Welfare Effects of Consumption Taxes

A Dissertation presented

by

Qian Li

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Economics

Stony Brook University

May 2014

Stony Brook University

The Graduate School

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Abstract of the Dissertation

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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. The first two chapters of the dissertation study long run consequences of changing to a consumption tax regime, as well as short run welfare effects evaluated in transitional dynamics.

In the first chapter, we found that 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.

The second chapter is built on the first chapter, answering the following two questions: Is there any welfare gain if a consumption tax reform is announced in advance? Does welfare inequality reduce in response to pre-announcements? In this framework, households respond to two opposite effects of changing from labor income taxes to consumption taxes. First, anticipating higher consumption taxes in the future, households tend to consume more, substitute labor for leisure and save less. Second, eliminating labor income taxes increases the volatility of future income. As a result, households accumulate more capital under stronger precautionary motives. I show that changes in aggregate variables and welfare inequality depend crucially on the risk aversion parameter because the degree of risk aversion determines the intensity of precautionary motives. If the risk aversion parameter is low, anticipation motives dominate precautionary motives, such that the aggregate capital falls before the tax change and bounces back afterwards. Households with relatively low wealth and relatively high earnings benefit from consumption tax reforms in the long run, but are hurt in the short run during the anticipation because of an increasing interest rate and a falling wage rate. Nevertheless, the long run effect dominates the short run effect, hence households with a low wealth-to-earnings ratio still experience a welfare gain in the presence of anticipation. Given that the wealth distribution is more concentrated than the distribution of earnings, consumption tax reforms with a pre-announcement can deliver a positive aggregate welfare gain and a reduction in welfare inequality. However, if the risk aversion parameter is high, precautionary motives dominate anticipation motives, the transition pattern of the aggregate capital reverses. Moreover, the aggregate welfare gain is more substantial as compared to the previous case.

Given that flat consumption taxes have no effect on long run aggregate capital formation when markets are complete. The final chapter provides conditions on

utility under which a similar statement is true under incomplete markets. When these conditions are satisfied, using a flat consumption tax to finance an increase in government spending does not affect precautionary savings. In contrast, using lump sum taxes tends to increase precautionary savings.

Keyword Incomplete markets, Precautionary Savings, Flat consumption taxes, Progressive consumption taxes, Welfare inequality, Anticipation
JEL: E2 , D52, H21

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Acknowledgements

The success completion of my dissertation would not be possible without the guidance and assistance of my advisors, my dissertation committee and colleagues.

I would like to express my deep appreciation to my main advisor Eva Carceles-Poveda, who has been a tremendous mentor for me. Thank you for encouraging my research and creating opportunities for me. Your priceless advice and support has accompanied me through my successful moments as well as hard times. I would also like to thank my co-advice and co-author Alexis Anagnostopous, whose attitude toward research deeply impressed me. I am very honored to collaborate with you during my Ph.D.. Moreover, I appreciate the valuable advices and suggestions from my committee member Erem Atesagaoglu and Yulei Peng, as well as my colleagues.

Chapter 1

Welfare Effects of Consumption Taxes

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.

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

1.1 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.

1.2 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 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 pos-

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

itive 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*:

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

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.

1.3 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 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 and the distribution of wealth and earnings match the US data.

1.4 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.

Table 1.1: 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

1.4.1 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).

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 1.2: Steady state of aggregate variables after replacing a FLT with a FCT tax, with inelastic labor

				Aggregates				
Eco	τ_c	τ_w	r	w	w^τ	K	C	Wel
Pre	0	0.269	6.00	0.551	0.403	4.32	0.830	100
FCT	0.290	0	4.37	0.599	0.599	5.43	0.886	106.5
	(29%)	(36.8%)	(-27.17%)	(8.71%)	(48.71%)	(25.59%)	(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 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.

[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 $\frac{C}{Y} = 0.62$.

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 1.3: Steady state distribution after replacing a FLT with a FCT, 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

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 1.4: Steady state of aggregate variables after replacing a FLT with a 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.

The comparison between an incomplete market and a complete market

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

Table 1.5: Steady state distribution after replacing a FLT with a 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

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

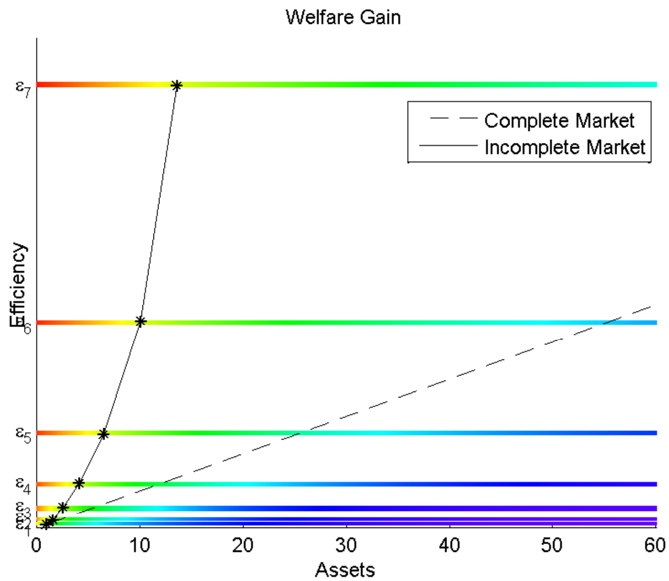

Figure 1.1: Comparison of welfare gain between a complete market and an incomplete market

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.

1.4.2 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:

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

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

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

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.

Steady State Analysis

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

Table 1.6: Steady state of aggregate variables after replacing a PLT with a PCT, with elastic labor

			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

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.

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.

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.

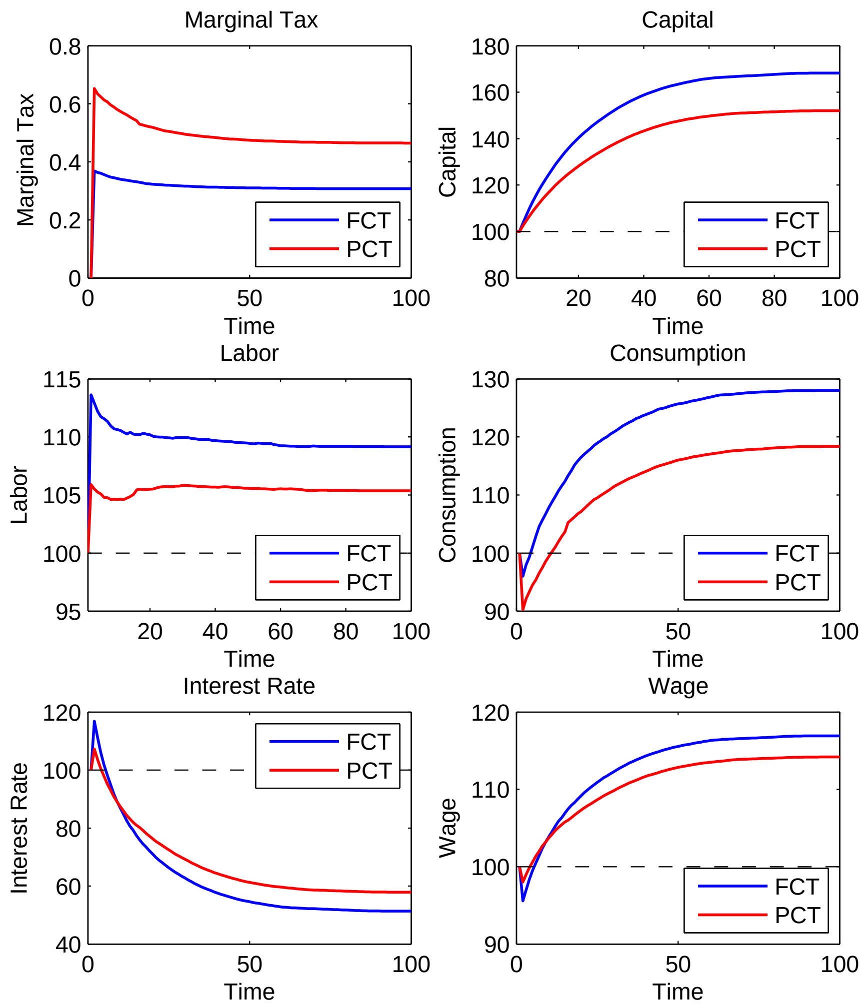

Figure 1.2: Comparison of aggregate variables between FCT and PCT, with elastic labor

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.

