Adaptation, Taxation, and Public Goods[*]

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Abstract

This paper shows how the first-best and second-best rules for optimal public good provision depend on the adaptation to private and public consumption. Adaptation in private consumption typically leads to over-provision relative to the Samuelson condition, while adaptation in public consumption works the other way around. The two sources of adaptation only cancel out in the extreme case of full adaptation.

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1. Introduction

This short paper deals with the optimal provision of public goods when people adapt both to their private and public consumption. Empirical evidence suggests that people adapt to most circumstances in life, and the degree to which people adapt may actually be substantial. For instance, a permanent increase in the consumption may only affect utility temporarily as the potential utility gains decline over time. According to Clark, Frijters, and Shields (2008), adaptation may eliminate as much as 60 percent of the initial positive effect of an increase in the individual income level on happiness within two years.[1] Nevertheless, Becker and Murphy (1988) argue that adaptation does not challenge normative economic theory and, in particular, the insights gained from optimal taxation theory when people are fully aware of their adaptation-behavior when making their consumption choices. We show, however, that adaptation substantially alters the conditions for the optimal provision of public goods both in a first-best world where the government can use lump-sum taxes to finance public good provision and in second-best tax world where the government must raise revenue through distortionary taxes.

Our model follows Pollak (1970) and subsequent economics literature in describing adaptation in terms of (internal) habit formation. We consider a representative-consumer economy in which the government raises tax revenue to provide a public good, and where the consumers adapt both with respect to private and public consumption. Whereas adaptation to private consumption works in the direction of over-provision of public goods relative to the standard policy rule without adaptation, adaptation to the public good works in the opposite direction. In the extreme case of full adaptation in both private and public consumptions, both the standard first-best and second-best policy rules for public good provision apply. In general, however, the effects of the two types of adaptation do not cancel out, meaning that the rules for optimal public good provision depend on the degrees to which consumers adapt to private and public good consumption.

2. The Model

Consider a two-period economy where the representative consumer derives utility from private consumption, leisure, and a public good. The population is normalized to one for notational convenience and the representative consumer's life-time utility function is written

[1] For further evidence on the importance of adaptation, see Lucas (2007), Diener et al. (2009), Luhmann et al. (2012), and Weimann, Knabe, and Schöb (2014).

$$U = u(c_1, z, c_2 - \alpha c_1) + v_1(g) + v_2(g(1-\rho)). \quad (1)$$

In equation (1), c_1 and c_2 denote private consumption in the first and second period, while *z* denotes leisure, defined as a time-endowment normalized on one minus the hours of work, *l*, and *g* denotes a public good. The individual works in the first period and is retired in the second (meaning that the leisure-argument in the utility function refers to the first period), whereas the benefit of the public good is enjoyable in both periods (although it remains in fixed quantity over both periods). Since indirect effects of the public good via consumption and work hours are of no concern for the main results to be derived below, we simplify by assuming that public consumption is separable from the other goods in the utility function, and that $v_1(\cdot) = v_2(\cdot) = v(\cdot)$ for $\rho = 0$. The utility function is increasing in each argument and strictly concave.

We allow for adaptation both with respect to private and public consumption, where the parameters $\alpha \in [0,1]$ and $\rho \in [0,1]$ denote the degrees of adaptation. As such, if $\alpha = 0$, there is no adaption at all in the private consumption, whereas $\alpha = 1$ means full adaptation. The interpretation of the parameter ρ is analogous in terms of public consumption. We assume that there is no adaptation with respect to leisure, as otherwise the utility derived from leisure when retired would depend on the leisure-consumption choice in the first period.[2]

The individual budget constraints can then be written as

$$wl(1-\tau) - T - s = c_1, \quad (2a)$$

$$s = c_2, \quad (2b)$$

in which *w* denotes the before-tax wage rate, *s* denotes savings, τ denotes a linear labor income tax, and *T* denotes a lump-sum tax. We assume that labor is the only production factor, and that the production technology is such that the before-tax wage rate is fixed. The individual consumer is an atomistic agent, who treats the policy variables (*g*, τ, and *T*) as exogenous. Individuals are fully aware of their adaptive behavior so that the individual first order conditions for labor supply and saving are given by (using $x_1 = c_1$ and $x_2 = c_2 - \alpha c_1$)

$$U_{x_1} w(1-\tau) - U_{x_2} \alpha w(1-\tau) = U_z, \quad (3a)$$

$$U_{x_1} = U_{x_2}(1+\alpha). \quad (3b)$$

[2] As long as leisure time is (at least partly) used to gain experiences, this assumption accords well with empirical evidence discussed in Dunn, Gilbert, and Wilson (2011), according to which people seem to adapt more to material than experiential purchases.

For $\alpha = 0$, our model reproduces the standard economic model. For $\alpha > 0$, the first order conditions suggest that adaptation provides an incentive for the individual to substitute current for future consumption. The intuition is that decreased current consumption is associated with an additional benefit to the individual through an adaptation-induced increase in the future utility. The indirect utility function becomes

$$V = V(\tau, T, g) = u(wl(1-\tau) - T - s, 1-l, s - \alpha(wl(1-\tau) - T - s)) + v_1(g) + v_2(g(1-\rho)), \quad (4)$$

where *l* and *s* are implicitly defined by equations (3a) and (3b) and, therefore, functions of τ and *T*.

