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MACROECONOMIC AND REDISTRIBUTIONAL EFFECTS OF CONSUMPTION TAXES IN THE USA*

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This paper studies the effect of an increase in consumption taxes using a dynamic general equilibrium model of overlapping generations calibrated to the US economy. When the proceeds are used to reduce income taxes, the reform raises the aggregate capital and labour supply in the long run. Workers increase labour supply immediately in response to the reform, while consumption rises only gradually. The tax reform also transfers wealth from old consumers to young consumers. As a result, while future generations experience significant welfare gains, current generations, particularly old consumers, tend to experience sizable welfare losses. When the proceeds are used for a lump-sum transfer, the aggregate capital and labour both decrease in the long run. This reform is welfare-improving for the current low-income households.
JEL Classification Numbers: E62, H24, H31.

1. Introduction

The tax rates on goods and services, or "consumption tax," vary significantly across countries. The total value added taxes (VAT) and goods and services taxes (GST) in many European countries are 15–20%, while the rates are much lower in other countries, such as Japan and Canada.[1] The USA is the only Organisation for Economic Cooperation and Development (OECD) country without the VAT and the sales taxes operated at the sub-federal level are substantially lower in general.[2] The taxes on goods and services in the USA collect revenues that correspond to 5% of GDP, while the number for European OECD countries is 12% on average.

There has been a long history of proposals for fundamental tax reform to replace the current income taxes with a consumption tax.[3] Arguments for a consumption-based tax system are motivated by various reasons, such as the transparency and simplicity of consumption taxes and reduced administration and enforcement costs relative to income taxes, or the efficiency gains from reducing distortions that income taxes impose on labour supply, saving and investment. Traded off against gains is a concern over distributional consequences due to the fact that consumption taxes are more regressive than the progressive income taxes. In particular, fundamental tax reform may have unfavourable effects on low-income households, who spend more of their resources on consumption, or

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[1] The VAT/GST is 19.6% in France, 19.0% in Germany, 20.0% in Italy, 16.0% in Spain and 17.5% in the UK as of January 2010 (Consumption Tax Trends, OECD).

[2] The general sales taxes are in the range of 0–8.25% at the state level, with an un-weighted average of 5.0%. In some cases additional sales taxes are assessed at sub-state levels.

[3] See, for example, Summers (1981), Gravelle (1991), Hall and Rabushka (1995) and Aaron and Gale (1996) for earlier studies.

on retirees at the time of the reform, who have already contributed to the system and are taxed heavily as they spend down accumulated assets. Despite the expected gains from fundamental tax reform, especially the improved efficiency in resource allocations and a rise in economic activities in the long run, we have not seen a shift from income taxes to consumption taxes in the USA. The average consumption tax rate has remained low, in the range of 4–6%, over the last several decades.[4] Even in Europe, where the government relies much more heavily on consumption taxes, less than one-third of the total tax revenues is raised through taxation on goods and services.[5] A complete elimination of income taxes and a transition to a consumption-based tax system therefore might be difficult to implement in reality for various reasons, both politically and economically.

This paper considers a shift from income to consumption taxes, though in a milder degree than fundamental tax reform, in which the US consumption tax rate is raised from the current level of about 5%, up to the levels that are close to those observed in many European countries. We use a simulated overlapping generations model of heterogeneous agents in the tradition of Auerbach and Kotlikoff (1987) to study macroeconomic and redistributional effects of a policy change. The model is calibrated to match key macro and micro features of the US economy and serves as the benchmark to evaluate effects of counterfactual policy reforms.

Our study is related to various papers that quantitatively study the effects of consumption tax reform in a life-cycle model of heterogeneous agents, including Auerbach and Kotlikoff (1987), Auerbach (1996), Altig *et al*. (2001), Nishiyama and Smetters (2005) and Athreya and Reilly (2009). Auerbach and Kotlikoff (1987) and Altig *et al*. (2001) use a deterministic life-cycle model of overlapping generations of households and show that fundamental tax reform brings about a significant increase in output and improves welfare in the long-run. Nishiyama and Smetters (2005) build a life-cycle model with idiosyncratic wage shocks and study a reform to replace the progressive income tax system with a flat consumption tax and quantify welfare effects from the transition. They show that the reform generates efficient gains in a model without idiosyncratic shocks, but it fails to do so once the income uncertainty is introduced. This is because the loss of intra-cohort insurance provided by the progressive income tax system is eliminated.[6] Our study considers a milder and perhaps more realistic change in policy by raising consumption taxes by fixed percentage points, rather than a complete shift to the consumption-based system in combination with the elimination of income taxes as studied in the above papers. We also consider alternative fiscal adjustments in response to the rise in revenues from consumption taxes, including a reduction in income taxes at different degrees of progressivity and a lump-sum transfer. In terms of the model, we introduce permanent productivity differences across households, besides idiosyncratic productivity risks that households face during the working period. This approximates the differences in education or innate abilities that are pre-determined at the entry to the labour market and fixed throughout the life-cycle. We consider the role of alternative tax systems to redistribute across different types of households, as well as the role of taxes to provide insurance against idiosyncratic shocks.

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[4] See, Mendoza *et al*. (1994), for example.

[5] 31.1% for European OECD countries in 2007 (OECD Revenue Statistics, 2009).

[6] Conesa and Krueger (2006) also investigate insurance roles of the progressive income tax system and efficiency trade-off in a study of optimal income tax system.

The paper is organized as follows. Section 2 presents the model, households' problem and equilibrium definition. Section 3 discusses the calibration of the model. Numerical results are presented in section 4. Section 5 concludes.

2. Model

2.1 Demographics, endowment and preference

The economy is populated by overlapping generations of households of age $j = 1, 2, \ldots, J$. The size of a new cohort grows at a constant rate n. The lifespan is uncertain and households of age j survive until the next period with probability s_j. Accidental bequests are collected and distributed to all households in the economy as a lump-sum transfer and denoted by b. Households retire from market work at an exogenous retirement age j_R.

In every period, each household is endowed with one unit of time, which can be spent supplying labour in a competitive market or consuming leisure. New households enter the economy with no assets, besides a lump-sum transfer from accidental bequests.

Labour income is defined as $\varepsilon_j zelw$. Households are heterogeneous along three dimensions that affect their labour productivity. First, ε_j captures age-dependent deterministic labour productivity, with $\varepsilon_j = 0$ for $j \geq j_R$. Second, z denotes permanent differences in productivity, standing in for heterogeneities in educational attainment or innate abilities. This permanent productivity, or the "type" of households is given as they enter the economy and fixed over the households' life-cycle. Third, e represents an idiosyncratic productivity shock, which follows a Markov process. l is the hours of work that households choose optimally and w denotes the market wage.

