Review of Economic Dynamics 15 (2012) 551–572

Contents lists available at SciVerse ScienceDirect

Review of Economic Dynamics

www.elsevier.com/locate/red

Optimal taxation over the life cycle

Aspen Gorry [a], Ezra Oberfield [b,*,1]

[a] Economics Department, University of California-Santa Cruz, 1156 High Street, Santa Cruz, CA 95064, United States
[b] Federal Reserve Bank of Chicago, 230 S. LaSalle Street, Chicago, IL 60604, United States

ARTICLE INFO

Article history:
Received 10 April 2011
Revised 11 May 2012
Available online 22 May 2012

JEL classification:
H21
E60

Keywords:
Optimal taxation
Life cycle
Extensive margin
Ramsey problem
Non-linear taxation
Primal approach

ABSTRACT

We derive the optimal labor income tax schedule for a life cycle model with deterministic productivity variation and complete asset markets. An individual chooses whether and how much to work at each date. The government must finance a given expenditure and does not have access to lump sum taxation. We develop a solution method that uses the primal approach to solve for the optimal non-linear tax function. The average tax rate determines when an individual will work while the marginal tax rate determines how much she will work. Even in the absence of redistributive concerns, the optimal tax schedule has an increasing average tax rate at low levels of income to encourage labor market participation. The marginal tax rate at the top is strictly positive. Finally, the model is used to assess the effects of changing the current tax schedule to the optimal one. Under the preferred parameters, this delivers a welfare gain equivalent to 0.67 percent of lifetime consumption.

1. Introduction

Individuals exhibit substantial variation in earnings over their lifetimes. Estimates of life cycle wage patterns show that wages approximately double during workers' lives and individuals regularly shift between tax brackets.[2] Individual consumption, savings, and work decisions reflect both current and future income. Labor supply decisions at a given point in time are influenced by tax rates in several brackets. As a consequence, life cycle variation in earnings links segments of the tax schedule through both incentive constraints and the individual's lifetime budget constraint. Given these considerations it is important to understand how life cycle consumption and labor supply dynamics influence optimal tax policy.

This paper extends the existing tax literature by solving for the optimal non-linear labor income tax schedule in a simple life cycle labor supply model. As in Rogerson and Wallenius (2009) and French (2005), we model an individual who faces an exogenous productivity profile and a fixed cost of going to work. Fixed costs generate realistic patterns of labor supply in which an individual works only a fraction of her life. With hump shaped productivity, this model captures the basic pattern of lifetime labor supply: a period of non-participation followed by working and finally retirement.

Following Ramsey (1927) and Lucas and Stokey (1983), we model a government that must raise revenue to finance a given level of expenditure but does not have access to lump sum taxes. In contrast to the Ramsey literature, the government

* Corresponding author.
E-mail addresses: aspen.gorry@gmail.com (A. Gorry), ezraoberfield@gmail.com (E. Oberfield).

[1] The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Chicago or the Federal Reserve System.

[2] Fullerton and Rogers (1991) argue that lifetime and annual income classifications are significantly different in their implications for tax incidence. In particular, using PSID data they compare annual income from 1984 to lifetime income for individuals by decile. They find that only 24.8 percent of individuals are in the same annual as lifetime decile in that given year and that only 56.1 percent are within one step of their lifetime decile.

1094-2025/$ – see front matter
http://dx.doi.org/10.1016/j.red.2012.05.002

can impose a non-linear labor income tax schedule.[3] In this model, labor taxes distort both the extensive and intensive margins of work. The average tax rate determines whether an individual works on a given date, while the marginal tax rate determines how much labor is supplied.

To solve the problem, we generalize the standard primal approach to allow for a non-linear tax function. The incentive constraints are combined into a single implementability constraint. When the government chooses a feasible allocation subject to this implementability constraint, the allocation can in fact be implemented provided that income is strictly increasing in wages. With proportional taxes, this last step is trivial; here it is more difficult because with a non-linear tax schedule, the individual's constraint set is not generally convex.

Solving the optimal tax problem in the life cycle model generates two analytical results. First, the average tax rate is increasing in income at the extensive margin. It is optimal to have a low and rising average tax rate at the extensive margin in order to induce workers to enter the labor force earlier and retire later. This is accomplished with a low average tax rate but a high marginal tax rate at the extensive margin.