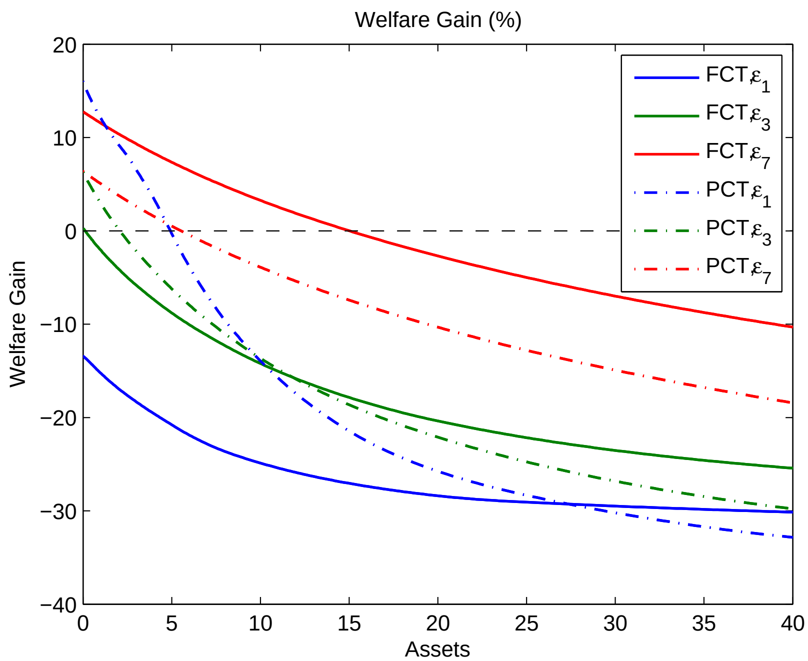

Figure 1.3: Comparison of individual welfare gain between FCT and PCT, with elastic labor

1.4.3 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.

1.5 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.

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Table 1.7: Steady state distribution after replacing a PLT with a PCT, with elastic labor

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

Chapter 2

Preannounced Consumption Tax Reforms

Abstract

This paper answers the following two questions: Is there any welfare gain if a consumption tax reform is announced in advance? Does welfare inequality reduce in response to pre-announcements? In this framework, households respond to two opposite effects of changing from labor income taxes to consumption taxes. First, anticipating higher consumption taxes in the future, households tend to consume more, substitute labor for leisure and save less. Second, eliminating labor income taxes increases the volatility of future income. As a result, households accumulate more capital under stronger precautionary motives. I show that changes in aggregate variables and welfare inequality depend crucially on the risk aversion parameter because the degree of risk aversion determines the intensity of precautionary motives. If the risk aversion parameter is low, anticipation motives dominate precautionary motives, such that the aggregate capital falls before the tax change and bounces back afterwards. Households with relatively low wealth and relatively high earnings benefit from consumption tax reforms in the long run, but are hurt in the short run during the anticipation because of an increasing interest rate and a falling wage rate. Nevertheless, the long run effect dominates the short run effect, hence households with a low wealth-to-earnings ratio still experience a welfare gain in the presence of anticipation. Given that the wealth distribution is more concentrated than the distribution of earnings, consumption tax reforms with a pre-announcement can deliver a positive aggregate welfare gain and a reduction in welfare inequality. However, if the risk aversion parameter is high, precautionary motives dominate anticipation motives, the transition pattern of the aggregate capital reverses. Moreover, the aggregate welfare gain is more substantial as compared to the previous case.

Keyword: Incomplete markets, Consumption taxes, Anticipation, Welfare inequality

JEL: E2 , D52, H21

2.1 Introduction

The study of consumption taxes is an emerging topic. Hall (1995) illustrates the principle of consumption taxes: people are taxed on what they take out of the economy, instead of what they put in. Thus, consumption taxes can exempt savings/investment from taxation. As a result, the added investment will lead to a bigger economic "*pie*" to be divided among households. This opinion is also shared by economists like Kaldor (1955) and Summer (1984b), Seidman (1995) etc..

From a fairness point of view, Correia (2010) proves that shifting from labor income taxes to consumption taxes benefits households with lower wealth-to-earnings ratios under complete markets. Li (2012) extends this result to an incomplete market setting and shows that consumption tax reform can effectively reduce the welfare inequality. The main reason is that consumption reforms stimulate more precautionary savings, such that the interest rate decreases and the wage increases. Moreover, the after-tax wage increases more than the consumption tax, so households with low wealth-to-earnings ratios are more likely to be better off.

So far the discussion of consumption tax reforms is limited to unexpected changes of tax schemes. Ligquist and Sargent (2004) examine the transition paths of anticipated tax changes under a complete market setting and with inelastic labor supply. A higher consumption tax in the future translates into a lower return to capital, so the representative household reduces the capital accumulation during the anticipation until the tax change. In avoidance of a higher consumption tax in the future, consumption undoubtedly increases before the reforms and drops on impact at the arrival new tax regimes.

Different features emerge from market incompleteness: precautionary motives and an endogenous distribution of households. Thus, this paper explores the effects of anticipated consumption tax reforms in an incomplete market setting. I study both aggregate transition patterns and individual reactions to such reforms. Since changing from labor income tax schemes to consumption tax schemes distorts both the intertemporal and intratemporal margins, I assume elastic labor supply to fully capture the impact of consumption tax reforms.

The main results are as follows. The anticipation of a switch from a labor income tax system to a consumption tax system stimulates opposite motives from households. First, a higher consumption tax in the future implies a lower return to capital, thus the anticipation motives drive households to consume more, substitute labor for leisure and save less. Second, eliminating labor income taxes increases the volatility of future income. As a result, household accumulate more assets under stronger precautionary motives. With a low relative risk aversion parameter, anticipation motives dominate precautionary motives, the aggregate capital falls during the anticipation. On the contrary, if the relative risk aversion parameter is high, then precautionary motives dominate and the aggregate capital increases throughout the transition.

The feature of welfare gain with anticipation is similar to an unanticipated case where households with low wealth-to-earnings ratios are better off. In the long run, consumption tax reforms favor households with relatively low wealth relatively high earnings. In the short run, with a low relative risk aversion parameter, anticipation motives dominate and the capital drops. As a result of a higher interest rate and a low wage rate, the above households are worse off. Nevertheless, the long run welfare effect dominates the short run effect resulting in a welfare gain for households with low wealth-to-earnings ratios. After compensating for the delay effect as Domeij and Klein (2005), namely measuring the welfare gains associated with different length of anticipation at the same time point, the welfare gain diminishes with anticipation durations because a larger weight is assigned to the short run welfare effect. In contrast, with a high relative risk aversion parameter, driven by stronger precautionary motives, households tend to substitute more consumption and leisure for savings. As a result of a lower interest rate and a higher wage, households with low wealth-to-earnings ratios also win in the short run. Thus the aggregate welfare gain is more substantial with a higher relative risk aversion parameter.

The rest of paper is structured as follows. Section 2 describes the model. The numerical results are discussed in Section 3. Section 4 concludes the paper and sketches the future work.

