

Tax Policy and Aggregate Demand Management Under Catching Up with the Joneses

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This paper examines the role for tax policies in productivity-shock driven economies with catching-up-with-the-Joneses utility functions. The optimal tax policy is shown to affect the economy countercyclically via procyclical taxes, i.e., “cooling down” the economy with higher taxes when it is “overheating” in booms and “stimulating” the economy with lower taxes in recessions to keep consumption up. Thus, models with catching-up-with-the-Joneses utility functions call for traditional Keynesian demand-management policies but for rather unorthodox reasons. (JEL E21, E62, E63)

Envy is one important motive of human behavior. In macroeconomics, theories built on envy have been used in trying to explain the equity premium puzzle as described by Rajnish Mehra and Edward C. Prescott (1985). Andrew B. Abel (1990, 1999) and John Y. Campbell and John H. Cochrane (1999) postulate utility functions exhibiting a desire to catch up with the Joneses, i.e., if others consume more today, you, yourself, will experience a higher marginal utility from an additional unit of consumption in the future.¹ In some ways, the idea of catching up with the Joneses is a variation of the theme of habit formation (see George M. Constantinides, 1990). The key difference is that catching up with the Joneses postulates a consumption externality since agents who increase their consumption do not take into account their effect on

the aggregate desire by other agents to “catch up.” While this may not make much of a difference for asset-pricing implications aside from convenience, it is interesting to take the externality implied by the “catching-up” formulation seriously, and investigate its policy implications. The externality allows room for beneficial government intervention: the optimal tax policy would induce agents in the competitive equilibrium to behave in a first-best manner, which is given by the solution to a social planner’s problem with habit formation.

While catching up with the Joneses has been the focus of quite some research in the asset-pricing literature, its implications with respect to policy-making have rarely been explored. The purpose of this paper is to do exactly that. In particular, we examine economies driven by productivity shocks where agents care about consumption as well as leisure, and there is a “catching-up” term in the consumption part of the utility function. For simplicity, the model abstracts from capital formation. In this framework, we examine the role for taxing labor income. The optimal tax policy turns out to affect the economy countercyclically via procyclical taxes, i.e., “cooling down” the economy with higher taxes when it is “overheating” due to a positive productivity shock. The explanation is that agents would otherwise end up consuming too much in boom times since they are not taking into account the “addiction effect” of a higher consumption level. In recessions, the effect goes the other way around and

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¹ Jordi Galí (1994) explores an alternative assumption where agents’ preferences depend on current, instead of lagged, per capita consumption (keeping up with the Joneses as compared to catching up with the Joneses).

taxes should be lowered to “stimulate” the economy by bolstering consumption. Thus, models with catching-up-with-the-Joneses utility functions call for traditional Keynesian demand-management policies but for rather unorthodox reasons.

The paper is organized as follows. In Section I, we examine a simple one-shot model as well as an infinite-horizon version, where agents care about keeping up with the Joneses. The assumption is that contemporaneous average consumption across all agents enters the utility function. In that case, it turns out that there is a constant tax rate on labor, which delivers the first-best outcome independent of the productivity shock. In Section II, we allow the agents’ benchmark level to be a geometric average of *past* per capita consumption, i.e., specifying a utility function which exhibits catching up with the Joneses. The optimal tax rate is now found to vary positively with the productivity shock, and we explore the determinants, dynamics, and welfare implications of such a countercyclical demand policy. Section III concludes.

I. Keeping Up with the Joneses

We imagine an economy with many consumers, each with the same utility function

$$\frac{(c - \alpha C)^{1-\gamma} - 1}{1 - \gamma} - An,$$

where $c \geq 0$ is the individual’s consumption, $C \geq 0$ is average consumption across all agents, and $n \geq 0$ is labor supplied by the individual. The parameters $\alpha \in [0, 1]$, $\gamma \geq 0$, and $A > 0$ determine the relative importance of average consumption, the curvature of the consumption term, and the relative importance of leisure. This utility function captures the notion of keeping up with the Joneses, i.e., average consumption decreases an individual’s level of utility and increases his marginal utility of an additional unit of consumption. This specification is different from the formulations in Abel (1990, 1999), who uses ratios, rather than differences, to aggregate consumption, but is in line with the “catching-up” formulation in Campbell and Cochrane (1999). No “keeping up” is imposed on

the leisure part of the utility function. In other words, we assume that agents are competing in, say, having the biggest car or the biggest house rather than having the most amount of leisure. The utility in leisure is also assumed to be linear. This assumption is partly done for convenience, but can also be motivated by indivisibilities in the labor market and is an often-used assumption in the real-business-cycle literature (see, e.g., Gary D. Hansen [1985] and the explanations therein).