Preferences over the sequence of consumption and leisure $\{c_j, (1-l_j)\}_{j=1}^{J}$ are represented by a time-separable utility function $E\{\sum_{j=1}^{J} \beta^{j-1} u(c_j, 1-l_j)\}$, where β is the time discount factor and expectation is with respect to the idiosyncratic productivity uncertainty and mortality risks.

2.2 Technology and market structure

A representative firm produces output according to a constant returns to scale technology: $Y = F(K, L) = AK^{\alpha}L^{1-\alpha}$, where K and L are aggregate capital and labour and α is the capital share. The constant A normalizes units in our economy. Capital depreciates at rate δ. The firm rents capital and labour efficiency from households in competitive markets, where factor prices r and w are equated to the marginal productivities.

There is no market for state-contingent assets. Households can only purchase and accumulate a positive amount of one-period riskless asset that pays at the market interest rate.

2.3 Government

The government purchases an exogenous amount of goods and services G and supplies an amount of one-period risk-free debt D, which, by no arbitrage, carries the same return r in equilibrium as claims to physical capital. The expenditure G and the payment of the principal and interest on the debt $(1 + r)D$ are financed by the revenue from taxes on consumption and income and proceeds from newly issued debt. The consumption tax is

proportional at rate τ_c and the income tax is given by a function $\mathcal{T}(y_L, y_K)$, where y_L and y_K represent labour and capital income. The government also operates a self-financed pay-as-you-go social security system, represented by a payroll tax τ_{ss} on labour income and a benefit ss for each retiree.

2.4 Household problem

The households' problem is computed recursively. Households are heterogeneous in four dimensions in terms of age j, assets at the beginning of a period a, permanent ability type z and idiosyncratic labour productivity e. The state vector is denoted as $x \equiv \{j, a, z, e\}$. A household's problem is to solve:

$$V(x) = \max_{c,l,a'} \{u(c, 1-l) + \beta E[V(x')]\} \tag{1}$$

subject to

$$c + a' = (1+r)(a+b) + \varepsilon_j zelw + T, \quad a' \geq 0, \quad l \in [0,1] \tag{2}$$

where T represents the net transfer from the government.

$$T = -\tau_c c - \mathcal{T}(y_L, y_K) - \tau_{ss} y_L \quad \text{if} \quad j < j_R \tag{3}$$

$$T = -\tau_c c - \mathcal{T}(0, y_K) + ss \quad \text{if} \quad j \geq j_R. \tag{4}$$

The labour income and capital income are given as $y_L = \varepsilon_j zelw$ and $y_K = r(a + b)$.

2.5 Competitive equilibrium

A competitive stationary equilibrium, for a given set of fiscal variables $\{G, D, \tau_c, \tau_{ss}\}$, is households' decision rules $\{c, l, a\}$ in each state $x \equiv \{j, a, z, e\}$, factor prices $\{r, w\}$, income tax function $\mathcal{T}$, social security benefit $\{ss\}$, a lump-sum transfer of accidental bequests $\{b\}$ and a distribution of households $\{\mu(x)\}$ over the state space, which satisfy the following conditions.

1 Households' allocation rules solve the optimization problems defined in section 2.4.
2 Factor prices are determined competitively, i.e. $r = F_K(K, L) - \delta$ and $w = F_L(K, L)$.
3 The labour and capital markets clear, i.e. $L = \sum_x \varepsilon_j zel(x)\mu(x)$ and $K + D = \sum_x [a(x) + b]\mu(x)$.
4 The income tax function satisfies the government budget constraint.[7]

$$G + (1+r)D = \sum_x [\tau_c c(x) + \mathcal{T}(y_L(x), y_K(x))]\mu(x) + D', \tag{5}$$

[7] To satisfy (5), at least one of the parameters that define the income tax function must adjust. This parameter depends on the form of the tax schedule. We discuss more details in section 3.

where D' denotes proceeds from the debt issued in the current period.[8]

5 The social security system is self-financed.

$$ss\sum_{x}\mu(x|\, j \geq j_R) = \sum_{x}\tau_{ss}y_L(x)\mu(x). \tag{6}$$

6 The final good market clears.

$$C + K' + G = Y + (1-\delta)K, \tag{7}$$

where K' denotes aggregate capital in the next period and C is aggregate consumption.

7 The lump-sum bequest transfer is consistent with the amount of assets left by the deceased.

$$b = \sum_{x|j\geq 2} a(x)(1-s_{j-1})\mu(x) \tag{8}$$

8 The distribution of households is time-invariant. The law of motion for the distribution of households over the state space satisfies $\mu(x) = R_\mu[\mu(x)]$, where R_μ is a one-period transition operator on the distribution.

3. Calibration

This section describes the parametrization of key parameters in the model. The values of calibrated parameters are summarized in Table 1.

The model period is 1 year. Households enter the economy at age 20, retire from market work at 65 and live up to the maximum age of 100. The population grows at an annual rate of $n = 0.012$. Households rank a bundle of consumption c and leisure $(1 - l)$ according to the period utility function defined as

$$u(c, 1-l) = \frac{\left[c^{\nu}(1-l)^{1-\nu}\right]^{1-\theta}}{1-\theta}. \tag{9}$$

The parameter ν determines the weight on utility from consumption relative to that from leisure. We calibrate the parameter so that one-third of disposable time is spent on the market work on average and the value is 0.376. We set $\theta = 4$, which implies the intertemporal elasticity of substitution of about 0.5, in the middle of the range of micro estimates (see Attanasio, 1999, for a survey). The conditional survival probabilities s_j are taken from the study by Bell and Miller (2002) and we use their mortality estimates in 2005. The subjective discount factor β is set at 1.001 so that the model generates a capital-output ratio of 3.

The idiosyncratic component e of labour productivity is specified as a simple first-order autoregressive process with a persistence parameter $\rho = 0.97$ and a variance of the

[8] In a stationary equilibrium, all aggregate variables grow at a constant rate n. Therefore we have a relationship, $X(1 + n) = X'$, where X is an aggregate variable such as D and K, and X' denotes the level of the variable in the next period.

