l1}, \kappa_{l2})$	r	w	K	L	C	Wel
Ben	-	0	(0.414, 0.888, 1.34)	5.97	0.539	4.86	1.91	0.879	100
FCT	0	0.270	(0.00, -, -)	3.07	0.630	8.18	2.09	1.13	98.7
PCT1	\$3,200	0.308	(0.00, -, -)	3.22	0.624	7.89	2.08	1.10	104.0
PCT2	\$6,500	0.362	(0.00, -, -)	3.35	0.619	7.57	2.03	1.07	110.9
PCT3	\$10,000	0.435	(0.00, -, -)	3.46	0.615	7.40	2.02	1.04	112.7
PCT4	\$14,000	0.593	(0.00, -, -)	3.53	0.612	7.18	1.99	0.98	113.6

The aggregate variables are displayed in Table 6, where FCT denotes the flat consumption tax reform, and PCTs represent progressive consumption tax reforms. The first column describes the deduction levels in consumption and the second column reports the corresponding marginal tax rates. Shifting from a labor income tax to consumption taxes increases the aggregate capital because of stronger precautionary motives. Since a flat consumption tax does not distort the capital formation, the aggregate capital reaches the highest level with the reform FCT. As the consumption tax becomes more progressive, more distortion is brought into the economy and the aggregate capital falls.

Specifically, the Euler equation is written as $\frac{u_c(t)}{1+\tau_{ct}} = \beta E_t(1 + r^{\tau}_{t+1})\frac{u_c(t+1)}{1+\tau_{ct+1}}$, where τ_{ct} and τ_{ct+1} are non-zero if consumption exceeds deduction thresholds. As compared to the flat consumption tax reform, the progressive consumption tax schemes have no other impact on households with consumption far below or far above the deduction threshold because the consumption taxes in the two contingent periods cancel out in both cases. However, progressive consumption taxes particularly affects saving behaviors of households with consumption around the deduction levels and the impact are reversed for households with low efficiency and households with high efficiency. For example, let us assume that households with low labor efficiency are currently consuming below the deduction threshold, so no consumption tax is charged. With a certain probability they receive a higher labor shock in the next period, such that consumption exceeds the threshold and a consumption tax is imposed. In this case, the intertemporal saving decision is reflected by Euler equation $u_c(t) = \beta E_t(1 + r^{\tau}_{t+1})\frac{u_c(t+1)}{1+\tau_{ct+1}}$. With a tax on next period consumption, the marginal benefit of saving decreases, thus these households incline to reduce their asset holdings. The reverse is true for households with high labor efficiency: if they receive a bad shock in the next period, their consumption may drop below the deduction threshold and no tax will be levied. As a result, their marginal benefit of saving increases, which encourage them to increase their asset holdings. In order to be around the consumption deduction threshold, households with low labor efficiency should have more asset holdings than households with high labor efficiency. Households with

more asset holdings (lower labor efficiency) dominate the change in the aggregate capital, the aggregate capital is lower in the presence of progressivity.

Table 7: Distribution replacing a progressive labor tax with a flat/progressive consumption tax

Distribution of Wealth									
	Gini	Quintile					Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.825	0	0	2.02	6.77	91.21	42.48	19.76	10.49
FCT	0.846	0	0	2.02	4.40	93.57	46.88	21.91	11.57
PCT1	0.854	0	0	1.64	3.78	94.57	47.62	22.27	11.76
PCT2	0.864	0	0	1.19	3.02	95.78	48.53	22.70	11.99
PCT3	0.859	0	0	1.47	3.36	95.17	48.32	22.64	11.97
PCT4	0.856	0	0	1.57	3.51	94.92	48.20	22.58	11.93
Distribution of Labor									
	Gini	Quintile					Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.186	24.36	24.36	22.54	18.89	9.85	3.27	1.54	0.83
FCT	0.179	23.20	23.20	22.45	21.06	10.10	3.59	1.73	0.93
PCT1	0.184	22.50	22.50	22.90	21.75	10.36	3.70	1.79	0.96
PCT2	0.185	22.00	22.00	23.22	22.11	10.67	3.88	1.87	1.00
PCT3	0.185	23.84	23.84	22.31	20.23	9.80	3.64	1.76	0.94
PCT4	0.190	24.22	24.22	21.99	20.02	9.55	3.71	1.78	0.95
Distribution of Consumption									
	Gini	Quintile					Top Groups		
Eco		1st	2nd	3rd	4th	5th	Top 5%	Top 2%	Top 1%
Ben	0.567	4.10	4.10	14.75	17.33	59.72	26.27	12.28	6.61
FCT	0.574	3.36	3.36	13.98	17.56	61.75	29.02	13.85	7.38
PCT1	0.560	3.55	3.55	14.06	17.57	61.27	28.66	13.69	7.29
PCT2	0.561	3.90	3.90	14.06	17.32	60.82	28.39	13.53	7.24
PCT3	0.540	4.59	4.59	14.15	17.18	59.50	27.77	13.24	7.06
PCT4	0.532	4.85	4.85	14.36	17.56	58.40	27.31	12.90	6.87