We imagine that the production function takes the form

$$(1) \quad y = \theta n,$$

where y is output per worker and θ is a productivity parameter. Thus, there is no capital, and output is simply linear in labor.

The government levies a flat tax τ on all labor income and the tax revenues are then handed back to the agents in a lump-sum fashion. Let v be the lump-sum transfer to each agent. Since all agents are identical, the government’s budget constraint can be written as

$$v = \tau y.$$

A competitive equilibrium is calculated by having an agent maximize the utility function above with respect to c and n subject to his budget constraint,

$$c = (1 - \tau)y + v = (1 - \tau)\theta n + v.$$

A consumer’s optimal consumption is then found to be

$$(2) \quad c = \alpha C + \left(\frac{\theta}{A} (1 - \tau) \right)^{1/\gamma},$$

where average consumption C is taken as given by the individual agent. However, in an equilibrium it must be true that $c = C$, so the equilibrium consumption level is

$$(3) \quad c = C = \frac{1}{1 - \alpha} \left(\frac{\theta}{A} (1 - \tau) \right)^{1/\gamma}.$$

The government’s optimal choice of τ can be

deduced from the solution to the social planner's problem. The social planner would take the externality into account by setting $c = C$ in the utility function above, and then maximize with respect to consumption and labor subject to the technology constraint. The first-best outcome is then given by

$$C^* = \frac{1}{1-\alpha} \left(\frac{\theta}{A} (1-\alpha) \right)^{1/\gamma}.$$

Comparing the social planner's solution to the competitive equilibrium, we find the following proposition.

PROPOSITION 1 (Keeping Up with the Joneses): *The first-best consumption allocation can be achieved with a tax rate*

$$\tau = \alpha.$$

This result is quite intuitive. A fraction α of any increase in the representative agent's consumption does not contribute to his utility since it is offset through the consumption externality. It is therefore socially optimal to tax away a fraction α of any labor income so that the agent faces the correct utility trade-off between leisure and consumption. It can also be noted that the optimal tax is independent of the productivity parameter θ . While the tax can potentially be high depending on the value of α , it does not react to current economic conditions. In particular, we do not get any Keynesian effects in the sense of setting taxes procyclically.

Given the solution above, one can easily examine a dynamic model, in which there are periods denoted by $t = 0, 1, 2, \dots$ and agents have the utility function

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t - \alpha C_t)^{1-\gamma} - 1}{1-\gamma} - An_t \right),$$

where E_0 is the expectation operator conditioned upon information at time 0 and $\beta \in (0, 1)$ is a discount factor. The production function is the same as before,

$$y_t = \theta_t n_t,$$

and so are the budget constraints of the government and the agents. There is no capital formation. There is now also some stochastic process driving productivity θ_t . Computing the competitive equilibrium and the social planner's solution amounts to the same calculations as above, since this dynamic model simply breaks into a sequence of one-shot models. The first-best solution is again achieved at $\tau = \alpha$, i.e., there are no cyclical consequences for the tax rate.

The parameter α governing the optimal tax rate also ties in with the value for the relative risk aversion η for gambles with respect to consumption, given by $\eta = \gamma/(1-\alpha)$ from the perspective of the individual agent, but given by $\eta_{SP} = \gamma$ from the perspective of the social planner, taking into account $c_t = C_t$. The social planner would thus be willing to forgo a premium as a fraction of mean consumption approximately equal to $\gamma\sigma^2/2$ to avoid mean-zero random fluctuations in aggregate consumption with a standard deviation of $100 * \sigma$ percent. This is also the premium an individual agent would pay if that would avoid simultaneously fluctuations in his individual consumption as well as aggregate consumption. In the decentralized economy, however, the individual agent takes C_t as given. To avoid mean-zero random fluctuations in c_t with a standard deviation of $100*\sigma$ percent, which are uncorrelated with fluctuations in C_t , he would be willing to pay a premium as a fraction of his mean consumption approximately equal to $\gamma\sigma^2/(2(1-\alpha))$. Alternatively, it is instructive to calculate the premium the agent would pay to avoid the fluctuations in his individual consumption, assuming them to be perfectly correlated and of equal size to the fluctuations in aggregate average consumption, which is also the equilibrium outcome in our representative-agent model. This premium ρ is given by

$$\rho = \left(1 - \frac{\alpha}{1-\alpha} \right) \frac{\gamma\sigma^2}{2},$$

as can be seen from a second-order Taylor ap-

proximation.² Interestingly, that premium vanishes at $\alpha = 0.5$ and becomes negative for $\alpha > 0.5$; there, the marginal utility of an agent fluctuates less, when the same uncertainty affects both individual as well as aggregate consumption compared to the case when uncertainty only affects aggregate consumption. Similar calculations and remarks apply in the following sections, where we shall replace C with a benchmark level X , calculated from past aggregate consumption.