TABLE 1
Benchmark calibration

Demographics		
Population growth rate	n	0.012
Conditional survival rates	$\{s_j\}_{j=1}^{J}$	Bell and Miller (2002)
Labour productivity		
Age-specific efficiency	ε_j	Hansen (1993)
Idiosyncratic risk: AR(1) process	$\{\rho, \sigma^2\}$	{0.97, 0.02}
Technology		
Capital share parameter	α	0.33
Depreciation rate	δ	0.07
TFP	A	Normalization
Preference		
Discount factor	β	1.001
Preference weight on consumption	ν	0.376
Risk aversion ($CRRA = 1 - \nu(1 - \theta)$)	θ	4.0
Government		
Consumption tax	τ_c	0.05
Income tax function	$\{\kappa_0, \kappa_1\}$	{0.258, 0.768}
Social security tax	τ_{ss}	0.106
Social security benefit	ss	46% of average labour income
Government expenditures	G	20% of GDP
Government debt	D	40% of GDP

white noise $\sigma^2 = 0.02$, which lie in the range of estimates in the literature, such as Heathcote *et al*. (2010). We approximate the process by a transition matrix defined over five grid points using the method of Tauchen (1986). Households make a random draw of e from its stationary distribution as they enter the economy. For the permanent ability type z, we assume that there are two types of households, which we call high- and low-types. The ratio of the productivity of the two types is set at 2 and the fraction of the high-type at one-third, corresponding to the average college wage premium and a share of college graduates reported in the Annual Demographic Survey of the Census Bureau.[9] Age-dependent labour productivity ε_j follows the estimates of Hansen (1993).

The capital share parameter α is set at 0.33 and the depreciation rate δ at 7%, implied by the law of motion for the capital in the steady state, $\delta = \frac{X/Y}{K/Y} - n$ with the target investment-output ratio X/Y of 25% and capital-output ratio K/Y of 3.0. The productivity parameter A is normalized so that the average per-capita income is 1.0 in the benchmark economy.

The government expenditure G is set at 20% of the total output in the benchmark economy, which is the average ratio of government consumption expenditures and investment to GDP excluding transfers, at the federal, state and local levels (The Economic Report of the President, 2007). The government issues debt of the amount equivalent to 40% of the output, which is the ratio of the federal debt held by public to GDP in 2008 and also coincides with the historical average during 1950–2008. The income tax is given

[9] The type heterogeneity is captured as difference in permanent productivity in the model. We note that if the types of households represent educational levels, there would be differences in other variables, including mortality risks and variability and persistence in idiosyncratic labour productivities across levels of educational attainment. We abstract from these additional dimensions of heterogeneity and their policy effects are left to be explored.

by a non-linear tax function of total income, $y = y_L + y_K$. The income tax function approximates the progressive income tax schedule in the USA following the functional form estimated by Gouveia and Strauss (1994):

$$\mathcal{T}(y) = \kappa_0 \left\{ y - \left(y^{-\kappa_1} + \kappa_2 \right)^{-1/\kappa_1} \right\}. \tag{10}$$

Parameter κ_0 is the limit of marginal taxes as income goes to infinity and κ_1 determines the curvature of marginal taxes. κ_2 is a scaling parameter, that is, the tax function is preserved by appropriately adjusting the parameter κ_2, when all variables are scaled up or down, by a fixed factor. Because κ_0 and κ_1 are unit free, we use Gouveia and Strauss' estimates of $\{\kappa_0\ \kappa_1\} = \{0.258, 0.768\}$. κ_2 is set so that the government budget constraint (5) is satisfied in equilibrium.

As mentioned in the Introduction, consumption taxes vary from state to state in the USA and general taxes on goods and services are in the range of 0–8.25%, with the un-weighted average of 5% across states. Mendoza *et al*. (1994) compute the effective average tax rate on sales of consumption goods across OECD countries and obtain the average for the USA at 5.6% during the period of 1965–1991.[10] In the benchmark economy, we set the proportional consumption tax rate τ_c at 5% to approximate the average.

The social security tax τ_{ss} is set at 10.6%. The pension benefit *ss* that balances the social security budget (6) is 46.3% of the average earnings in the benchmark economy, close to the average replacement rate of the US social security system.

4. Numerical results

4.1 Computational experiment

In this section we present numerical results of a change in the tax policy to raise consumption taxes and analyze how the reform affects various economic variables both at the aggregate and household levels relative to the benchmark economy. We will first study the effects in the steady state implied by an alternative tax system and then compute the transition dynamics from the initial steady state, which is the calibrated benchmark economy, to the final steady state under the alternative policy. We will also study the long-run and short-run welfare effects of the policy change.

In the baseline experiment presented below, we assume that the consumption tax is doubled from the benchmark level of 5% to 10%. The policy change is revenue neutral and the amount of expenditure G that has to be financed by the tax system remains the same as in the benchmark economy. The level of the debt D also remains at the level of the benchmark economy. We will focus on the effect of the changes in the tax system, and therefore keep other parts of the government unchanged through the transition as well as in the final steady state. In order to satisfy the government budget constraint, we assume that the income tax function is adjusted proportionally, that is, the parameter κ_0 in the tax function (10) will adjust to satisfy the budget constraint and it will be determined in equilibrium. The new value of this tax parameter is denoted as $\tilde{\kappa}_0$. In section 4.4, we

[10] The effective consumption tax rate in Mendoza *et al*. (1994) is computed as general taxes on goods and services plus excise taxes divided by pre-tax value of consumption obtained from the national accounts.

TABLE 2
Aggregate effects of a consumption tax increase from 5% to 10% and long-run welfare effects

	Benchmark	
Output Y	—	+4.0%
Capital K	—	+8.7%
Labour L	—	+1.5%
Work hours	—	+1.6%
Consumption C	—	+3.4%
Wage	—	+2.5%
Interest rate	5.3%	4.8%
Average income tax rate	19.5%	15.9%
Welfare effect (CEV)		
Average	—	+2.14%
Low-type	—	+2.00%
High-type	—	+2.67%

CEV, consumption equivalent variation.

consider alternative ways of making fiscal adjustments as well as policies with even higher consumption taxes.

4.2 Steady state comparison

The aggregate effects of the policy change are summarized in Table 2. As a result of a consumption tax increase from 5% to 10%, the income tax schedule is adjusted downward by approximately 20% in the level of tax rates and the parameter $\tilde{\kappa}_0$ that satisfies the government budget is $0.811 \times \kappa_0 = 0.209$. As shown in Table 2, the average income tax rate falls by 3.6 percentage points. As a result, the policy will raise incentives to work and save and the aggregate labour supply and capital increase by 1.5% and 8.7%, respectively. Given the higher taxes imposed on consumption, more disposable resources are allocated towards saving and the capital rises significantly. The aggregate production will increase by 4.0% and the aggregate consumption will rise as well by more than 3.0%.