2.2 The Model

The economy is populated with a continuum (with measure 1) of infinite lived households, who differ in assets a_t and labor efficiencies ϵ_t, which is $i.i.d.$ across households and follows Markov process with the transition matrix $\Pi(\epsilon_t|\epsilon_{t-1})$. Each agent is endowed with 1 unit of time to be divided between labor and leisure. The preference over sequences of consumption takes the form,

$$\max_{c_t,a_{t+1},h_t} \sum_{t=0}^{\infty} \beta^t Eu(c_t, h_t),$$

where $\beta \in (0,1)$ is the subjective discount factor. The period utility function u satisfies $Inada$ conditions.

The capital and labor income are taxed at τ_a and τ_w respectively. In addition, a flat tax τ_c is levied on the consumption level. The budget constraint at period t is

$$\begin{aligned}
(1+\tau_c)c_t + a_{t+1} &= (1+r_t^{\tau})a_t + (1-\tau_w)\epsilon_t w_t \\
\text{where } r_t^{\tau} &= (1-\tau_a)r_t \\
\epsilon_{t+1} &\sim \Pi(\epsilon_{t+1}|\epsilon_t).
\end{aligned}$$

The representative firm maximizes its profit according to

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

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

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

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

The government collects its revenue through taxes to finance its spending G, which is constant and exogenously given.

$$G = \tau_c C_t + \tau_a r_t K_t + \tau_w w_t L_t$$

where C_t denotes the aggregate consumption at period t.

The asset and labor markets clearing requires that the aggregate capital and labor provided by 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 consumption.

$$\int_S a_t d\Gamma_t(a, \epsilon) = K_t$$
$$\int_S l_t \epsilon_t d\Gamma_t(a, \epsilon) = L_t$$
$$\int_S c_t d\Gamma_t(a, \epsilon) = C_t$$
$$C_t + K_{t+1} - (1 - \delta)K_t + G = AF(K_t, L_t)$$

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

Equilibrium prices and allocations are characterized by firm demand functions, household and government budget constraints and market clearing conditions.

2.3 Numerical Results

This section presents the quantitative results. We first discuss the calibration of the benchmark economy. Then we study the effects of replacing a flat labor income tax with a flat consumption tax under a balanced government budget with different anticipation durations. At last, we do the robustness check by changing the relative risk aversion parameter.

2.3.1 Calibration

For preferences, we assume a CRRA utility $u(c) = \frac{(c^{\gamma}(1-h)^{1-\gamma})^{1-\sigma}}{1-\sigma}$ with a relative risk aversion parameter $\sigma = 2$. γ is calibrated to be 0.38, such that the average hour worked is 0.3 in the benchmark economy. The production function is Cobb-Douglas, $F(K,L) = AK^{\alpha}L^{1-\alpha}$, with $\alpha = 0.36$ matching the capital's share in the 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 0.88 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 labor tax to be 0.279 in the benchmark economy. For the purpose of this exercise, we assume there is no capital tax in order to study the difference between labor taxes and consumption taxes without the interference of other taxation. The earning process (Table 1) is borrowed from Davila et al. (2012), who calibrate the shock parameters to match the Gini index of earnings of 0.6.

Table 2.1: Earning Process

Earning Process			
$\epsilon \in \{\epsilon_1, \epsilon_2, \epsilon_3\}$	1.00	5.29	46.55
	0.992	0.008	0.0
$\Pi_{\epsilon'\|\epsilon}$	0.009	0.980	0.011
	0.000	0.083	0.917
Stationary Distribution			
$\epsilon*$	0.481	0.456	0.063

2.3.2 Steady States

We briefly describe the steady state results in the long run. The first line of Table 2 shows the steady state of the benchmark economy and the second line corresponds to the post-reform steady state. In this experiments we cut the current labor income tax by 10% and use a consumption tax to balance the government budget. [1] The aggregate capital increases by 2.59% because of stronger precautionary motives. The aggregate labor also increases because the higher after tax wage induces more labor from households with higher labor efficiencies. In fact, households with high labor efficiency are more likely to possess larger amount of assets and thus lower labor supply. Therefore, switching from a labor income tax system to a consumption tax system provokes a stronger substitution effect (captured by the Frisch Elasiticity, which is large when the labor supply is low) than an income effect, so these households provides more labor. Finally, the aggregate consumption follows the aggregate capital due to the fact that the aggregate capital is below the golden rule level. The last column displays the welfare gain in terms of consumption equivalent. Consumption tax reforms result in a positive welfare gain because the interest rate falls but the wage rate raises and the after-tax wage increases more than the consumption tax, so households with low asset-to-efficiency ratios are better off. Since the asset distribution is more concentrated than the distribution of efficiency, the aggregate welfare increases.

Table 2.2: Steady states of aggregate variables after moving from a labor income tax regime to a consumption tax regime

	τ_c	τ_w	r	w	w^τ	K	L	C	Wel
Ben	0	0.27	6.37e-2	0.495	0.36	4.59	2.04	1.03	100
Ref	0.023	0.24	6.22e-2	0.499	0.38	4.70	2.05	1.04	100.91
%	(1.23)[2]	(-3.68)	(-2.42)	(0.71)	(4.41)	(2.59)	(0.58)	(1.30)	(0.91)

2.3.3 Transition

This subsection shows the transition processes of the above reform with difference announcement dates. During the anticipation, the labor income tax and the con-

[1]The reason of reducing τ_w by 10% rather than eliminating it is that we want to be consistent with the experiment in the next section, where the relative risk aversion is higher, $\sigma = 4$. Completely eliminating τ_w will result in a negative interest rate. Thus, in avoidance of a negative interest rate, we reduce τ_w by a very conservative amount.

sumption tax is maintained at the current level; at the moment of the implementation, the labor income tax and the consumption tax are changed once and for all to the new steady state level. Throughout the transition, a lump-sum tax is adjusted to balance the government budget.

Figure 1 exhibits the transition paths of aggregate variables with different anticipation durations. Time 0 is the implementation date and the time indexes prior to 0 denotes the anticipation. In the unanticipated case, the aggregate capital increases monotonically to the new higher steady state because of stronger precautionary motives stimulated by the elimination of labor income taxes. The aggregate labor shoots up on impact of the tax change because the sudden switch of tax systems provokes a stronger substitution effect than an income effect. The aggregate consumption drops unambiguously because of the tax levy.

The feature of post-reform transition paths in an unanticipated case can be carried over to reforms with pre-announcements. Therefore, we focus on anticipation periods to discuss the impact of preannouncements. The aggregate capital is subject to two opposite effects during the anticipation. First, anticipating a higher consumption tax in the future, households tend to consume more, substitute labor for leisure and save less. Second, eliminating labor income taxes increases the volatility of future income. As a result, household accumulate more assets under stronger precautionary motives. With a low relative risk aversion parameter, the anticipation motives dominate the precautionary motives, thus the aggregate capital decreases until the arrival of the new tax scheme. Comparing across reforms with different announcement dates, as the anticipation prolongs, households have more sufficient time to prepare for the future lower return to capital. Thus the minimum of the aggregate capital, which occurs at the time of the tax change, becomes even lower with a longer anticipation duration.

The aggregate labor falls before the new tax scheme is carried out. Reducing the labor tax and increasing a consumption tax means that the leisure will be more expensive than the consumption because the opportunity cost of leisure $(1 - \tau_w)w\epsilon$ increases more than the cost of consumption $(1 + \tau_c)$ (Li (2012)). The difference between the cost of leisure and consumption is more prominent for households with high labor efficiency. Thus, it is optimal for these households to take chance to substitute labor for leisure before the new tax regime and supply more labor afterwards.