The premia calculated above require the calculation of σ^2 , which could potentially be influenced by the taxation experiments considered here.³ Inspecting equation (3), we see that this is not so. When computing the variance σ^2 of the proportional changes in aggregate consumption, the multiplicative term involving τ drops out. Thus, σ^2 is solely a function of the stochastic process for the productivity θ .

Finally, the tax analysis presented here is closely related to the literature on redistributive taxation when individual welfare depends on relative income. Given a social welfare function, Michael J. Boskin and Eytan Sheshinski (1978) analyze how the standard results of optimal tax theory are altered when individuals care about relative income, and they demonstrate that the scope for redistribution becomes much larger. Mats Persson (1995) extends their argument by showing that high taxation can even constitute a Pareto improvement as long as individuals' pretax incomes are not too different. In fact, his discussion of the special case of

² For a general utility function $u(c, C)$, and mean-zero random variables ν, ξ , we solve for a risk premium ρ by setting

$$\begin{aligned} E_0[u(\bar{c}(1 + \nu), \bar{C}(1 + \xi))] &\approx u(\bar{c}, \bar{C}) + u_{11}(\bar{c}, \bar{C})\bar{c}^2\sigma_\nu^2/2 \\ &\quad + u_{12}(\bar{c}, \bar{C})\bar{c}\bar{C} \operatorname{Cov}(\nu, \xi) \\ &\quad + u_{22}(\bar{c}, \bar{C})\bar{C}^2\sigma_\xi^2/2 \end{aligned}$$

equal to

$$\begin{aligned} E_0[u(\bar{c}(1 - \rho), \bar{C}(1 + \xi))] &\approx u(\bar{c}, \bar{C}) - u_1(\bar{c}, \bar{C})\bar{c}\rho \\ &\quad + u_{22}(\bar{c}, \bar{C})\bar{C}^2\sigma_\xi^2/2. \end{aligned}$$

³ Additionally, one generally needs to consider the premium for the reduction in the variance of leisure. However, with our utility specification, the agent is risk neutral with respect to gambles in leisure.

identical individuals corresponds directly to our treatment of keeping up with the Joneses.

II. Catching Up with the Joneses

A. The Model

We now assume that the utility function does not depend on current average consumption as assumed above, but rather on some measure X , of *past* average consumption,

$$(4) \quad E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t - X_t)^{1-\gamma} - 1}{1-\gamma} - An_t \right).$$

In particular, we let the benchmark level X_t be a geometric average of past per capita consumption levels,

$$(5) \quad X_t = (1 - \phi)\alpha C_{t-1} + \phi X_{t-1},$$

with $0 \leq \phi < 1$ and $0 \leq \alpha < 1$. Otherwise, the production technology is

$$y_t = \theta_t n_t,$$

and likewise, the budget constraints of the consumers and the government are the same as before. There is no capital formation. In addition, we now need to be more careful about the productivity process. We postulate the following stochastic process,

$$(6) \quad \frac{1}{\theta_t} = \left(\frac{1 - \psi}{\bar{\theta}} + \frac{\psi}{\theta_{t-1}} \right) (1 + \varepsilon_t),$$

where $\psi \in [0, 1]$ and ε_t is independently and identically distributed (i.i.d.), has mean zero, and is bounded below by $\varepsilon_t > -1$.⁴

For the competitive equilibrium in this

⁴ The stochastic process (6) is approximately the same as postulating an AR(1) process for the logarithm of θ_t ,

$$\log(\theta_t) = (1 - \psi)\log(\bar{\theta}) + \psi \log(\theta_{t-1}) + \varepsilon_t.$$

Thus, our exact analytical results below pertaining to the stochastic process (6) can also be interpreted as approximations to the corresponding formulas valid for the more commonly used AR(1) process for the logarithm of θ_t .

model, one finds analogously to (2) that the agent will set consumption equal to

$$(7) \quad c_t = X_t + \left(\frac{\theta_t}{A} (1 - \tau_t) \right)^{1/\gamma}.$$

Thus, given a first-best path for consumption $c_t^* = C_t^*$, one can achieve this outcome with a sequence of taxes τ_t satisfying

$$(8) \quad \tau_t = 1 - \frac{A}{\theta_t} (C_t^* - X_t)^\gamma.$$

To characterize the optimal tax policy, we now turn to the social planner's problem.