Figure 1 shows the life-cycle profile of work hours and savings in the benchmark and the economy with higher consumption taxes. They are computed as the average of each age and type, across other states of assets and idiosyncratic productivity. Both work hours and savings will increase over the life-cycle under the high consumption tax regime. The rise in work hours is concentrated among middle- to old-age households since the higher capital–labour ratio lowers the equilibrium interest rate and makes the optimal profile of labour supply flatter over the life-cycle.

To quantify the long-run effects of the policy, we compute the consumption equivalent variation (CEV) from the perspective of a new-born agent in the economy, which quantifies the percentage change in consumption across all possible states that makes the household indifferent between the benchmark economy and the economy implied by the alternative policy. A positive number indicates that households would be better off under the alternative tax system and there will be a welfare gain in the long run. As shown in the bottom part of Table 2, the long-run welfare effect of the reform is positive at 2.14% in consumption equivalence on average. The high-type households will benefit more from the policy change since the income tax falls more in percentage points for households

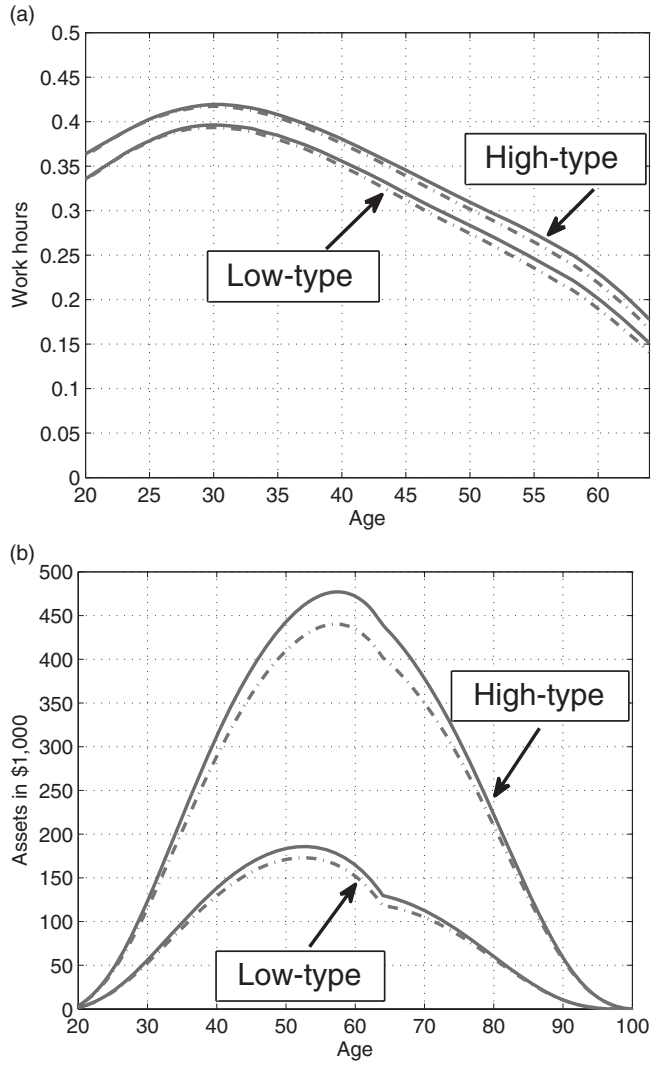


FIGURE 1. Effects on life-cycle profiles of work hours and savings: the average of each age and type. Dotted lines represent the benchmark economy and solid lines represent the economy with a higher consumption tax

with higher income. They will also benefit more from the lower tax on capital income from their wealth, which is typically larger than that of low-type households.

4.3 Transition dynamics and welfare

The results so far are based on the comparison of two steady states, one implied by the benchmark that approximates the US tax system ("initial steady state") and the other implied by the new tax system ("final steady state"). Now we turn to the study of the policy effects through the transition between the two steady states. We evaluate how the economy responds to the policy change and evolves over time making a transition to

the final steady state. The economy is assumed to be in the initial steady state in period 0, and at the beginning of period 1, the new policy is announced and implemented. It is a one-time unexpected change in the fiscal policy and there is no policy uncertainty thereafter.

Figure 2 shows how the aggregate labour, capital, consumption, wage, interest rate and income tax parameter evolve over time. Immediately after the announcement of the new policy and an increase in consumption taxes, consumption jumps down by 0.8%. The labour supply will jump up in response to the fall in income taxes, while the capital rises only gradually. As a result, the capital–labour ratio drops immediately, reducing the wage and raising the interest rate. As shown in Figure 1, income taxes that are required to balance the government budget will decline sharply, and the value of the tax parameter $\tilde{\kappa}_0$ falls by more than 15% in the first period of the reform. In addition to the rise in revenues from consumption taxes, the income tax base will expand as well, given the rise in labour supply, which more than offsets the initial decline in the wage, and an increase in the capital income due to the rise in the interest rate. The income tax rate will decrease further over time as both consumption tax revenues and income tax base increase gradually. Although the labour supply will reach close to the final steady state level quickly, it will take several decades for the capital stock to fully converge. Factor prices and consumption essentially follow the trajectory of the capital stock and many of the households that are alive at the time of the reform will not be able to enjoy the full benefit of the higher level of consumption and wages as future generations do in the final steady state.

By computing the transition dynamics, we are able to study the welfare effect of the policy change on generations that are currently alive and ask if the new policy can bring a welfare gain for the majority. We compute consumption equivalent variation of households at each state in period 1, when the policy is announced. It measures the percentage change in consumption in all the possible states for the remainder of each household's life in the benchmark economy that would make the household indifferent between the benchmark economy and the economy that will go through the transition. Table 3 presents summary statistics and Figure 3 plots the welfare effects from the transition in consumption equivalence, the average of each age and type across other states of households. The majority of households experience a welfare loss from the transition and the average consumption equivalent variation is negative for both types of households, workers and retirees. The last column of Table 3 shows the fraction of households who experience a welfare loss. The consumption equivalence will be negative for 74% of the population at the time of the reform. As shown in Table 3, the average welfare loss is –1.14%. Figure 3

TABLE 3
Welfare effects from a transition to the high consumption tax regime

	Welfare (CEV) from transition			
	All	Workers	Retirees	% w/CEV < 0
All types	–1.14%	–0.70%	–3.08%	73.5%
Low-type	–0.83%	–0.83%	–3.04%	78.4%
High-type	–0.31%	–0.43%	–3.15%	63.6%

CEV, consumption equivalent variation.