The government's decision-problem is to choose *g*, τ, and *T* to maximize the indirect utility function given in equation (4) subject to its budget constraint

$$\tau wl + T = g. \quad (5)$$

In what follows, we distinguish between a first-best solution where the government is free to use the lump-sum tax (in which case the optimal labor income tax rate is zero), and a second-best solution where it cannot use the lump-sum tax. We can then derive the following result:

Proposition 1. *The optimal provision of the public good satisfies*

(i) $\frac{U_g}{U_{x_1}} = \frac{v_{1,g} + v_{2,g}(1-\rho)}{U_{x_1}} = \frac{1}{1+\alpha}$ *if based on lump-sum taxation, and*

(ii) $\frac{U_g}{U_{x_1}} = \frac{v_{1,g} + v_{2,g}(1-\rho)}{U_{x_1}} = \frac{1}{1+\alpha}\frac{1}{1+\varepsilon}$ *if based on labor income taxation,*

where $\varepsilon = \frac{\partial l}{\partial \tau}\frac{\tau}{l}$ *is the tax rate elasticity of labor supply.*

Without any adaptation, i.e., if $\alpha = \rho = 0$, our model reproduces (in a two-period setting) both the first-best Samuelson condition and the second-best modified Samuelson condition as derived in Atkinson and Stern (1974), in which the marginal cost of public funds is unity under lump-sum taxation and $1/(1+\varepsilon)$ under labor income taxation. To see how adaptation alters both the first-best and second-best rules for optimal public good provision, we rewrite the optimality conditions derived in Proposition 1 such that the left-hand side reflects the standard rule and the right-hand side reflects the direct effect adaptation has on the optimal provision of public goods, i.e.,

$$\frac{v_{1,g} + v_{2,g}}{U_{x_1}} - 1 = -\frac{\alpha}{1+\alpha} + \frac{\rho v_{2,g}}{U_{x_1}}, \quad (6)$$

$$\frac{v_{1,g}+v_{2,g}}{U_{x_1}}-\frac{1}{1+\varepsilon}=-\frac{\alpha}{1+\alpha}\cdot\frac{1}{1+\varepsilon}+\frac{\rho v_{2,g}}{U_{x_1}}. \tag{7}$$

Consumption adaptation, covered by α, reduces the cost of public good provision. Shifting income from private to public consumption implies that the utility from private consumption in the second period increases and thus lowers the opportunity cost of public good provision in the first period. Thus, in the case of adaptation in terms of private consumption, public good provision should be higher the higher the degree of adaptation α is, ceteris paribus.[3] In fact, if $\alpha=1$, we have $1/(1+\alpha)=1/2$. This result suggests that the marginal cost of providing public goods may be much lower if consumers adapt to their private consumption, and this holds irrespective of whether the public good is financed through lump-sum taxation or distortionary taxation. Adaptation with respect to public good consumption works in the opposite direction, since increased public good provision lowers the marginal utility derived from the public good in the second period.

In general, the two opposing effects do not cancel out. Only in the case of full adaptation both to private and public consumption, i.e., $\alpha=\rho=1$, we find that the conventional first-best and second-best formulae of optimal public good provision continue to hold. In this case we have $2\cdot v_g/U_{x_1}=1$ and $2\cdot v_g/U_{x_1}=(1+\varepsilon)^{-1}$, respectively. As $2\cdot v_g=v_{1,g}+v_{2,g}$ for $\rho=0$, we derive the same qualitative policy rules as in the case without adaptation.

> **Corollary 1.** *In the case of full adaptation to both private good and public good consumption, the standard formulae of optimal public good provision continues to hold. In case of imperfect adaptation, however, the optimal public good provision depends on the degrees of adaptation.*

In summary, our results show that adaptation to private consumption motivates over-provision of public goods relative to the Samuelson condition, while adaptation to public consumption motivates under-provision. Also, the two type of adaptation do not cancel out except in the extreme case where the consumers fully adapt both to private and public consumption. This means that adaptation generally matters for the optimal provision of public goods, and thus normative economic theory. With respect to the policy implications, however, it remains an empirical question whether adaptation implies over- or under-provision relative to the Samuelson condition.

[3] This means over-provision relative to the conventional policy rule, i.e., we are focusing on the "rule issue" here and not the "level issue". See Gaube (2000) for an excellent study on the level issue, where he derives conditions under which the optimal second-best level of public good provision falls short of the optimal first-best level.

References

Atkinson, Anthony B., and Nicholas H. Stern (1974): "Pigou, taxation and public goods", *The Review of Economic Studies* 41, 119-128.

Clark, Aandrew E., Paul Frijters, and Michael A. Shields (2008): "Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles", *Journal of Economic Literature* 46, 95-144.

Diener, Ed, Richard E. Lucas, Ulrich Schimmack, and John F. Helliwell (2009): *Well-Being for Public Policy*, Oxford: Oxford University Press.

Dunn, Elizabeth W.; Daniel T. Gilbert and Timothy D. Wilson (2011): "If money doesn't make you happy, then you probably aren't spending it right", *Journal of Consumer Psychology* 21, 115-125.

Gaube, Thomas (2000): "When do distortionary taxes reduce the optimal supply of public goods?" *Journal of Public Economics* 76, 151-180.

Lucas, Richard E. (2007): "Adaptation and the set-point model of subjective well-being - Does happiness change after major life events?" *Current Directions in Psychological Science* 16(2), 75-79.

Luhmann, Maike, Wilhelm Hofmann, Michael Eid, and Richard E. Lucas (2012): "Subjective well-being and adaptation to life events: A meta-analysis", *Journal of Personality and Social Psychology* 102, 592-615.

Pollak, Robert A. (1970): "Habit Formation and Dynamic Demand Functions", *Journal of Political Economy* 78, 745-763.

Weimann, Joachim, Andreas Knabe und Ronnie Schöb (2014): *Measuring Happiness. The Economics of Happiness*, Cambridge: MIT Press.