Anticipating the consumption tax would be higher in the future, households increase consumption as soon as reforms are announced. From the third panel in Figure 1, we observe a more dramatic increase in consumption when anticipation durations are shorter. The reason is that households do not have sufficient time to prepare themselves against the future higher cost of consumption, so they increase consumption to the largest extent before the higher consumption taxes.

2.3.4 Welfare Effects

As discussed in Li (2012), a switch from labor taxes to consumption taxes benefits households with low asset-to-efficiency ratios. This is because such reforms decrease the interest rate and increase the after-tax wage. Thus, households with lower asset-to-efficiency ratios, who mainly obtain their income form labor, would expect a promotion in their total incomes. Moreover, the increase in the after-tax wage is more sizeable than the increase in the consumption tax, so these households are more likely to be better off. The pre-announcement does not change this feature, but the magnitude depends on the length of anticipation durations. As shown in the first line of Table 3, the welfare gain decreases as the anticipation prolongs because a reform takes place in a distant future tends to have less impact than a reform around the corner.

Table 2.3: Welfare gain of the consumption tax reform (in %), with $\sigma = 2$

Anticipation	0	1	5	10	25	50
Welfare Gain (%)	0.91	0.74	0.42	0.11	0.020	0.006
Welfare Gain (%) (Comp. Delay Effect)	0.045	0.04	0.038	0.029	0.020	0.020

Since the intensity of the response to reforms depends on the length of anticipation durations, we first compensate the delay effect following the approach proposed by Domeij and Klein (2005) and then compare the welfare gain at the same time point. More specifically, we evaluate welfare gains of all the reforms at 25 periods prior to the implementation. If the pre-announcement exceeds 25 periods, we truncate welfare at $t = 25$; otherwise, the allocations between the $t = 25$ and the date that a reform is announced are the same as the allocations under the current tax scheme. The reason of choosing 25 periods prior to the tax change is that households barely react to any pre-announcement until there are roughly 25 periods left before the implementation. For instance, if the pre-announcement takes place at 30 periods ahead of the reform, households would wait for 5 periods and start preparing for the new tax regime at 25 periods in advance. The results are shown in the second line of Table 1. After compensating for the delay effect, the welfare gain decreases as the anticipation duration increases. Recall that with a low relative risk aversion parameter, anticipation motives dominate precautionary motives during the anticipation. Thus households reduce asset holdings and in exchange of more consumption and leisure. This effect is more prominent for households with larger assets. As a result of a lower aggregate capital, a higher interest rate and a lower wage rate, they are better off in the short run. On the other hand, households with low asset-to-efficiency ratio, who experience welfare gain in the long run, are hurt in the short run. Because the distribution of assets is more concentrated that the distribution of labor efficiency, households with relatively low assets and relatively high efficiency dominates the aggregate welfare. As anticipation prolongs, more weight is given to the short run effect, so the aggregate welfare gain decreases.

2.3.5 Robustness

We know from the precious section that when anticipation is involved, the aggregate capital is subject to two effects that move in the opposite directions: precautionary motives stimulation capital accumulation, but anticipation a lower return to assets discourages savings. With a relative risk aversion of 2, the second effect dominates. Thus, in this section, we increase the relative risk aversion parameter to 4 in the hope to confirm that the first effect plays an indispensable role in the transition.

The transition paths of aggregate variables are displayed in Figure 3. The aggregate capital increases persistently starting from the announcement date and exhibits a kink at the implementation. This pattern reflects that precautionary motives dominate anticipation motives.

Table 2.4: Welfare gain of the consumption tax reform (in %), with $\sigma = 4$

Anticipation	0	1	5	10	25	50
Welfare Gain (%)	0.69	0.64	0.44	0.41	0.32	0.066
Welfare Gain (%) (Comp. Delay Effect)	0.0019	0.0025	0.0047	0.0098	0.026	0.066

The aggregate welfare gains that are calculated at different time points and that are compensated for the delay effect are shown in Table 4. For the same reason that households response to a nearby reform more actively than to a remote reform, the welfare gains decreases in the length of anticipation, as shown in the first line. Since precautionary motives dominate anticipation motives with a larger relative risk aversion parameter, the aggregate capitals grows during the anticipation. As a result, a lower interest rate and a higher wage rate favor households with low asset-to-efficiency ratios in the short run as well as in the long run. Hence, the welfare gain increases as the anticipation duration extends. After compensating the delay effect at 50 period prior to the reform, the aggregate welfare gain stabilize at 0.066%, which is more than that obtained from the previous section, in which the relative risk aversion parameter is low.

2.4 Conclusion and Future Work

This paper discusses the effect of anticipated consumption tax reforms that replace one portion of the current labor income tax under a balanced government budget. At the new steady state, aggregate variables are higher. Moreover, the interest rate drops, after tax wage increases and the magnitude of the increase in wage rate is greater than that of consumption tax. As a result, households with low wealth-to-earnings ratios are better off and the aggregate welfare increases. During the transition, the aggregate capital is subject to two effects. Precautionary motives, which are stimulated by future more volatile income, promote capital accumulation. On the other hand, the anticipation of future higher consumption tax, which indicates a lower return to capital, depresses savings. With a low relative risk aversion, the second effect dominates and the aggregate capital drops before the implementation of the new tax scheme. Households with low wealth-to-earnings ratios, who receive welfare gains in the long run, are hurt by the increase interest rate and decreasing wage rate in the short run. However, since the long run welfare effect dominates, these households still experience welfare gains in the presence of anticipation. After compensating for the delay effect, the aggregate welfare gain decreases with the length of anticipation duration, because more weight is given to the short run effect. In contrast, with a high relative risk aversion parameter, precautionary motives dominate and the aggregate capital exhibits a reversed pattern during the anticipation. The aggregate welfare gain increases after compensating the delay effect because households with low asset-to-efficiency ratios benefit both in the short and in the long run.

So far, the discussion of consumption taxes is limited to nondurable consumptions. However, almost one third of consumer expenditure consists of durable goods. Since consumer durables can provides a stream of utilities, they are more sensitive to the timing of the tax change. Hence our future work will incorporate durable goods in studying the effects of consumption tax reforms.

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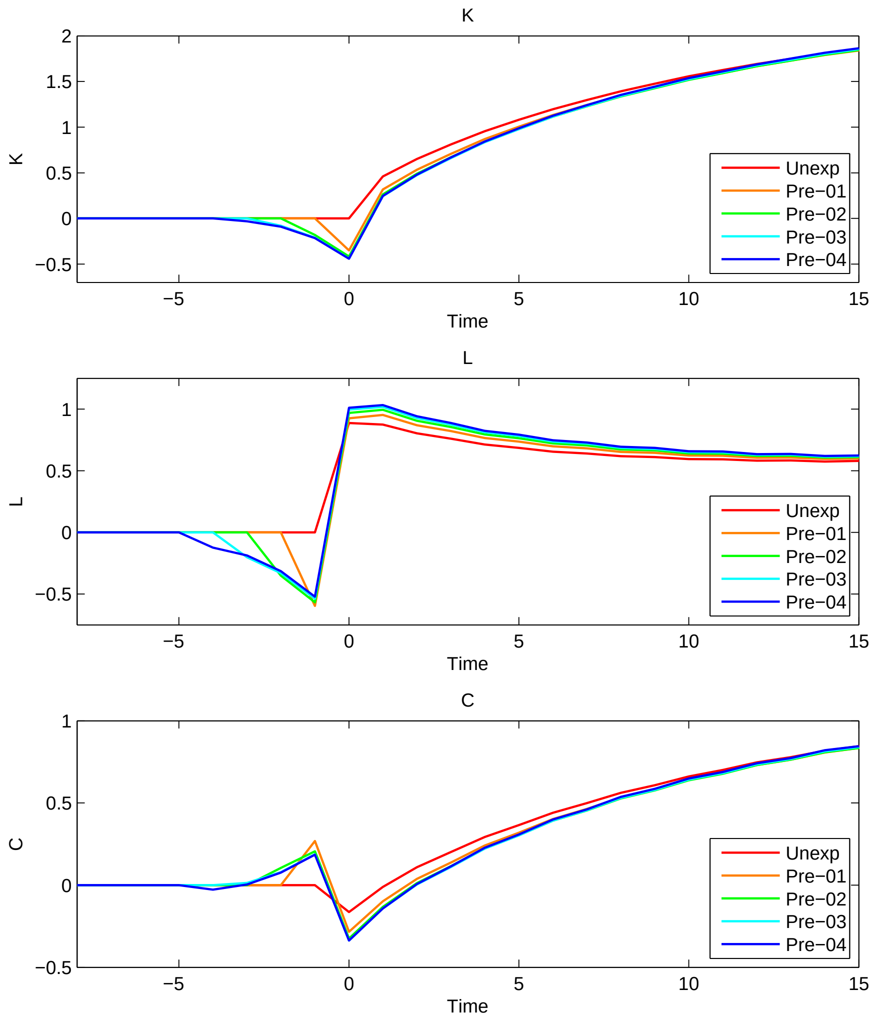