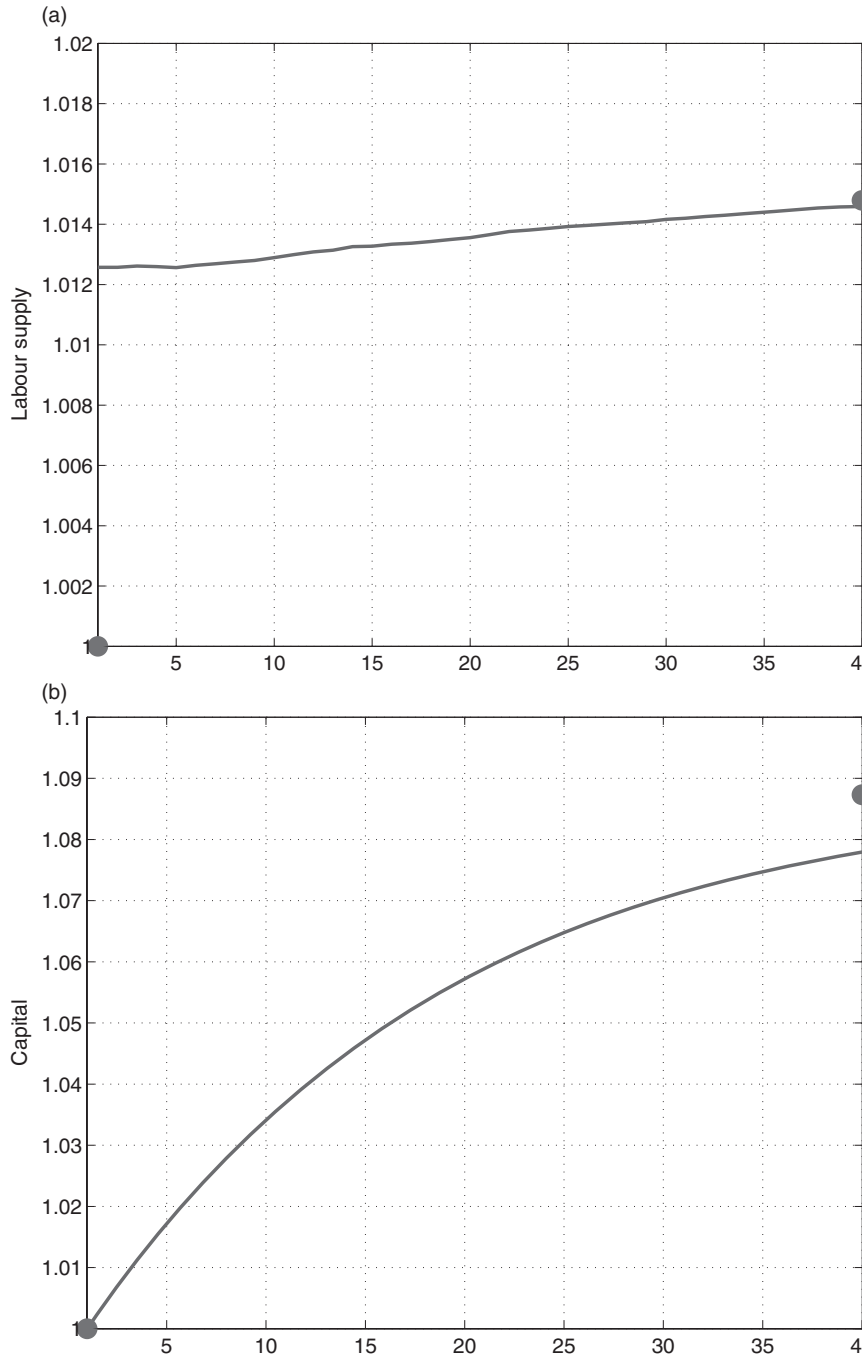


FIGURE 2. Transition of aggregate variables: two circles in each plot at the first and last periods indicate the levels in the initial and final steady states, except for the plot of the tax adjustment expressed as a ratio of $\tilde{\kappa}_0$ during the transition to κ_0 in the initial steady state, where the value in the initial steady state is 1.0 and lies outside of the plot range. Variables are normalized so that they take the value of unity in the initial steady state. On horizontal axes are the number of years elapsed since the announcement of the new policy