B. Solving the Social Planner's Problem

The social planner maximizes the utility function (4) subject to the production technology and the constraint (5), taking as given the process for θ_t and the initial conditions X_0 and θ_0 . Since this maximization problem is a concave one, we can analyze it by using first-order conditions. Let μ_t be the Lagrange multiplier for the constraint (5). The two first-order conditions with respect to C_t and X_{t+1} can then be written as

$$(9) \quad (C_t - X_t)^{-\gamma} = \frac{A}{\theta_t} + \alpha(1 - \phi)\mu_t,$$

$$(10) \quad \begin{aligned} \mu_t &= \beta E_t[(C_{t+1} - X_{t+1})^{-\gamma}] \\ &\quad + \beta\phi E_t[\mu_{t+1}]. \end{aligned}$$

The first equation contains the additional third term $\alpha(1 - \phi)\mu_t$ as compared to the corresponding equation of the private agent's optimization problem. Here, the social planner takes into account the "bad" effect on future utility of additional aggregate consumption today, since it raises the benchmark level X_{t+1} tomorrow and beyond. In particular, a fraction $\alpha(1 - \phi)$ of an increase in today's per capita consumption spills over to X_{t+1} , and the shadow value of a higher X_{t+1} is given by μ_t . Equation (10) shows in turn how the shadow value μ_t is the sum of the expected effect on tomorrow's discounted marginal utility of consumption and its impact on still future periods. The latter effect is captured by the discounted

expected value of μ_{t+1} multiplied by ϕ , where ϕ is the fraction of the benchmark level that carries over between two consecutive periods.⁵

Using the two first-order conditions (9) and (10) as well as the constraint (5), the optimal steady-state⁵ consumption level can be calculated to be

$$\bar{C}^* = \frac{1}{1 - \alpha} \left(\frac{\bar{\theta}}{A} \left(1 - \frac{\alpha\beta(1 - \phi)}{1 - \beta\phi} \right) \right)^{1/\gamma}.$$

Comparing this expression to the agent's consumption rule in equation (7) and noting that $\bar{X} = \alpha\bar{C}$, we see that the first-best steady-state allocation is supported by a tax of

$$\bar{\tau} = \frac{\alpha\beta(1 - \phi)}{1 - \beta\phi}.$$

For example, if the benchmark level is simply α times the level of yesterday's per capita consumption ($\phi = 0$), we get $\bar{\tau} = \alpha\beta$. This formula is rather intuitive compared to the simple model above of keeping up with the Joneses, where we got $\tau = \alpha$. Since the consumption externality now enters the utility function with a one-period lag, the adverse future effect of being "addicted" to today's consumption is discounted by β so the optimal steady-state tax rate is also scaled down by β .

In order to characterize the optimal consumption and taxation outside of a steady state, we can actually solve the dynamic equations in closed form. The substitution of equation (9) into (10) yields a first-order difference equation in the shadow value μ_t , which can be solved forward in the usual manner,

$$(11) \quad \mu_t = \beta A E_t \left[\sum_{j=0}^{\infty} \delta^j \frac{1}{\theta_{t+1+j}} \right],$$

where

$$\delta = \beta(\phi + \alpha(1 - \phi)) < 1.$$

⁵ The term "steady state" is used in this paper to denote a deterministic steady state in which the productivity shock is always equal to $\bar{\theta}$.

With the law of motion for θ_t in (6), one can then calculate μ_t to be

$$(12) \quad \mu_t = \frac{\beta A}{(1 - \delta)\bar{\theta}} + \frac{\beta A\psi}{1 - \delta\psi} \left(\frac{1}{\theta_t} - \frac{1}{\bar{\theta}} \right).$$

After substituting this expression into the first-order condition (9), the optimal consumption level is found to be

$$(13) \quad C_t^* = X_t + \left(\frac{A}{\bar{\theta}} \frac{1 - \beta\phi}{1 - \delta} + A \left(\frac{1}{\theta_t} - \frac{1}{\bar{\theta}} \right) \frac{1 - \beta\phi\psi}{1 - \delta\psi} \right)^{-1/\gamma}.$$

The tax necessary to support this optimal consumption allocation is then given by equation (8).

Rather than calculating the tax rate τ_t , it is more appealing to calculate the ratio of taxes to after-tax income. Using equations (8) and (9), we get

$$(14) \quad \frac{\tau_t}{1 - \tau_t} = \frac{\alpha(1 - \phi)}{A} \theta_t \mu_t.$$

With the productivity process in (6), μ_t is given by (12) and the tax ratio can then be rewritten as in the following proposition.