The aggregate consumption follows the aggregate capital, increases after all the consumption tax reforms. It reaches the maximum by changing to the flat consumption tax regime because of the non-distortionary feature of flat consumption taxes. However, the flat consumption tax reforms shift the tax burden from wealthier households who are more likely to possess higher labor efficiency to households at the lower ends of the wealth and earnings distributions, so the Gini index of consumption increases. As the progressivity is introduced, households with larger wealth and earnings are taxed more heavily, so they reduce consumption. Since the decline in consumption by households at the higher ends of the wealth and earnings distribution dominates the change in consumption of other types of households, the aggregate consumption is lower in the progressivity consumption tax regimes. Because of

the shrinking gap between consumption by poor and wealthy households, the progressive consumption tax reforms reduce the inequality in consumptions, which are reflected by the lower Gini indexes of consumption in Table 7.

Moreover, consumption tax reforms also boost the aggregate labor. The increase in the effective labor is more sizeable than the increase of the average hour worked implies that the additional labor is provided by households with higher labor efficiency. In fact, as we explained in an earlier section, switching from a labor income tax scheme to a consumption tax scheme inspires a stronger substitution effect than an income effect for households with high labor efficiency. Thus, the aggregate labor increases but the inequality of the hour worked decreases by all the consumption tax reforms. As the progressivity of the consumption tax increases, a higher consumption tax is imposed on households who can afford more consumption. Since these households are most likely to possess larger wealth and higher labor efficiency, the discrepancy between their cost of consumption and their cost of leisure shrinks and the advantage of the substitution effect diminishes. As a result, high earnings households reduce their labor supply. On the other hand, in the presence of progressive consumption taxes, the income effect becomes less dominant for households with low earnings due to lower wages as compared to wages in the flat consumption tax regime. Thus, households at the lower end of the wealth distribution and more likely the lower end of the earnings distribution provide more labor. Initiated by the increasing progressivity in consumption taxes, the changes in labor supply by different types of households cause the aggregate labor to decrease and the inequality of the hour worked to increase, as shown in Table 6 Table 7.

4.2.2. Transition

In addition to the steady state analysis, we also evaluate the effects of consumption tax reforms in the transitional dynamics. In order to understand the impact of the progressivity on aggregate variables and welfare, I compare the transitional paths of two tax reforms: FCT and $PCT3$ with $\$10,000$ annual deduction on consumption. In both reforms, we introduce an unexpected change in the tax code. The progressive labor tax is removed once and for all and the marginal consumption tax rates are adjusted accordingly to balance the government budget.

Displayed in Figure 2, the marginal tax rate jumps immediately after the reform because the portion of the government revenue which was previously financed through a labor income tax is now collected from consumption taxes. On impact of the tax change, the aggregate consumption falls. Note that the aggregate consumption drops more severely in the case of $PCT3$. This is because households at higher ends of the wealth and earnings distributions are taxed more heavily under a progressive consumption tax scheme compared to a flat tax scheme and they dominate the change in the aggregate consumption. In response to a sudden elimination of the labor income tax, the aggregate labor shoots up because the substitution effect dominates the income effect on average. As time goes by, more capital is accumulated because of the stronger precautionary motives and aggregate consumption grows monotonically. As a result of a larger tax base, the marginal tax rate falls gradually. The comparison between the two tax reforms shows that the marginal tax rate of $PCT3$ is always higher than that of FCT due to a tax deduction in consumption. Moreover, since the degree of the distortion to the economy increases in the progressivity of consumption

taxes, $PCT3$ delivers lower levels of aggregate variables throughout the transition relative to FCT.