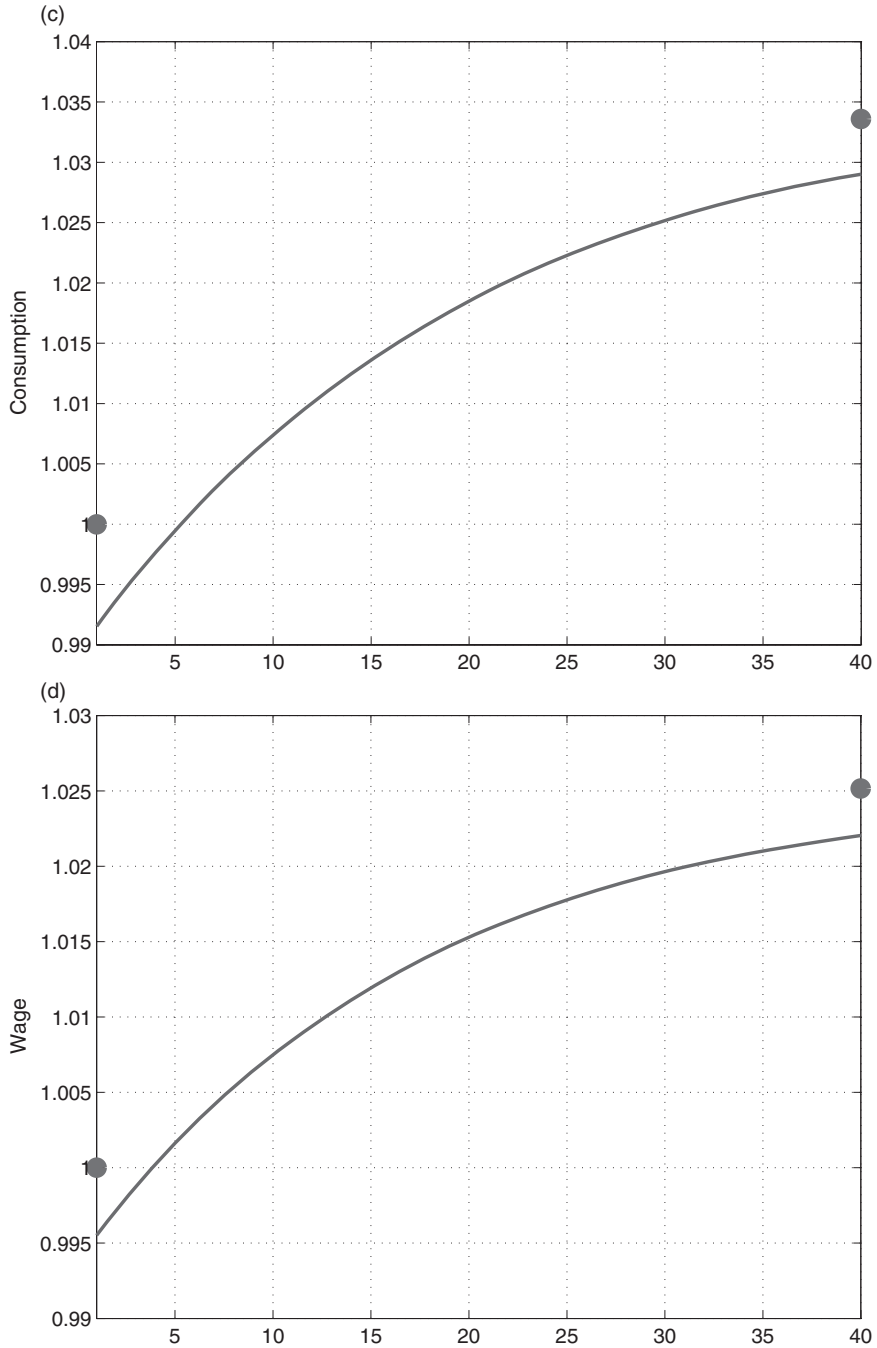
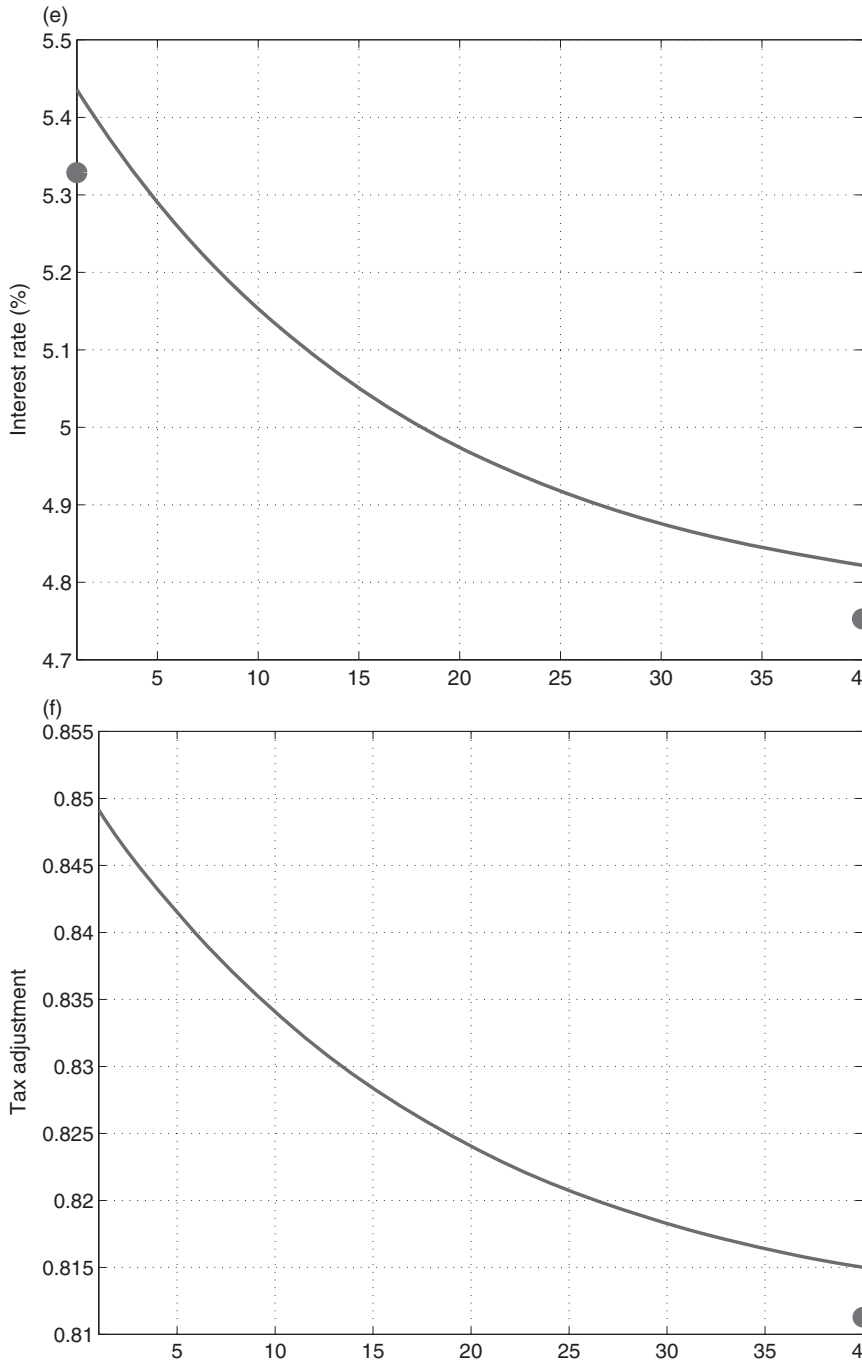


FIGURE 2. (*Continued*)



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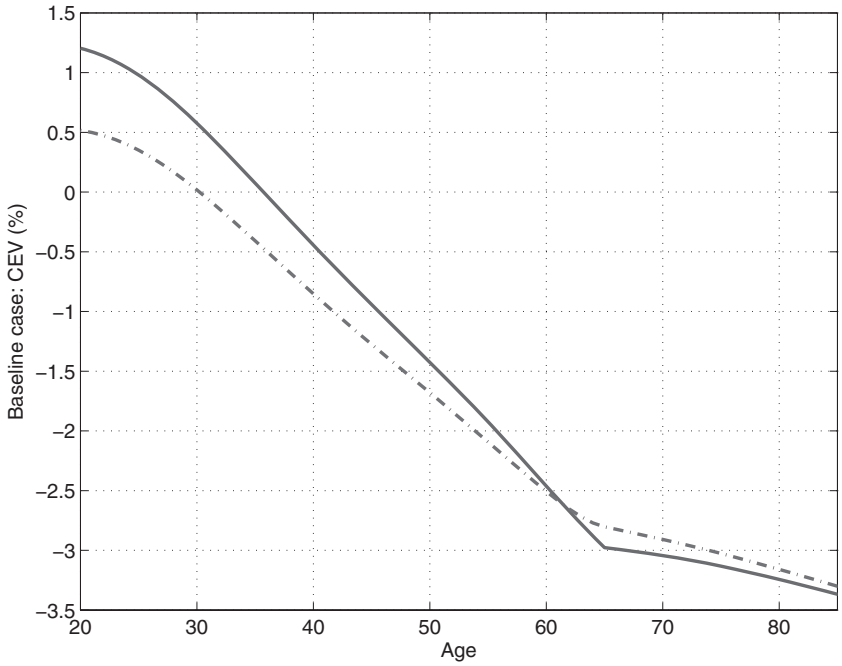