PROPOSITION 2 (Catching Up with the Joneses): *The tax rate τ_t supporting the first-best consumption allocation can be solved from*

$$(15) \quad \frac{\tau_t}{1 - \tau_t} = \frac{\alpha\beta(1 - \phi)}{1 - \delta\psi} \left(\psi + \frac{1 - \psi}{1 - \delta} \frac{\theta_t}{\bar{\theta}} \right),$$

with a steady-state value of

$$(16) \quad \bar{\tau} = \frac{\alpha\beta(1 - \phi)}{1 - \beta\phi}.$$

C. Tax Policy Implications

The implications for an optimal tax policy are seen to depend critically on the timing of the

consumption externality. In the case of keeping up with the Joneses in Proposition 1, the optimal tax rate does not depend on the productivity shock. Since only contemporaneous average consumption affects the individuals' welfare, the social planner can correct the consumption level period by period without any intertemporal considerations. In each period, the social planner establishes the right trade-off between consumption and leisure for individuals by taxing away a fraction α of any labor income. In contrast, catching up with the Joneses means that individuals care about past average consumption levels that are functions of past productivity shocks while current consumption opportunities depend on today's productivity shock. The social planner is now not only concerned about the trade-off between consumption and leisure in any given period but also the effects of today's consumption on future utilities. Thus, the interdependence between the past, present, and future gives rise to optimal time-varying tax rates that depend on the realizations of the productivity shock.

It is fruitful to compare this observation to the calculation of term premia in models with "keeping-up" and "catching-up" preferences. Abel (1999) defines the term premium to be the excess of the expected one-period rate of return on a n -period asset over the expected one-period rate of return on a one-period asset, when comparing assets for which the log dividends have the same constant proportionality to log consumption. For a slightly different specification of preferences⁶ and assuming that consumption growth is i.i.d., Abel (1999) shows that "keeping-up" preferences imply that all term premia are identical to zero, while more complicated term premium structures may arise with "catching-up" preferences. In his analysis, the stochastic properties of the consumption growth until the next period are enough to calculate the returns on these assets in the "keeping-up" case, regardless of their remaining maturity, while the "catching-up" case introduces additional interdependencies across periods. Analogously, the social planner here

⁶ Abel (1999) uses $u(c_t, X_t) = (c_t/X_t)^{1-\gamma}/(1-\gamma)$, where $X_t = C_t^{\xi_0} C_{t-1}^{\xi_1}$, i.e., he assumes that the representative consumer's utility depends on the ratio of c_t to X_t , rather than on the difference between c_t and X_t .

only needs to offset the current consumption externality in the “keeping-up” case, while he needs to worry about the interdependencies across periods in the “catching-up” case.

COROLLARY 1 (Catching Up with the Joneses): *The optimal tax policy affects the economy countercyclically via procyclical taxes.*

The corollary follows directly from equation (15); the tax ratio (and thus the tax rate itself) varies positively with productivity θ_t .⁷ Thus, we get Keynesian-style policy recommendations. A government that maximizes welfare should “cool down” the economy during booms via higher taxes because agents would otherwise consume too much as compared to the first-best solution. Likewise, the government should “stimulate” the economy during recessions by lowering taxes and thereby bolstering consumption. Of course, these optimal fiscal policies are here driven by a rather unorthodox argument. Taxation is needed to offset the externalities associated with private consumption decisions. One individual’s consumption affects the welfare of others through agents’ desire to catch up with the Joneses.

To shed light on how different parameters affect the cyclical variations of optimal taxation, let ω_t be the relative deviation of the tax ratio $\tau_t/(1 - \tau_t)$ from its steady-state value. That is, ω_t tells us how the ratio of taxes to after-tax income responds to productivity shocks relative to its steady-state value. From equation (15), we can calculate

$$(17) \quad \omega_t \equiv \frac{\tau_t}{1 - \tau_t} \left(\frac{\bar{\tau}}{1 - \bar{\tau}} \right)^{-1} - 1 \\ = \frac{1 - \psi}{1 - \delta\psi} \frac{\theta_t - \bar{\theta}}{\bar{\theta}}.$$

Doing comparative statics on this expression, we see that the size of the cyclical tax effect in absolute terms varies negatively with ψ and

⁷ This result holds for a much larger class of stochastic processes than given by equation (6). According to equations (11) and (14), the optimal tax rate goes up with θ_t as long as $E_t[\sum_{j=0}^{\infty} \delta^j \theta_{t+1+j}^{-1}]$ decreases less than proportionally with the inverse of θ_t .

