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Optimal linear and two-bracket income taxes with idiosyncratic earnings risk☆

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ABSTRACT

This paper quantitatively characterizes optimal linear and two-bracket income taxes. We consider a dynamic-stochastic-general-equilibrium model in which tax design involves redistributing income for both equity and social insurance. Substantive findings include: (i) a significant fraction of agents supply zero labor or hold zero assets at the optimum; (ii) neglecting tax distortion imposed on either of labor–leisure and consumption–saving decisions will lead to the prescription of tax codes that deviate substantially from the optimum; and (iii) the optimal two-bracket tax schedule will turn from regressivity to progressivity in the marginal tax rate once the volatility of idiosyncratic shocks becomes sufficiently large. The last finding is consistent with the results in Apps et al. (forthcoming), and it also reconciles the contradictory results regarding the optimal two-bracket tax schedule between Slemrod et al. (1994) and Strawczynski (1998).

1. Introduction

Mirrlees (1974) pioneered the study of optimal income taxation in a setting where ex ante identical agents face idiosyncratic shocks to their earnings, but relevant insurance markets are missing. This missing-market setting invites a role for income tax to serve as a partial substitute to absorb income fluctuations and share the idiosyncratic risk across agents. The motive for redistributive taxation here is not for equity per se, but rather for social insurance.

Varian (1980) took up the issue addressed by Mirrlees (1974) with the emphasis that a large portion of income differences between agents is attributable to pure luck rather than innate ability. Unlike Mirrlees's static framework where agents make a choice between labor and leisure, Varian considered a dynamic framework where agents make a choice between current and future consumption.

The Mirrlees–Varian model of optimal income taxation is one of the pioneering works in the moral hazard class of the principal-agent problem, in which the key tradeoff involved is between inducing incentives and providing insurance (Laffont and Martimort, 2002). Subsequent works, including Tuomala (1984), Strawczynski (1998), Low and Maldoom (2004) and Kanbur et al. (2008), have elaborated on Mirrlees–Varian's original idea in a variety of directions. Our paper contributes to this line of the optimal taxation literature mainly on the front that the tax design problem in our model involves "correcting" income distribution across agents for equity as well as providing social insurance to buffer against agents' idiosyncratic risk.[1]

Under plausible assumptions, Mirrlees (1971) found that the optimal non-linear income tax is approximately linear. In contrast to Mirrlees (1974), this 1971 seminal work belongs to the adverse selection class of the principal-agent problem, in which income differences between agents are attributed to innate ability (type) rather than pure luck. The government's tax design in the Mirrlees (1971) framework is to trade off "correcting" income distribution for equity against dulling incentives to work (Laffont and Martimort, 2002).

Subsequent studies following Mirrlees (1971) have further explored the tax schedules of optimal income taxation.[2] Many of them are based on the mechanism design approach, which gives rise to highly nonlinear tax schedules. However, in the real world, virtually all income tax systems are piecewise linear. In this paper we focus on piecewise linear income tax and, in particular, the linear and the two-bracket income tax.

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[1] Strawczynski (1998) mainly considered the Varian problem in a representative-agent framework; however, he also analyzed a four-agent economy in which two levels of skill apply respectively to two realizations of shock. See also Eaton and Rosen (1980) and Diamond et al. (1980).

[2] Tuomala (2010) provides a recent study on the issue; see the references therein for other studies.

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Stern (1976) is perhaps the most celebrated work that quantitatively characterizes the optimal linear income tax. His model is static and deterministic in the framework of Mirrlees (1971), while our model is dynamic and stochastic. In the context of the two-bracket income tax, Slemrod et al. (1994) found quantitatively that the second marginal tax rate is lower than the first at the optimum, whereas Strawczynski (1998) derived the opposite result.[3] It should be noted that the former is framed in a static, deterministic, and ability-driven environment à la Mirrlees (1971), whereas the latter is framed in a dynamic, stochastic, and luck-driven environment à la Varian (1980). The results of our model are driven by agent heterogeneity in both ability and luck. We investigate why the optimal two-bracket income tax may be progressive or regressive in the marginal tax rate.

The work of Slemrod et al. (1994) basically follows that of Stern (1976), but extends the numerical analysis to the two-bracket case. Specifically, it assumes a lognormal wage rate (ability) distribution, the parameters of which are taken from Stern (1976). In a recent paper, Apps et al. (forthcoming) revisited the problem of the optimal two-bracket income tax and presented simulation results based on Pareto wage rate distributions. They numerically discerned the circumstances under which marginal tax rate progressivity or regressivity will arise. Apps et al. (forthcoming) considered their problem in the framework of Mirrlees (1971) and so naturally they did not address the issue of conflicting findings between Slemrod et al. (1994) and Strawczynski (1998). We complement the Apps et al. (forthcoming) results by tackling the left-out issue.