FIGURE 3. Welfare effects from a transition, average of each age and type. Baseline case. The dotted line represents the welfare effects of low-type households and the solid line represents high-type. CEV, consumption equivalent variation

shows that households in the 20s and 30s will experience a welfare gain on average, although the highest welfare gains of the youngest households that stand at 0.5% and 1.2% for low- and high-types are still much lower than those of the corresponding long-run welfare gain of 2.0% and 2.7% reported in Table 2. As we saw in the dynamics of economic variables along the transition in Figure 2, workers immediately increase work hours in response to a drop in income taxes, which alone would imply lower period-utility throughout the transition due to higher disutility from work. The rise in consumption, which offsets the welfare loss from longer work hours, occurs only gradually along the transition as households accumulate more capital stock over time. It takes more than 10 years before the aggregate consumption level reaches 1% above the benchmark level, and another 10 years for a 2% increase. Thereafter, consumption rises even more slowly to reach the final steady state level of 3.4% above the benchmark level. The delay in the rise of consumption contributes to the transitional welfare effects that are worse than the welfare effects in the long run.

Among working-age households, the welfare effect of low-type households will be more negative than that of the high-type since the high-type will benefit more from the decline in income taxes. Not only are the income and the tax base larger for the high-type, but also the decline in income tax rates in percentage points will be larger as the reform scales down the progressive income tax schedule proportionally. The new policy will significantly hurt the middle- to old-age households, in particular the retirees, who spend most of their disposable income on consumption and are taxed heavily as they run down their wealth. They also do not benefit as much from the lower income taxes as younger households.

TABLE 4
Welfare effects from a transition to the high consumption tax regime: model with no idiosyncratic productivity shocks

	Welfare (CEV) from transition			
	All	Workers	Retirees	% w/CEV < 0
All types	–0.69%	–0.15%	–3.02%	58.7%
Low-type	–0.53%	–0.29%	–3.00%	60.9%
High-type	–0.15%	–0.13%	–3.05%	54.2%

CEV, consumption equivalent variation.

Nishiyama and Smetters (2005) emphasized the importance of the insurance role provided by the progressive income tax system, which will be lost by fundamental tax reform. To quantify the welfare effect of the lost insurance from the policy change in our model, we compute an equilibrium in an alternative model, which is identical to our benchmark except that households face no idiosyncratic productivity shocks. We then repeat the same policy experiment of raising the consumption tax to 10% and using the proceeds to reduce income taxes. Figure 4 compares the welfare effects of the consumption tax increase in a model with and without idiosyncratic risks. Figure 4a reproduces the results of baseline experiment, Figure 3, under different scales to facilitate comparison. Table 4 summarizes the results under the alternative model, including the welfare effects for different types of workers and retirees, comparable to the results reported in Table 3 for the baseline case. The negative welfare effects from the transition are mitigated under the no-shock economy, especially for younger workers, and the average welfare effect for workers is –0.15%, while it is –0.70% in the model with idiosyncratic shocks. The fraction of households that experience a welfare loss declines by about 15 percentage points.

4.4 Alternative fiscal adjustments and consumption tax rates

In this section we will study the effects of a rise in consumption taxes with two alternative uses of the additional tax revenues. In the first, which we call Policy A, income taxes will be reduced as in the baseline experiment studied above, but the tax rate will fall by a fixed percentage point, which is common across households. In other words, the tax schedule shifts down across income levels in a parallel fashion rather than proportionally as in the baseline policy experiment. In the second, which we call Policy B, a lump-sum transfer is provided to all households and the amount of the transfer is determined to balance the government budget constraint. Table 5 summarizes the results of the two policy experiments.

In Policy A, the income tax rate will decline by 4.3 percentage points for all households in the final steady state. Since the magnitude of the decline in tax rates is larger for households with lower income than in the baseline policy, the long-run welfare gain for the low-type households is larger, while it is slightly lower for the high-type. Given that high-type households contribute more to the changes in labour supply and saving but that their responses will be smaller than in the baseline, the rise in aggregate capital and