positively with α , β , and ϕ . The intuition for this is straightforward by considering the tax response to a positive productivity shock. A higher ψ , i.e., a more persistent productivity shock, means that future production and consumption opportunities are also expected to be better than average. The anticipation of the economy being able to sustain a higher consumption level for a prolonged period of time mitigates the adverse effects of making people “addicted” to higher consumption today. It is therefore socially optimal to take more advantage of a persistent productivity shock, so the optimal tax hike is lower with a higher ψ . In contrast, preferences with a higher weight on yesterday’s consumption (a higher α), a higher degree of persistence in the benchmark level (a higher ϕ), or a higher emphasis on the future (a higher β) give rise to a larger cyclical tax effect. The reason is, of course, that the consumption externality is more important for such preferences and the government must consequently be more resolute in moderating agents’ consumption behavior.

As a point of reference, the largest tax effect as defined by (17) is attained for transient one-period productivity shocks ($\psi = 0$). The percentage deviation of the tax ratio from its steady-state value responds then one-for-one to the percentage change in the productivity from its steady state. However, besides noting that the cyclical tax effect can be large relative to the magnitude of the productivity shock, it is also important to keep in mind that most aggregate economic shocks are usually relatively small so the cyclical tax changes considered here are really examples of extreme “fine-tuning” of taxes.

Finally, Figure 1 illustrates the consumption dynamics in response to a productivity shock. After a one-percent initial shock to θ_t at time $t = 0$, the hump-shaped lower solid line traces out the response of consumption from the steady state when taxes are adjusted optimally and the upper solid line displays the consumption response when the tax rate is not changed but kept constant at its steady-state value. As a parameterization, we used $\psi = 0.9$, $\beta = 0.97$, $\alpha = 0.8$, $\phi = 0$, and varied $\gamma \in \{0.5, 1.5\}$. Not surprisingly, the consumption response becomes muted with a higher γ , since a more rapidly diminishing marginal utility of con-

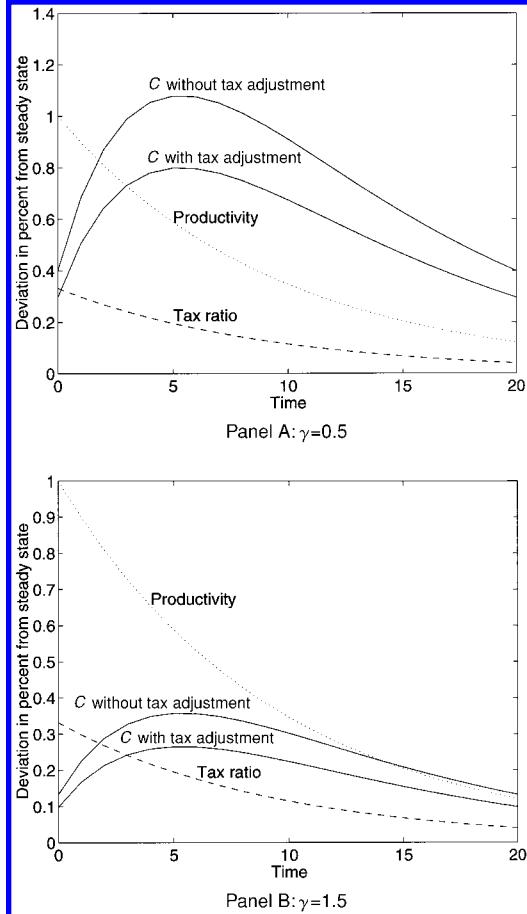


FIGURE 1. CONSUMPTION DYNAMICS IN RESPONSE TO A 1-PERCENT PRODUCTIVITY SHOCK FROM THE STEADY STATE

Notes: The lower solid line traces out the consumption response when taxes are adjusted optimally and the upper solid line displays the consumption response when the tax rate is kept constant at its steady-state value. The dashed line depicts the optimal response in the tax ratio $\tau_t/(1 - \tau_t)$. The evolution of the productivity shock θ_t is described by the dotted line. The parameters are $\gamma \in \{0.5, 1.5\}$ (Panel A and Panel B, respectively), $\psi = 0.9$, $\alpha = 0.8$, $\phi = 0$, and $\beta = 0.97$.

sumption reduces the attractiveness of increasing consumption. It is interesting to note that for both values of γ in Figure 1 the deviation of consumption from steady state is reduced by around 25 percent under optimal tax adjustment as compared to keeping the tax rate constant at its steady-state value. The figure also contain the change in the tax ratio ω_t needed to accomplish this “cooling down” of the economy.