Figure 2.1: Transition path of aggregate variables with $\sigma = 2$

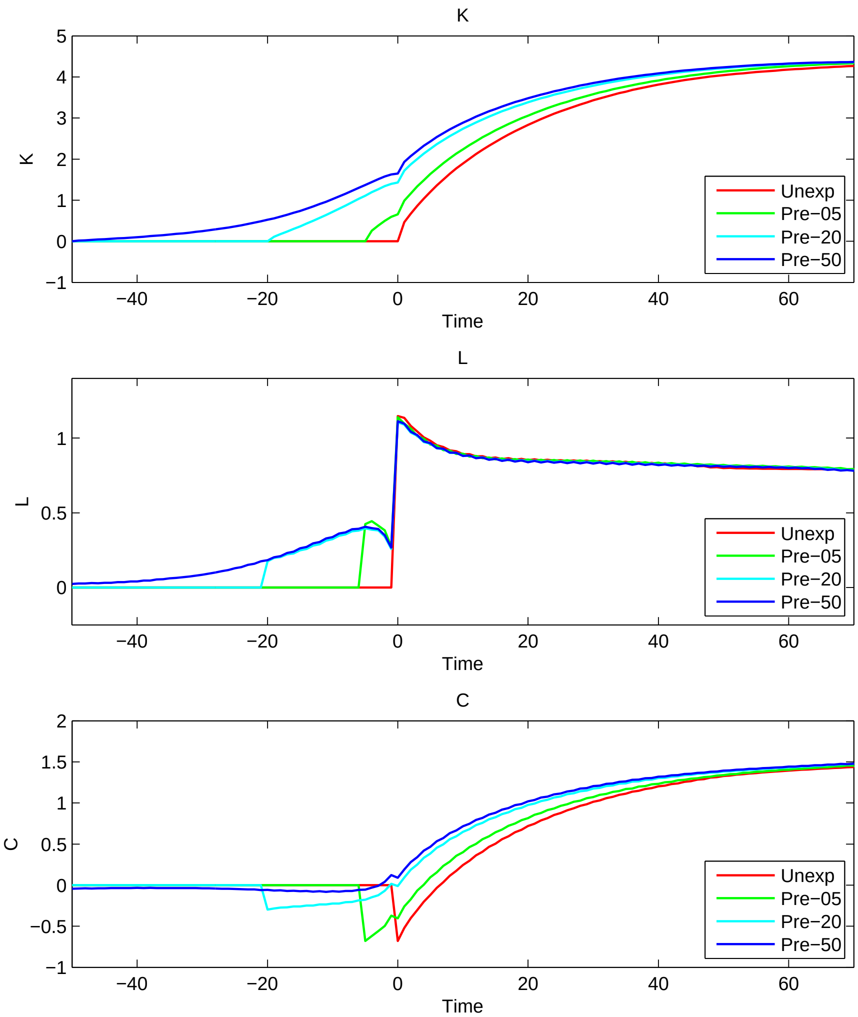

Figure 2.2: Transition path of aggregate variables with $\sigma = 4$

Chapter 3

Consumption Taxes and Precautionary Savings[1]

[1]With Alexis Anagnostopoulos. Published in *Economics Letters* 119(2013), no. 3, 238-242

Abstract

Flat consumption taxes have no effect on long run aggregate capital formation when markets are complete. In this note, we provide conditions on utility under which a similar statement is true under incomplete markets. When these conditions are satisfied, using a flat consumption tax to finance an increase in government spending does not affect precautionary savings. In contrast, using lump sum taxes tends to increase precautionary savings.

Keywords: Incomplete Markets, Consumption Taxes, Precautionary Savings

JEL: E2, D52, H21

3.1 Introduction

Proposals for tax reforms which incorporate a shift away from income taxes toward consumption taxes are a recurrent theme in tax policy discussions. Such proposals often receive intellectual support, and are sometimes directly put forward, by academic economists.[2] This support is based on a body of theoretical work suggesting that a flat consumption tax is efficient in the sense of not distorting aggregate capital formation. A lucid review of the literature on consumption taxation, along with important qualifications to this result, is provided by Coleman (2000). A common feature in this literature is the assumption of market completeness. Under this assumption, the long run after-tax return to capital is pinned down by an exogenous rate of time preference. Since a flat consumption tax does not alter this after-tax return, the implication is that aggregate capital in the long run is not affected by such a tax. When markets are incomplete, the long run after-tax return to capital does not only depend on the exogenous rate of time preference. The (endogenous) intertemporal marginal rate of substitution also plays a role. As shown in Aiyagari (1994), a precautionary savings motive acts to increase the equilibrium capital stock relative to the first best. This note considers the effect of flat consumption taxes on precautionary savings and, hence, aggregate capital formation under incomplete

[2]Hall and Rabushka (1995) is, perhaps, the most well-known example.

markets.[3]

We provide conditions on utility such that a change in the flat consumption tax rate does not affect capital. The conditions have a straightforward economic interpretation and are analogous to the restrictions on preferences required for balanced growth. These restrictions consist of a constant elasticity of intertemporal substitution in consumption and a marginal rate of substitution between consumption and leisure that is proportional to consumption. As such, our result is of independent theoretical interest. In addition, our result contributes to a growing literature which aims to evaluate specific tax reforms in the presence of incomplete markets, in the following sense. The effects of reducing one type of tax (e.g. a capital income tax) are often evaluated while government budget balance is maintained by raising some other tax.[4] In a complete market framework, there is a natural way to balance the budget, namely by using lump sum taxes. Since lump sum taxes are not distortionary in that setup, they have the desirable property that they do not bring any additional effects on equilibrium variables over and above the effects of the tax reduction under consideration. This allows one to interpret the reform effects on equilibrium variables as arising purely from the reduction in the specific tax one is considering. With incomplete markets, however, lump sum taxation does not have this neutrality property, because lump sum taxes can have effects on precautionary savings. To put it differently, if one is interested in the pure effects of a reduction in some type of tax (say capital income taxes), then balancing the budget using lump sum taxes will not be the best way to achieve this. Our result suggests that, for certain utility specifications, flat consumption taxes can play this role.

The model is briefly described in Section 2, the main result along with intuition is presented in Section 3, additional insights arising from numerical computations are discussed in Section 4 and concluding remarks are given in Section 5.