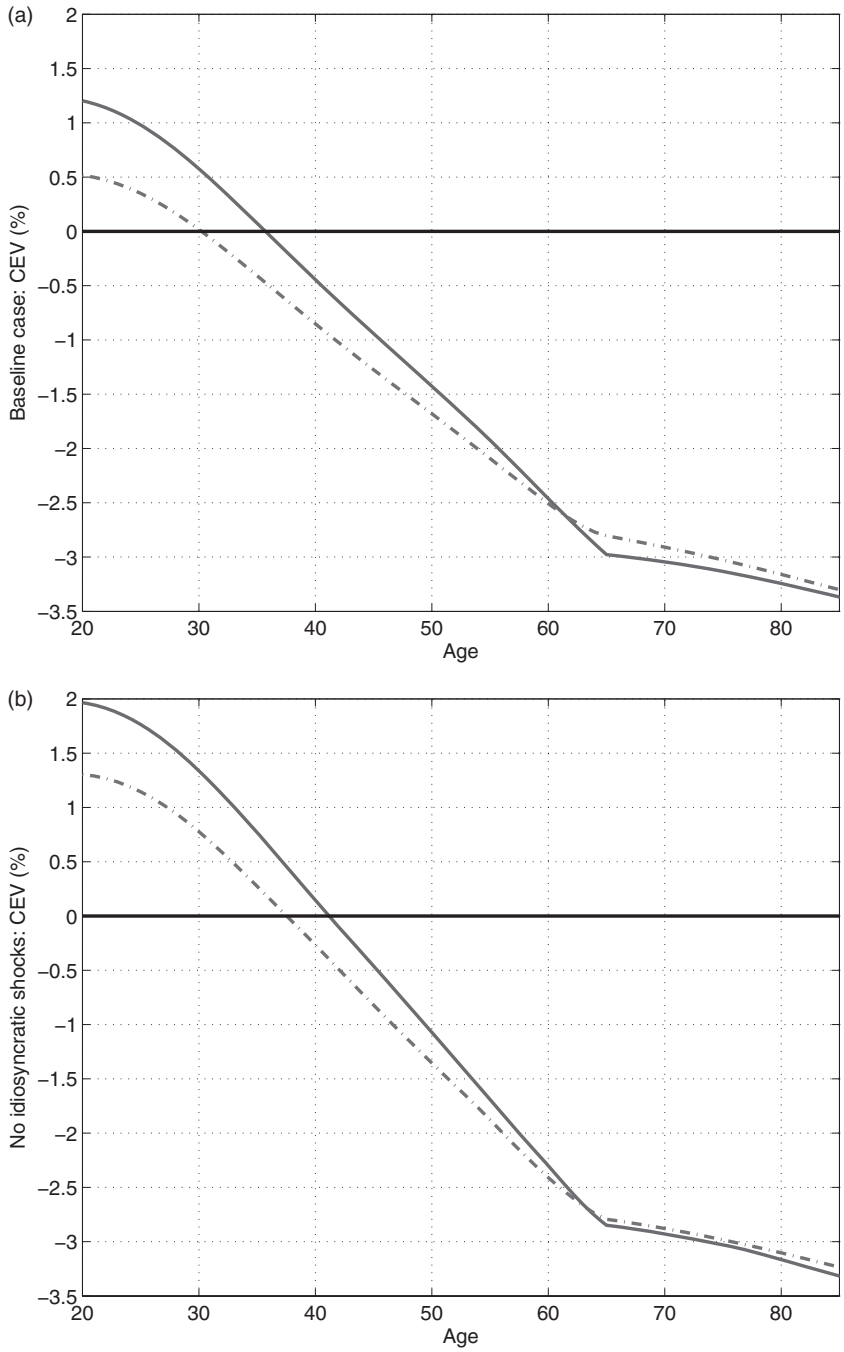

FIGURE 4. Welfare effects from a transition, average of each age and type, with and without idiosyncratic productivity shocks. The dotted line represents the welfare effects of low-type households and the solid line represents high-type. CEV, consumption equivalent variation

TABLE 5
Alternative fiscal adjustments

	Baseline	Policy A	Policy B
Output Y	+4.0%	+3.5%	−1.9%
Capital K	+8.7%	+7.8%	−1.1%
Labour L	+1.5%	+1.1%	−2.3%
Work hours	+1.6%	+1.1%	−4.5%
Consumption C	+3.4%	+2.7%	−2.9%
Wage	+2.5%	+2.4%	+0.5%
Interest rate	4.8%	4.8%	5.2%
Welfare effect (CEV)			
Average	+2.14%	+2.44%	+4.21%
Low-type	+2.00%	+2.39%	+5.17%
High-type	+2.67%	+2.61%	+0.85%
CEV: transition			
Average	−1.14%	−1.10%	+0.07%
Low-type	−0.83%	−0.76%	+0.61%
High-type	−0.31%	−0.34%	−0.54%

CEV, consumption equivalent variation.

labour supply is subdued. Capital and labour increase by 7.8% and 1.1%, respectively, compared to the rise of 8.7% and 1.5% in the baseline experiment.

In Policy B, the government will make a transfer of 0.022 in the model unit, which corresponds to about $1,000.[11] There will be no positive effects on the aggregate labour or capital as in the other policy reforms. There are no incentive effects from the lower income taxes. On the contrary, both aggregate labour and capital decline and the output will fall by 1.9% in the long-run. Work hours decline by 4.5%, much more than the decline of labour supply by 2.3%, implying that a fall in hours is concentrated among low-productivity households, due to greater income effects on them. The low-type households will benefit not only from the transfer, which is large relative to their other sources of income, but also from the rise in the wage, which constitutes a larger fraction of income than for high-type households. Relative to the other two experiments in which income tax rates fall, low-type households will gain significantly more from the reform in the long-run and they will also experience a welfare gain, albeit smaller in magnitude, from the transition on average. Although households allocate more of their income to savings faced with higher consumption taxes, the decline in earnings reduces the disposable resources and aggregate capital declines by 1.1%.

Next, we present the results of consumption tax increases in different magnitudes. Table 6 summarizes the macroeconomic and welfare effects of an increase in consumption tax rates from 5% to 10% in the baseline experiment and to 15% and 20% as two additional exercises. Qualitative effects are the same across experiments, but the quantitative effects are larger when the consumption taxes are raised even further. With the consumption tax at 15% and 20%, the tax schedule will shift down by 37% and 55% relative to the benchmark economy and the average income tax rate declines to 12.3% and 8.8%, respectively. The lower income taxes will raise the economic activities significantly,

[11] Relative to per capita income of $47,000 in 2008.

TABLE 6
Effects of consumption tax increase from 5% to 10, 15 and 20%

Consumption tax	10%	15%	20%
Output Y	+4.0%	+7.6%	+10.8%
Capital K	+8.7%	+16.9%	+24.4%
Labour L	+1.5%	+2.7%	+3.8%
Work hours	+1.6%	+3.0%	+4.3%
Consumption C	+3.4%	+6.2%	+8.6%
Wage	+2.5%	+4.8%	+6.7%
Interest rate	4.8%	4.3%	3.9%
Average income tax rate	15.9%	12.3%	8.8%
CEV: long-run			
Average	+2.14%	+3.86%	+5.23%
Low-type	+2.00%	+3.60%	+4.85%
High-type	+2.67%	+4.87%	+6.67%
CEV: transition			
Average	−1.14%	−2.30%	−3.50%
Low-type	−0.83%	−1.67%	−2.52%
High-type	−0.31%	−0.63%	−0.98%

CEV, consumption equivalent variation.

increasing the output by 7.6% and 10.8%. The policy changes will bring a large welfare gain in the long-run, but the transition would be costly, especially for low-type households.

5. Conclusion

The USA has much lower consumption taxes than many OECD countries in Europe. This paper studies macroeconomic and distributional effects of a rise in consumption taxes in the USA to the levels closer to some European countries. We have shown that doubling the tax rate from 5% to 10% and using the proceeds to reduce income taxes will significantly boost economic activities in the long-run, raising both aggregate capital and labour. The policy change will also bring a sizable welfare gain in the long-run of about 2–3% in consumption equivalent variations. During the transition, however, there is a significant redistribution of wealth across generations and the middle- to old-age households, and especially retirees, will experience a large welfare loss in the short-run. The average welfare effect from the transition is negative. This is because while workers respond to the reform by raising labour supply immediately, the consumption will rise only gradually as they slowly accumulate capital. Part of the loss from the transition is attributable to the partial loss of insurance provided by the progressive income taxes.

An interesting extension of the study will be to evaluate the use of consumption taxes to deal with a rising fiscal pressure and a rise in the public debt due to factors such as increasing government expenditures, falling income tax revenues associated with suppressed economic activities, or aging demographics and expansion of age-related programs, such as social security and Medicare. We leave these topics for future research.

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