D. Welfare Gains

To examine the welfare gains due to taxation, we compute welfare levels for three stochastic economies; laissez-faire without taxation (LF), the social-planner outcome with optimal taxation (SP_{τ^*}), and an economy where the tax is kept constant at its steady-state value ($SP_{\bar{\tau}}$). The calculations are based on 10,000 randomly generated sequences of the productivity shock θ , each one of length 1,100 periods. Using steady states as initial conditions, we compute the economic outcomes associated with the three different economies. The welfare level for each economy is then obtained by discarding the first 100 periods in each sequence, and averaging over all 10,000 runs. For purposes of comparison, we also compute welfare levels for two nonstochastic economies where θ is constant and equal to its mean value; a laissez-faire outcome (LF) and the social-planner solution (SP).⁸

The welfare comparisons between the three stochastic economies use SP as a reference. In particular, we compute the fractional reduction ($-\Delta$) in a single individual's consumption in economy SP which will make her as well off as in the alternative stochastic economy,

(18)

$$\begin{aligned} & \sum_{t=0}^{\infty} \beta^t \left(\frac{((1 - \Delta)c_t^{\overline{SP}} - X_t^{\overline{SP}})^{1-\gamma} - 1}{1 - \gamma} - An_t^{\overline{SP}} \right) \\ &= E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^j - X_t^j)^{1-\gamma} - 1}{1 - \gamma} - An_t^j \right), \end{aligned}$$

where the superscript on c_t , X_t , and n_t denotes to which economy the values refer, and $j \in \{SP_{\tau^*}, SP_{\bar{\tau}}, LF\}$. In the simulations, we have chosen ε_t to be uniformly distributed with a standard deviation of $\sigma_\varepsilon \in \{0.01, 0.04\}$. The other parameter values are $\psi = 0.9$, $\beta = 0.97$, $\phi = 0$, $\gamma \in \{1.5, 5\}$, and $\alpha \in \{0.2, 0.5, 0.8\}$.

The first column with results in Table

⁸ Note that $\bar{\theta}$ is not the mean of the stochastic process in (6); instead we use the average value of θ computed over all the simulations.

TABLE I—WELFARE LOSS WHEN SWITCHING FROM ECONOMY i TO j ($i \rightarrow j$)

σ_e	γ	α	$\overline{SP} \rightarrow SP_{\tau^*}$	$\overline{SP} \rightarrow SP_{\bar{\tau}}$	$\overline{SP} \rightarrow LF$	$\overline{LF} \rightarrow LF$
0.01	1.5	0.2	0.030	0.030	1.377	0.032
		0.5	0.013	0.014	7.782	0.019
		0.8	0.009	0.009	11.844	0.024
	5	0.2	0.045	0.045	0.423	0.053
		0.5	0.026	0.026	1.976	0.046
		0.8	0.011	0.011	2.891	0.041
0.04	1.5	0.2	0.457	0.457	1.797	0.496
		0.5	0.336	0.338	8.058	0.461
		0.8	0.145	0.152	11.907	0.418
	5	0.2	0.635	0.636	1.002	0.755
		0.5	0.398	0.398	2.293	0.692
		0.8	0.173	0.174	2.980	0.637

Notes: The table shows welfare loss when switching from economy i to j ($i \rightarrow j$), measured by the percentage reduction in a single individual's consumption in economy i which will equalize her expected utilities across the two economies. LF and SP denote laissez-faire and the social-planner solution, respectively, when productivity is equal to its mean value. The stochastic outcomes are represented by LF, SP_{τ^*} , and $SP_{\bar{\tau}}$, where the latter two distinguish between the case when taxes are adjusted optimally (τ^*) and when the tax rate is kept constant at its steady-state value ($\bar{\tau}$). The parameters are $\beta = 0.97$, $\phi = 0$, $\psi = 0.9$, and ε , is uniformly distributed with standard deviation σ_e .

1 reports on the welfare loss under optimal taxation due to uncertainty which is, as expected, increasing in the standard deviation of shocks σ_e . What is of foremost importance in Table 1 is the comparison of these numbers across columns. Indeed, a comparison of the first two columns reveals that there is hardly any difference in welfare when replacing the optimal time-varying tax with its steady-state value. The two columns are virtually the same. This result should not be surprising in light of our previous observation from equation (17) that optimal cyclical tax changes constitute extreme “fine-tuning” of taxes. However, there are relatively large welfare gains associated with the overall scheme of using taxation to overcome the externality arising from catching up with Joneses, as indicated by comparing the third column to the first two. Roughly speaking, the numbers in the third column have two components. First, the difference between the third column and one of the first two columns measures the welfare loss of having no income taxation. Second, the numbers in the third column also reflect what is measured in the first two columns, i.e., the welfare loss due to uncertainty, since all three columns use the social-planner solution for a deterministic economy SP as a reference. The welfare gains of taxation in the third column increase with the importance of the exter-