In addition to the studies mentioned above, our paper is closely related to Conesa and Krueger (2006) and Conesa et al. (2009), both of which address optimal income taxation in a dynamic-stochastic-general-equilibrium setting.[4] Besides modeling details and derived results, there are at least three major differences between our paper and theirs. First, we consider the piecewise linear income tax, whereas they considered a three-parameter family of nonlinear income tax schedules. As such, we are able to relate our findings directly to the previous literature on optimal linear and two-bracket income taxation, while they cannot. Second, they addressed optimal taxation in a life-cycle model, while we are in an infinite-horizon framework. Abstracting from life-cycle complications enables us to focus on non-life-cycle elements that are responsible for the design of income tax. Barro (1991) argued that the infinite horizon applies naturally if agents care about their children, who in turn care about their children, and so on. Third, while tax revenues collected are used solely to finance government consumption in Conesa and Krueger (2006) and Conesa et al. (2009), they are used to finance transfer payments as well as government consumption in our paper. In line with the tradition of optimal income taxation à la Mirrlees (1971, 1974), the so-called "tax" schedule in our model actually represents a "tax and transfer" schedule. As Brewer et al. (2010, p. 94) remarked: "Despite its name, optimal tax theory concerns itself just as much with the design of benefits as it does the setting of income tax rates …"

A recent paper by Boadway and Sato (2011) has analytically provided a fairly general treatment of optimal income taxation when differences in individual income are attributed to both ability and luck. For simplicity, they assumed that preferences are quasi-linear in labor so as to eliminate income effects in the demand for consumption. Even in this simplified setting, the derived analytical results seem rather complicated and may fail to prescribe concrete tax structures; see their Proposition 2. As noted by Boadway and Sato (2011), there has been relatively little attention devoted to studying optimal income taxation in the presence of heterogeneity in both ability and luck. Following Stern (1976), Slemrod et al. (1994), Strawczynski (1998), and Apps et al. (forthcoming), we quantitatively characterize optimal linear and two-bracket income taxes but synthesize these previous studies in a framework where both ability and luck matter for the determination of individual income.

The rest of the paper is organized as follows. Section 2 introduces our model. Section 3 calibrates the parameter values of the model. Section 4 considers welfare criteria for optimal taxation. Sections 5–8 report our results and Section 9 concludes.

2. Economic environment

In an important benchmark of the incomplete markets model,[5] Aiyagari (1994) considered a dynamic-stochastic-general-equilibrium (DSGE) setting in which agents face idiosyncratic earnings risk that cannot be insured. Our model follows his model closely. In the Aiyagari economy, labor hours are exogenously given and income is not subject to taxation. We allow for the choice of labor hours and the imposition of income taxes. The Aiyagari model is interesting from the viewpoint of taxation, in that it generates an endogenous cross-sectional distribution of income and of wealth, which is conditional upon tax parameters.

2.1. Setting

Time is discrete and runs from $t = 0, 1, \ldots, \infty$. The economy is populated by a continuum of infinitely-lived agents (households) of unit mass. Each agent is atomistic and so a price taker. Agents are heterogeneous in that they face different histories of realizations of idiosyncratic shocks to their labor productivity. This is the only source of heterogeneity across agents in the model.

There are three sectors in the economy: households, firms, and the government. There are three goods: the service of labor, the service of capital, and a final good that can be used for either consumption or investment. We let the final good be the numeraire.

2.2. Labor productivity shocks

There is no aggregate risk in the economy. All agents are subject to idiosyncratic labor productivity shocks, which are realized at the beginning of each period $t > 0$ (each agent starts identically at time 0 with some initial productivity shock). There are no viable insurance markets or state-contingent securities available for agents to insure against the risk of the shocks. The realized shocks take a finite number of possible values, which are observed by agents before making their labor–leisure and consumption–saving decisions in each period. The stochastic process of the shocks is identical and independent across agents, and follows a Markov chain with stationary transitions over time. The Markov chain is parameterized by appealing to econometric studies based on micro-level data. The details of this process will be deferred to the next section when we calibrate the model.

We let z denote the generic realization of the labor productivity shock, and normalize the mean of z to be unity. The effective labor supply for an agent equals zn, where n is her labor hours chosen.

2.3. Asset market

There are no state-contingent assets but a single risk-free, one-period asset. Agents have no asset at time zero; however, they can accumulate their asset holdings by saving. Saving will be channeled to become capital, which is used by firms in production. Since there is only one asset held by agents, the distribution of this asset represents the distribution of wealth in the economy.

[3] See also Sheshinski (1989), who presented a proof in the framework of Mirrlees (1971) that a regressive two-bracket tax code can never be optimal. However, Slemrod et al. (1994) showed that Sheshinski's proof is flawed since it ignores a possible discontinuity in the tax revenue function.

[4] There is also a literature called "new dynamic public finance," in which the emphasis is on the implications of information frictions for optimal taxes in dynamic settings; see Golosov et al. (2006) and Kocherlakota (2010) for reviews.

[5] For introductions to the incomplete market model, see Heathcote et al. (2009) and Guvenen (2011).