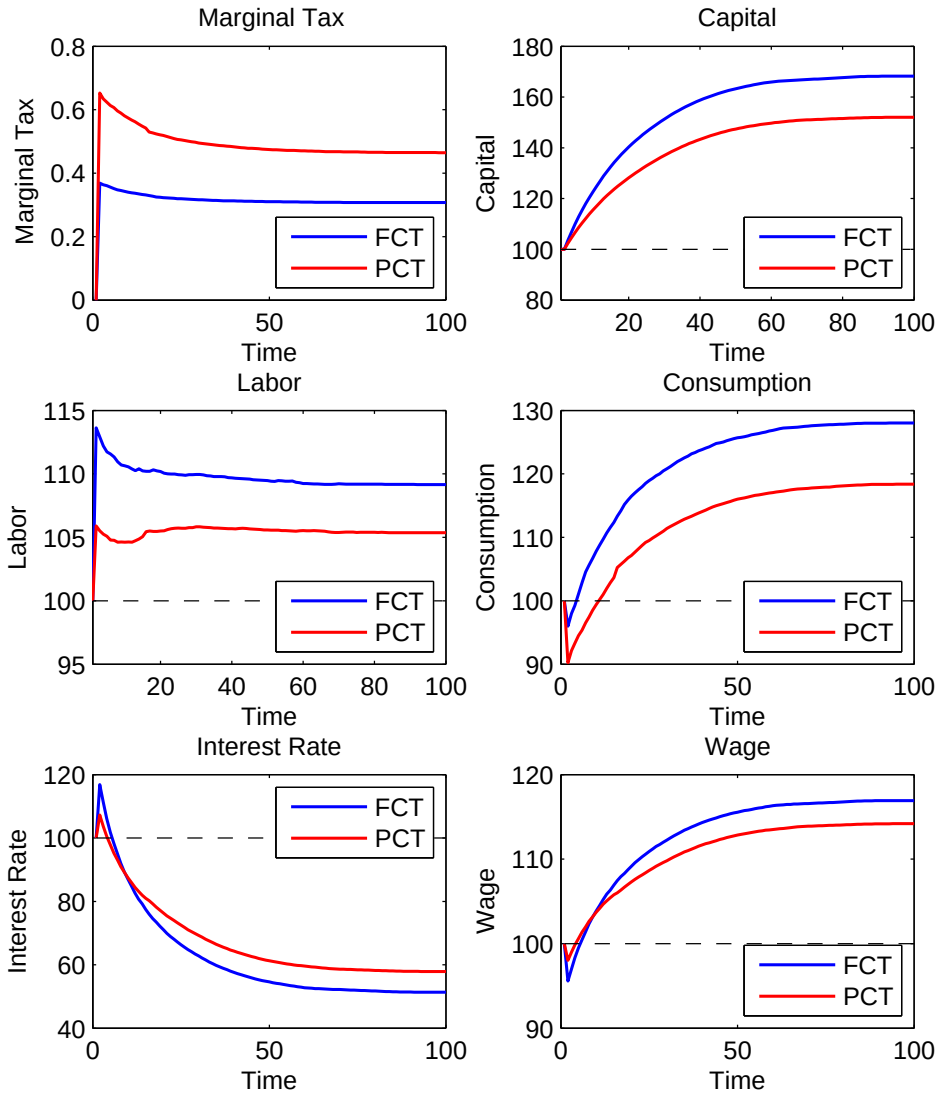

Figure 2: Comparison between FCT and PCT with inelastic labor, Aggregate Variables

Figure 3 exhibits the welfare gain of different types of households undergoing the two tax reforms. To limit the confusion without loss of generality, the figure represents households with three out of seven levels of labor efficiency. The solid lines represent the welfare gain associated with FCT and the dash lines correspond to the welfare gain of $PCT3$. Both reforms show that changing to consumption tax schemes sabotage households on the higher end of the wealth distribution, since they are more vulnerable to the drop in the interest rate. As more progressivity is introduced into the economy, households at lower end of the wealth distribution benefit more from the reform. Households with low earnings are especially in

favor of the reform because more households who were subject to a labor income tax are now exempted from taxation.