[3]We assume throughout an infinite lifetime, hence abstracting from life cycle considerations. Taxation models under incomplete markets which incorporate such considerations can be found in Imrohoroglu (1998) and Conesa et al. (2009). Browning and Burbidge (1990) and Ventura (1999) also provide such models, specifically focusing on consumption taxes.

[4]See, for example, Domeij and Heathcote (2004) and Anagnostopoulos et al. (2012).

3.2 The Model

The model used is a standard Aiyagari (1994) economy augmented with a government. Since this is a well-known model that has become a workhorse model in the study of incomplete markets and heterogeneity, it is only briefly presented here.

We consider an infinite horizon, discrete time economy with endogenous production and uninsurable labor income risk. A continuum (of measure 1) of households are indexed by $i \in [0,1]$ and time is indexed by $t = 0, 1, 2, ...$ A representative firm uses aggregate capital K_t and effective labor N_t to produce goods using a Cobb-Douglas production function

$$Y_t = AK_t^{\alpha} N_t^{1-\alpha} \tag{3.1}$$

where $\alpha \in (0,1)$ and $A > 0$ is a scaling factor. Capital and labor are rented from households at competitive prices r_t and w_t respectively. Capital depreciates at a rate $\delta \in [0,1]$ and the firm pays this depreciation before returning principal plus return to households. Profit maximization yields the usual input demand functions

$$r_t = \alpha AK_t^{\alpha-1} N_t^{1-\alpha} - \delta \tag{3.2}$$

$$w_t = (1-\alpha)\, AK_t^{\alpha} N_t^{-\alpha} \tag{3.3}$$

Household i derives utility from consumption c_{it} and disutility from work n_{it}. Utility is assumed to be additively separable over time, identical across households and given by

$$E_0 \sum_{t=0}^{\infty} \beta^t u\left(c_{it}, n_{it}\right) \tag{3.4}$$

where $\beta \in (0,1)$ is the subjective discount factor and E_0 denotes the expectation conditional on information at date $t = 0$. The precise form of the period utility function $u\,(.)$ will be discussed in the following section.

Each period t, households can save $a_{i,t+1}$. These savings are rented to the firm at the rate r_t, generating asset income in the following period. When a_{it} is negative, the household is in debt. In addition to asset income, household i earns labor income $w_t \epsilon_{it} n_{it}$ from supplying labor n_{it} to the firm. Labor income depends on individual specific productivity ϵ_{it} which varies stochastically. This productivity is i.i.d. across households and follows a Markov process with transition matrix $\Pi(\epsilon'|\epsilon)$.[5]

The government has an exogenous constant level of spending G to undertake which it finances using taxes. In order to focus on our main interest, namely consumption taxes, we only allow the government to raise taxes through a constant proportional tax on consumption τ^c or through lump sum taxes T_t.

Putting all elements together, the household's budget is given by

$$(1+\tau^c)\, c_{it} + a_{i,t+1} = w_t \epsilon_{it} n_{it} + (1+r_t)\, a_{it} - T_t \tag{3.5}$$

$$a_{i,t+1} \geq \bar{a},\ 0 \leq n_{it} \leq 1 \tag{3.6}$$

where $\bar{a}$ is an exogenous borrowing limit.[6] The government maintains a balanced budget

$$G = \tau^c C_t + T_t \tag{3.7}$$

where $C_t = \int_0^1 c_{it} di$ is aggregate consumption. In equilibrium, prices should be such that supply and demand for capital and effective labor are equalized. Market clearing for goods is given by

$$C_t + K_{t+1} - (1-\delta)\, K_t + G = A K_t^{\alpha} N_t^{1-\alpha} \tag{3.8}$$

and there should be consistency in the sense that the law of motion for aggregate capital must be consistent with the household's individual savings decisions.

Equilibrium prices and allocations are characterized by firm demand functions

[5] Although not crucial for our result, we make the simplifying assumption that there is no aggregate uncertainty, implying that wages and asset returns are certain.

[6] In what follows, we ignore the upper bound on n_{it} for simplicity. Our Proposition does not rely on this simplification. In our numerical experiments, this constraint never binds.

(3.2) − (3.3), household and government budget constraints (3.5) − (3.7), market clearing conditions and the consistency condition, as well as by the following household optimality conditions

$$u_c(c_{i,t}, n_{i,t}) \geq \beta\,(1 - \delta + r_{t+1})\, E_t u_c(c_{i,t+1}, n_{i,t+1}) \tag{3.9}$$

with equality when $a_{i,t+1} > \bar{a}$ and

$$-u_n(c_{i,t}, n_{i,t}) \geq \frac{\varepsilon_i w_t}{1 + \tau_c} u_c(c_{i,t}, n_{i,t}) \tag{3.10}$$

with equality when $n_{it} > 0$. These two describe the trade-offs from the household's perspective along the consumption-savings and the consumption-leisure margin respectively.

3.3 Consumption Tax Effects

Consider an exogenous increase in G, financed by consumption taxes. Our main result states that aggregate capital and effective labor, and hence prices w_t and r_t, will not be affected as long as preferences satisfy two properties: a constant elasticity of intertemporal substitution in consumption and a marginal rate of substitution between consumption and leisure that is proportional to consumption levels. The following proposition proves this statement by constructing the changes in the tax rate τ^c and in individual consumption levels needed to ensure all equilibrium conditions remain satisfied at the old levels of the aggregates.

Proposition 1 *In a standard Aiyagari (1994) model with a government, an exogenous increase in G financed by an increase in τ^c, has no effect on aggregate capital accumulation provided utility satisfies the following two conditions: 1. The elasticity of intertemporal substitution (IES) in consumption is constant and 2. The marginal rate of substitution between consumption and leisure is proportional to consumption.*

Proof. Suppose $\{c_{it}, n_{it}, k_{it+1}, r_t, w_t, K_t, N_t, C_t\}_{\forall t}$ are equilibrium allocations and prices corresponding to given policy variables $\{T_t\}_{\forall t}$, G and τ^c satisfying the government's budget. When G increases to G^*, it will be shown that the same aggregate allocations $\{K_t, N_t, C_t\}_{\forall t}$, prices $\{r_t, w_t\}_{\forall t}$ and individual savings and labor supply decisions $\{n_{it}, k_{it+1}\}_{\forall t}$ satisfy all equilibrium conditions as long as consumption is proportionally adjusted according to

$$c^*_{it} = \frac{1+\tau_c}{1+\tau^*_c} c_{it}$$
$$C^*_t = \frac{1+\tau_c}{1+\tau^*_c} C_t$$

where τ^*_c is such that the government's budget (3.7) is still balanced without any change in lump sum taxes T_t, i.e.

$$\tau^*_c = \frac{G^* - T_t}{C^*_t}$$

Since capital and labor allocations are left unchanged, market clearing in those markets is trivially satisfied. Since prices have not been perturbed, the firm demand equations $(3.2)-(3.3)$ are also trivially satisfied. Household budgets are still satisfied since overall consumption spending (including taxes) has been left unchanged and the government's budget is satisfied by construction of τ^*_c. Walras' law ensures that good's market clearing is also satisfied for the new allocations. The law of motion for aggregate capital has not been changed and individual savings have not changed, thus the consistency condition is also satisfied. The only remaining conditions to check are optimality of household decisions along the consumption-savings margin (3.9) and along the consumption-leisure margin (3.10). Constant IES implies that the intertemporal marginal rate of substitution (IMRS) $\beta E_t u_c(c^*_{i,t+1}, n_{i,t+1})/u_c(c^*_{i,t}, n_{i,t})$ depends on the ratio c^*_{it+1}/c^*_{it} and this ratio has remained the same since consumption in all date/events is adjusted by the same proportion $(1+\tau_c)/(1+\tau^*_c)$. The intratemporal condition (3.10) can be written as

$$-\frac{u_n(c^*_{i,t}, n_{i,t})}{u_c(c^*_{i,t}, n_{i,t})}(1+\tau^*_c) \geq \varepsilon_i w_t$$