nality in the preferences, as parameterized by α .⁹ When $\alpha = 0.8$ and $\gamma = 1.5$, an individual's consumption would have to be reduced by roughly 12 percent in the SP economy to give rise to a level of welfare equal to the expected utility in the stochastic laissez-faire economy, and the required reduction remains fairly substantial at around 3 percent if γ is raised to 5. It can also be noted that the tax levels needed to offset the consumption externality for the specifications in Table 1 are fairly high. According to equation (16), the steady-state tax rate is 19.4 percent, 48.5 percent, and 77.6 percent for α equal to 0.2, 0.5, and 0.8, respectively.

Finally, the last column in Table 1 reports on the welfare loss due to uncertainty in the laissez-faire economy. Specifically, we apply the formula in (18) after replacing the superscript SP by LF and setting $j = LF$. A comparison between the first and last column of the table indicates that the productivity shock gives rise to a higher risk premium in the laissez-faire economy relative to the social-planner outcome. Recall that the risk premia were invariant to the tax rate in the earlier case of keeping up with the Joneses.

⁹ The simulated welfare results were rather insensitive to different values of the persistence parameter ϕ for the benchmark level X . Our results for $\phi \in \{0.3, 0.6, 0.9\}$ are therefore not reported here.

E. Capital Formation

For simplicity, we have left capital accumulation out of our model. In a model studied by Martin Lettau and Uhlig (2000), the presence of both capital formation and catching-up-with-the-Joneses preferences implies counterfactually smooth consumption. Urban J. Jermann (1998) and Michele Boldrin et al. (1999) make a similar observation in models with (internal) habit formation, and they suggest that the problem can be solved with short-run rigidities such as capital adjustment costs.

The question arises, as to whether our policy results would change a lot, if capital formation were included? While leaving this extension of the model for future research, we shall here only investigate how volatile the interest rate is in the current framework. If our model implies a high volatility of the interest rate, this would give reasons to believe that adding possibilities for intertemporally smoothing consumption could change the results a lot. As usual, the return R_t , on a real safe bond can be calculated from the intertemporal Euler equation,

$$R_t^{-1} = \beta E_t \left[\frac{(c_{t+1} - X_{t+1})^{-\gamma}}{(c_t - X_t)^{-\gamma}} \right].$$

In the case of a constant tax rate, $\tau_t = \tau$, the interest rate is then given by

$$R_t = \beta^{-1} \left((1 - \psi) \frac{\theta_t}{\bar{\theta}} + \psi \right),$$

where we have invoked the equilibrium expression for consumption in (7), and the stochastic process for productivity in (6). Thus, the fluctuations in real returns are a fraction of the fluctuations in θ_t . Since we presume the latter to be quite small, the same will be true of the former. At the social optimum (13), the formula becomes a bit more complicated,

$$R_t = \beta^{-1} \frac{\frac{A}{\bar{\theta}} \frac{1 - \beta\phi}{1 - \delta} + A \left(\frac{1}{\theta_t} - \frac{1}{\bar{\theta}} \right) \frac{1 - \beta\phi\psi}{1 - \delta\psi}}{\frac{A}{\bar{\theta}} \frac{1 - \beta\phi}{1 - \delta} + A\psi \left(\frac{1}{\theta_t} - \frac{1}{\bar{\theta}} \right) \frac{1 - \beta\phi\psi}{1 - \delta\psi}},$$

which is harder to evaluate. However, since consumption, and therefore marginal utility,

fluctuates less when taxes are optimally adjusted as compared to the situation with a constant tax rate, it is most plausible that interest-rate volatility does not increase either. Thus, we conclude that volatility of interest rates is unlikely to pose a problem in our model.

III. Conclusions

The purpose of this paper has been to examine the role for tax policies in economies with catching-up-with-the-Joneses utility functions. These utility functions give rise to consumption externalities, but taxation can be used to get back to the first-best solution. The optimal tax policy turns out to affect the economy counter-cyclically via procyclical taxes. When the economy is “overheating” due to a positive productivity shock, a welfare-maximizing government should raise taxes to “cool down” the economy. Likewise, taxes should be cut in recessions to “stimulate” the economy by bolstering consumption. Thus, models with catching-up-with-the-Joneses utility functions call for traditional Keynesian demand-management policies but for rather unorthodox reasons.

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