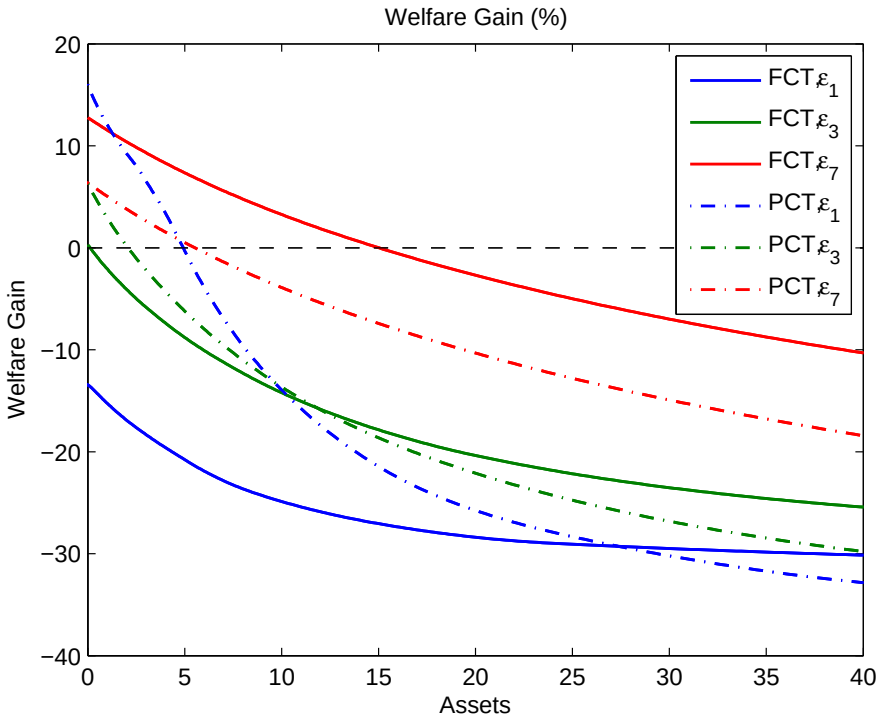

Figure 3: Comparison between FCT and PCT with inelastic labor, Individual Level

4.3. Comparison of FCT and PCT

From the previous analysis we know that households with low wealth-to-earnings ratios are in favor of consumption tax reforms. The main reason is that changing from a labor income tax scheme to a consumption tax scheme depresses the interest rate, but boosts the after-tax wage and the increases in the after-tax wage dominates the increase of consumption taxes, households with relatively lower wealth and higher earnings are more likely to be better off.

As compared to flat consumption tax reforms, progressive consumption tax reforms place more focus on households with low earnings. This is because with a deduction of consumption, more households at the lower ends of the wealth and the earnings distribution are exempted from taxation. As a result, progressive consumption tax reforms deliver more substantial welfare gains and distribution effects than a flat consumption tax reform.

5. CONCLUSION

In this paper, I study the effects of consumption tax reforms in an incomplete market setting. I focus on redistributional aspects in explaining the long run consequences and the short run welfare effects. Replacing labor income taxes with consumption taxes promotes the efficiency by increasing the aggregate capital, labor and consumption. At steady state, the

Gini index of wealth increases because stronger precautionary motives stimulate higher asset holdings from households at the higher end of the wealth distribution. The change in the Gini index of consumption and labor depends on the tax schemes. Once the steady state welfare gain is decomposed into the aggregate component and the distribution component following Domeij and Heathcote (2004), I obtain a positive distributional component, meaning that welfare is more equally distributed among households in the long run. Furthermore, I study the short run effects of consumption tax reforms by taking into account the entire transition processes and the post-reform steady state. I find that replacing a flat labor income tax with a flat consumption tax favors households with low wealth-to-earnings ratios; switching from a progressive labor income tax scheme to a progressive consumption tax scheme particularly benefits households with low earnings.

ACKNOWLEDGEMENT

I'd like to thank Alexis Anagnostopoulos and Eva Carceles-Poveda for valuable comments and suggestions.

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