The second restriction on utility requires that $-u_n(c^*_{i,t}, n_{i,t})/u_c(c^*_{i,t}, n_{i,t})$ is linear in consumption c^*_{it}. This implies that the left hand side is only perturbed if $(1+\tau^*_c)\, c^*_{it}$ changes. But overall consumption spending (including taxes) has not changed. Hence, all equilibrium conditions are satisfied at the new allocations. ■

Given the assumption of additive separability over time, the period utility form that satisfies the two conditions is of the familiar King et al. (1988) form (KPR henceforth)

$$u_1(c,n) = \frac{[cv(n)]^{1-\sigma} - 1}{1-\sigma},\ \sigma > 0,\ \sigma \neq 1 \tag{3.11}$$
$$= \log c + \log v(n),\ \sigma = 1$$

where $v(n)$ satisfies standard monotonicity and concavity assumptions discussed in King et al. (1988). King et al. (1988, 2002) show that this type of utility allows for balanced growth. The two properties used in our proposition are the crucial ones. First, in order for the Euler equation to hold in the presence of sustained growth, with constant consumption growth and constant returns, they show that a constant IES is needed. Second, in order for labor hours to remain constant in the presence of sustained growth in wages, utility must be such that income and substitution effects of permanent wage changes exactly offset each other. This property, which essentially boils down to our second condition, is crucial to ensure the intratemporal first order condition is satisfied. There is a clear analogy between their result and ours. With regard to the first condition, when consumption taxes change permanently, a permanent change in consumption levels maintains the same IMRS for every household and is thus consistent with no change in the return to saving. Regarding the second condition, a permanent increase in τ_c can be thought of as a permanent decrease in (tax-adjusted) wages $w_t/(1+\tau_c)$. The above utility will ensure that the resulting income and substitution effects will cancel each other and labor supply will be unaffected for all households.

Not all commonly used utility specifications satisfy the conditions imposed. Period utility that is additively separable in consumption and labor, but not logarithmic in consumption as in

$$u_2\left(c,n\right)=\frac{c^{1-\sigma}}{1-\sigma}-\chi\frac{n^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}},\ \sigma>0,\ \sigma\neq 1,\ \varepsilon>0 \tag{3.12}$$

will violate the second condition since the income effect will dominate when $\sigma > 1$ and the substitution effect will dominate when $\sigma < 1$. Non-separable preferences as in Greenwood et al. (1988)

$$u_3\left(c,n\right)=\frac{\left(c-\chi\frac{n^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}}\right)^{1-\sigma}}{1-\sigma},\ \sigma>0,\ \sigma\neq 1,\ \varepsilon>0 \tag{3.13}$$

will violate both the first and the second condition.

Violation of the second condition basically implies that changes in consumption taxes will affect labor supply and, as a consequence, capital accumulation. Thus consumption taxes will affect capital accumulation through a labor supply channel. This is not particular to the incomplete markets setting considered here, it is also true in a complete markets model.

Violation of the first condition will imply consumption taxes can affect capital accumulation directly through affecting individual savings choices. Indeed, this could arise even in the absence of a labor/leisure margin. If, for example, labor supply were assumed to be exogenously inelastic at $\bar{n}$, then (3.13) would essentially capture the idea of subsistence consumption $\bar{c}=\chi\bar{n}^{1+1/\varepsilon}/\left(1+1/\varepsilon\right)$ inherent in Stone-Geary type utilities like

$$u_4\left(c,n\right)=\frac{\left(c-\bar{c}\right)^{1-\sigma}}{1-\sigma},\ \sigma>0,\ \sigma\neq 1,\ \bar{c}>0 \tag{3.14}$$

In this case, condition 2 of our proposition is irrelevant, but condition 1 is violated. Consumption taxes will affect capital accumulation even in the long run. Contrast this result with the steady state of a representative agent, complete market economy. In that economy, capital accumulation will not be affected by consumption taxes since the IMRS is simply β, i.e. not affected by changes in the level of consumption. In the Aiyagari economy considered here, when utility is given by (3.14) consumption *levels* actually make a difference for the intertemporal marginal rate of substitution even in the long run. Individual households can be facing rising or falling expected consumption paths as they move across the distribution of wealth in response to idiosyncratic shocks, even though these shocks wash out on the aggregate. A uniform reduction in consumption levels for everyone, like the one suggested in our proof, will affect the IMRS and hence change savings decisions. This is not true in a complete market steady state, because there is no movement in consumption across time at the steady state. Put differently, the modified golden rule level of capital will still be optimal at the steady state of a complete markets economy, even with Stone-Geary type utility.[7]

Under the conditions provided in our proposition, consumption taxes do not affect inequality, in the sense that income and wealth are entirely unaffected and consumption is proportionally reduced, with the same proportion applied to everyone in the economy. Thus the Gini coefficients of income, wealth and consumption are unaffected. From a welfare perspective, it is clear that an increase in G will decrease welfare by assumption, since there is no production or utility benefit arising from government spending. Nevertheless, it is interesting to note that a decomposition of the welfare loss into aggregate and distributional components, along the lines of Domeij and Heathcote (2004), gives a zero distributional component. That is, the welfare loss arises from the direct fall in aggregate consumption due to an increase in G, but there are no distributional welfare effects. This is the sense in which consumption taxes can be useful to balance the budget in tax reform experiments. The needed revenue can be raised through consumption taxes without directly affecting the capital stock nor bringing additional distributional changes. This is to be contrasted with the case of financing G using lump sum taxes, a case treated numerically in the following section.

[7] Note, however, that a change in consumption taxes will affect savings behavior out of steady state even under complete markets, unless our utility conditions are satisfied.

3.4 Numerical Results

Numerical computations are used in order to address two questions. First, how does the effect of financing an increase in G using consumption taxes contrast with using lump sum taxes? Second, how does moving away from the utilities that satisfy our restrictions change the conclusions about the effects of consumption taxes on capital? To answer these questions, the economy is calibrated and steady states as well as transitions are computed.

3.4.1 Calibration

The time period is assumed to be one year. The parameters β, δ, G, α and χ are calibrated to match a capital-output ratio of 3, an investment to GDP ratio of 0.2, a government spending to GDP ratio of 0.2, a capital income share of 0.36 and an average fraction of time worked of 0.3, respectively. The borrowing limit $\bar{a}$ is set to zero and the scaling factor A in the production function is normalized to deliver a deterministic steady state output equal to one. In the steady state of our benchmark economy, no lump sum taxes are used ($T = 0$). All spending is financed through consumption taxes, which implies $\tau^c = G/C = 1/3$.

Table 1: Parameter values in the two economies

Parameters	β	δ	G	α	χ	A
KPR Economy	0.873	0.067	0.314	0.36	1.828	0.616
GHH Economy	0.863	0.067	0.438	0.36	68	0.584

Two economies distinguished by the period utility are considered. In the first, individual utility is given by

$$u_1(c, n) = \frac{[c(1-n)^{\chi}]^{1-\sigma} - 1}{1-\sigma} \tag{3.15}$$

which falls under the general KPR form in (3.11) with $v(n) = (1-n)^{\chi}$. In the second, individuals have GHH preferences as in (3.13), with the Frisch elasticity of labor supply set to $\varepsilon = 0.3$ following Domeij and Heathcote (2004). In both cases, risk aversion is set to $\sigma = 2$. Table 1 gives the value of the calibrated parameters used for each target in each of the two economies. The idiosyncratic labor productivity process is taken directly from Davila et al. (2012). Since the three productivity levels and Markov transition matrix are identical to that paper, the values are omitted here in the interest of brevity.