Second, the marginal tax rate at the highest realized income is strictly positive. This result stands in contrast to much of the optimal tax literature that follows Mirrlees (1971). In a Mirrleesian environment the optimal marginal tax rate for the highest skilled individual is zero when the skill distribution is bounded (see Diamond, 1998). To understand the logic of zero marginal tax at the top, suppose that the marginal tax at the highest income was not zero. Then if the tax schedule is extended beyond the top at a marginal rate of zero, the highest earner would choose to work and consume more. She would be better off while no tax revenue would be lost for the government. Therefore, the original tax schedule could not have been optimal. We show that this logic breaks down in a life cycle framework. Extending the tax function at a zero marginal rate still induces the worker to work and earn more when she is most productive, but the increase in wealth induces the worker to work less at other points in her life, diminishing tax revenue. Because of this income effect, the optimal tax function in our model features a positive marginal tax rate at the top of the income distribution.[4]

These results are robust. For the average tax rate to be increasing at the bottom, it is crucial that there is an active extensive margin. This is true as long as there are fixed costs of supplying labor. The positive marginal tax rate at the top is driven by wealth effects. This result is robust to adding other sources of wage heterogeneity as long as the most productive worker has income variation over her lifetime.

The model is parameterized to match the current tax and transfer system in the United States. The income tax system is approximated with the Gouveia and Strauss (1994) tax function and social security is modeled as a 12.4 percent proportional tax on labor income that is transferred back to individuals as lump sum payments after the age of 65. Holding the level of government revenues and transfer payments fixed, we consider reforms to the current tax system. First, moving from the current tax system to the optimal tax system increases welfare by between 0.42 and 1.6 percent in lifetime consumption equivalents depending on the parameter chosen for the Frisch elasticity of labor supply. For our preferred choice of the Frisch elasticity of 0.5 the welfare gain is 0.67 percent. Like the optimal tax schedule, the current tax code has low and rising average tax rates at the extensive margin. However, in contrast to the current tax code, the optimal schedule features high marginal tax rates at the extensive margin that are declining in income. The current tax policy is also compared to two simple tax reforms: constrained lump sum taxes, where the individual faces lump sum taxes only when working, and a proportional income tax. Constrained lump sum taxation places all of the distortion on the extensive margin. Such a policy generates large welfare losses of between 5.2 and 20.5 percent of lifetime consumption equivalents. The gains in moving to a proportional tax system are between 0.12 and 1.1 percent and generate about half of the gains of moving to the optimal tax system in the preferred parameterization.

When the elasticity of intertemporal substitution is smaller so that wealth effects have a more prominent role, the optimal tax schedule has a flatter profile of marginal tax rates and the consumption equivalent of moving to the optimal tax schedule is smaller. In contrast, with linear utility of consumption the optimal tax schedule features a steep profile of marginal tax rates that includes a zero marginal tax rate at the top.

This paper contributes to a growing literature that considers optimal taxation in life cycle environments. Our environment is most similar to Erosa and Gervais (2002), who study a life cycle economy with age dependent proportional taxes, Gervais (2009), who solves for the optimal tax among a particular family of functions, and Conesa and Krueger (2006), who consider the optimal progressivity of the tax code in a life cycle model where heterogenous agents face uninsurable productivity risk over their lifetime. We extend this literature by including an endogenous extensive margin of labor supply, solving for the optimal non-linear tax schedule, and clarifying the differing roles played by the average and marginal tax rates.

Following Saez (2002), we study both the intensive and extensive margins of labor supply adjustment.[5] Saez (2002) develops a simple expression relating the optimal tax rate to empirical local labor supply elasticities. We explicitly motivate

[3] Lump sum taxes are ruled out by imposing the restriction that individuals who earn no income cannot be taxed. Age dependent taxes are also ruled out by assumption as the tax schedule is only a function of individual labor income. With either lump sum taxation or non-linear age dependent taxation the government could achieve the first best allocation.

[4] Several other studies have qualified the classic Mirrleesian result of zero tax at the top. Tuomala (1984) shows numerically that marginal rates can remain far from zero until very close to the top income, while Diamond (1998) shows that when the distribution of skills is unbounded, the marginal tax rate may not converge to zero as income rises. Gaube (2007) shows that a top marginal rate can be positive in a multi-period model in which unobserved skill is constant over time but the tax schedule can vary by period. Other models in which a positive top rate is optimal include Varian (1980), in which income includes an exogenous stochastic component, and Oswald (1983) in which individuals care both about their own income as well as relative incomes.

[5] Diamond (1980) and Mulligan (2001) look at optimal tax policy focusing exclusively on the extensive margin.