3.4.2 Consumption vs Lump Sum Taxation with KPR Preferences

The focus of this section is on the economy with KPR utility as in (3.15). The effects of a 10% increase in G are analyzed in two separate experiments. In experiment 1, this increase in government spending is financed by an increase in τ^c, whereas in experiment 2 it is financed by an increase in T_t. The steady state values of G, τ^c, T, K, N, Y, C before and after this increase are reported in Table 2.

For experiment 1, the effects are exactly those predicted by Proposition 1. The only change is that τ^c rises to balance the budget and consumption falls in proportion to this increase in τ^c. Capital, labor and production remain the same. For experiment 2, individual savings and labor supply are affected. Both the aggregate capital stock and aggregate effective labor rise. Labor is higher as a direct result of the drop in disposable income, i.e. due to an income effect. Capital rises for two reasons. First, the increase in labor supply temporarily increases the return to capital thereby increasing investment. So capital increases through a labor supply channel. Second, independently of the labor channel, precautionary savings increase. The reason is that an increase in lump sum taxes works analogously to a tightening of the borrowing constraint.[8]

Table 2: Steady states and welfare effects of a 10% increase in G with KPR utility

[8] A precise derivation of this analogy is available upon request.

Variable	Benchmark	Experiment 1		Experiment 2	
G	0.314	0.346	(+10.0%)	0.346	(+10.0%)
τ^c	0.333	0.379		0.333	
T	0.00	0.00		0.033	
K	4.71	4.71	(+0.0%)	4.89	(+3.5%)
N	1.80	1.80	(+0.0%)	1.84	(+1.8%)
Y	1.57	1.57	(+0.0%)	1.61	(+2.4%)
C	0.942	0.910	(−3.3%)	0.937	(−0.5%)
Consumption Equivalent					
Overall	N/A	−3.3%		−15.7%	
Aggregate	N/A	−3.3%		−8.4%	
Distributonal	N/A	0.0%		−8.0%	

Welfare effects are computed based on a utilitarian social welfare criterion and decomposed into aggregate and distributional components following the method of Domeij and Heathcote (2004). Table 2 reports these welfare effects in consumption equivalent terms. In experiment 1, there is no transition, leisure is not affected and there is no change in the distribution of consumption. As a result, the decrease in welfare is entirely due to the drop in aggregate consumption and the distributional component is zero. In experiment 2, the steady state changes, so it is essential to compute the whole transition. The aggregate component of the welfare loss is significantly higher than in experiment 1. This is due to the combined effect of a fall in leisure and in consumption. Even though both short run and long run aggregate consumption falls by less than in experiment 1, the concurrent fall in leisure leads to an aggregate welfare loss of 8.4%. In addition, there are substantial welfare losses arising from negative redistribution, i.e. from individuals at the bottom of the consumption distribution who have high marginal utility to those at the top with low marginal utility. Overall, the welfare loss is significantly higher compared to the one in experiment 1, 15.7% vs 3.3% in consumption equivalent terms.

3.4.3 Consumption Tax Effects with GHH Preferences

This section focuses on the economy with GHH utility as in (3.13) and considers only experiment 1, i.e. a change in G financed by consumption taxes. Table 3 reports the results under the heading 'Elastic Labor Supply'.

Table 3: Steady states and welfare effects of a 10% increase in G with GHH utility

Variable	Elastic Labor Supply			Fixed Labor Supply		
	Benchmark	Experiment 1		Benchmark	Experiment 1	
G	0.441	0.485	(+10.0%)	0.279	0.307	(+10.0%)
τ^c	0.333	0.385		0.333	0.379	
T	0.00	0.00		0.00	0.00	
K	6.61	6.54	(−1.1%)	4.19	4.22	(+0.5%)
N	2.75	2.73	(−1.1%)	1.67	1.67	(+0.0%)
Y	2.20	2.18	(−1.1%)	1.40	1.40	(+0.2%)
C	1.32	1.26	(−4.8%)	0.838	0.811	(−3.2%)

In this case, consumption taxes induce changes in household savings and imply a transition to a new steady state with lower capital. The immediate effect of the increase in τ^c is to reduce the relative price of leisure $w/(1+\tau^c)$. Since with GHH utility there are no wealth effects, households substitute away from consumption towards leisure, thus decreasing labor supply. In turn, this implies a decrease in the return to investment which leads to a gradual reduction of the capital stock. That is, aggregate capital falls due to a mechanism working through labor supply. This labor supply channel would also be operative under complete markets, i.e. it is not directly connected to precautionary savings.

In order to abstract from the labor supply channel, we also consider a version with fixed labor supply.[9] Exogenously fixing labor supply for all individuals to $\bar{n} = 0.3$ makes the GHH utility equivalent to a Stone-Geary type utility as in (3.14), with

[9] Note that β, A and G are recalibrated for this experiment to match our targets in the benchmark.

$\bar{c} = \chi \bar{n}^{1+1/\varepsilon}/(1+1/\varepsilon)$. Results for this case are reported in Table 3 under the heading 'Fixed Labor Supply'. Shutting down the labor supply channel brings to the fore another operative mechanism. The decrease in consumption resulting from an increase in consumption taxes, reduces the term $c - \bar{c}$ in the utility thereby affecting intertemporal marginal rates of substitution. This has the effect of increasing precautionary savings, albeit by a modest amount. This effect would be larger if $\bar{c}$ were assumed to be larger or if G were increased by more.

3.5 Concluding Remarks

In a nutshell, this note investigates the effects of flat consumption taxes in an incomplete markets economy and compares them to lump sum taxation. It is shown that, under certain conditions on utility, consumption taxes do not affect aggregate capital or the distribution of wealth. In contrast, lump sum taxes increase precautionary savings, change the distribution of wealth and redistribute welfare from the bottom to the top. A numerical example identifies potential effects of consumption taxes on capital when the utility conditions are not met. When the intertemporal elasticity of substitution is not constant, precautionary savings can increase as a result of a consumption tax increase. In addition, consumption taxes can affect capital through a labor supply channel. The direction of the effect depends on the relative size of income and substitution effects resulting from the change in the relative price of leisure. In a numerical example, where the substitution effect dominates, this mechanism reduces aggregate capital.

In order to maintain simplicity in the presentation of the main result, the model used was simplified along several dimensions. First, it abstracted from other forms of taxation such as capital and labor income taxation. Second, it only incorporated idiosyncratic risk, abstracting from aggregate risk considerations. Third, it did not allow for preference heterogeneity across individuals. Finally, it assumed an exogenous borrowing limit stricter than the natural debt limit. None of these simplifications are crucial for the proposition proved. It is straightforward to show, albeit with some added notational complication, that the result holds in the presence of aggregate risk, preference heterogeneity and natural debt limits. It is also robust to adding other forms of taxation in the disposal of the government, as long as the experiment considered involves raising additional revenue by simply adjusting consumption taxes. Imposing an endogenous borrowing constraint, such as a participation constraint, could overturn the result to the extent that the constraint is affected by consumption taxes.

Although welfare effects were calculated and briefly commented upon, it has not been this paper's intention to provide a thorough analysis of the desirability of consumption taxes from a welfare perspective or to compare their welfare consequences to those of other forms of taxes. Such an analysis is provided by Correia (2010), who carefully addresses distributional concerns in addition to the traditional efficiency concerns under the assumption of complete markets. When markets are incomplete, it is shown in Davila et al. (2012) that the desirability of raising or lowering aggregate capital relative to the equilibrium allocation will depend on the specific assumptions about the nature of the exogenous risk and its implications for wealth and income heterogeneity. Thus, a welfare evaluation that incorporates such questions of constrained efficiency as well as distributional effects would require a carefully calibrated, quantitative model. This task is undertaken in Li (2012).

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