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Consuming your way to efficiency: Public goods provision through non-distortionary tax lotteries

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ABSTRACT

We revisit the classical result that taxation of private consumption is distortionary and therefore precludes the efficient provision of public goods. We introduce a nonlinear consumption tax which we call a 'tax lottery'. Under this scheme, an ad-valorem consumption tax is supplemented with a lottery in which consumers can win cash prizes. The winning probabilities in this lottery depend on all consumers' private good consumption decisions. We show that for a given ad-valorem tax, an appropriately designed lottery can implement an efficient allocation in pure-strategy Nash equilibrium. The lottery component corrects the distortion in private consumption due to the ad-valorem tax, while the resulting tax revenue is sufficient to efficiently provide the public good and pay out the lottery prize.

1. Introduction

This paper introduces a novel form of nonlinear taxation of private consumption in order to finance a pure public good. The 'tax lottery' scheme that we propose is a combination of an ad-valorem tax on private consumption, and a suitably designed lottery, in which consumers can win a cash prize. The winning probabilities in the lottery depend on all consumers' private goods consumption.

We consider the classical textbook case of a stylized n-person economy with two private goods (a consumption good and a numeraire) and a pure public good under perfect information. The public good is financed from tax revenue. It is well-known that an ad-valorem (or sales) tax distorts private consumption and therefore precludes the efficient provision of the public good. We show that adding an appropriately designed lottery can correct this distortion while simultaneously raising sufficient revenue to finance both the efficient level of the public good and the lottery prize. Thus, our contribution is to introduce a nonlinear consumption tax scheme that implements an efficient allocation in Nash equilibrium.

A tax lottery is an instrument to raise money without distorting private consumption. For this result to obtain, it does not matter whether or not private consumption decisions directly affect the provision level of the public good. From this point of view, there are two alternative ways of providing the public good. First, the government may directly produce the public good from tax revenue. Thus, the government's budget is always balanced and each individual consumption decision marginally affects the provision level of the public good. This has an effect on the marginal consumption decisions of the private good. Second, the government may commit to

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provide and finance the public good at its first-best (efficient) level regardless of tax revenue. Then the tax lottery only serves as a way of raising the required amount of funds in equilibrium, in a nondistortionary way. Under both public goods provision regimes, tax lotteries can implement an efficient allocation in Nash equilibrium.

Several countries employ mechanisms which are similar to the tax lotteries developed in this paper. The main objective for the introduction of these mechanisms is to improve tax compliance. An example is the Taiwanese *Uniform Invoice lottery*.[2] Under this system, every one of the roughly 11.5 billion receipts issued annually by Taiwanese shops comes with a unique lottery number, which enters a bi-monthly prize draw awarding prizes of up to $320,000. This receipt lottery was introduced in 1951 to increase tax revenue and proved so successful that it remained in place ever since. Since the lottery numbers come per receipt rather than per dollar spent, there is an incentive for customers to pay for every single item separately in order to get more receipts: a scene which many Taiwanese are familiar with. A similar example are the recently introduced Chinese *Fapiao* tax receipt lotteries. Under this scheme, each receipt for restaurant consumption or entertainment expenditures is a lottery scratch card creating incentives for customers to ask for receipts and, in turn, oblige restaurants to pay VAT.[3] These examples suggest that lotteries based on consumption are able to affect individual consumers' incentives and decisions. We show that, in order for these lotteries to implement efficiency in our model, marginal winning probabilities need to be specifically designed.[4]

We analyse a classical environment in which it is well known that, e.g., lump-sum taxation or a uniform commodity tax can implement efficiency. There is, however, a large literature asserting that these instruments may not be always available to the social planner.[5] We are, hence, motivated by theoretical interest in how the above introduced tax receipt lotteries can be integrated into a public goods provision model without creating distortions. For this purpose, our model makes use of a single-prize lottery in which one consumer wins a cash prize. We would like to point out prominently, however, that this approach is technically equivalent to a 'tax refund' scheme, where a consumer's probability of winning our lottery is interpreted as the deterministic share of sales tax revenue that is refunded to that consumer. As this 'cardinal' tax-refund interpretation does not require the transfer of large payments to a 'winning' player, it may well be a more practically fruitful way to read our model.

2. Literature

Our model combines two well-known mechanisms, an ad-valorem (sales) tax and a particular kind of lottery (or contest). At least since Samuelson (1954), it is well-known that a sales tax cannot finance a pure public good efficiently as it distorts private consumption. Similarly, employing lotteries for fundraising purposes is not a new idea.[6] The idea that in some circumstances efficiency can be induced through a rank order tournament is due to Lazear and Rosen (1981). In these tournaments, prizes are allocated according to a relative ranking, hence ordinal information on performance is sufficient.[7]

We are only aware of a handful of papers developing ideas directly related to this paper. It is important to note that we do not employ lotteries for direct fundraising, as is typically done in the literature on financing public goods by use of lotteries. Our lottery is used to make private consumption more attractive and thus increase sales tax revenue from which the public good is financed. Thus, private consumption decisions cannot be separated from the (indirect) contributions to financing the public good.

We briefly discuss some mostly recent papers in the following short review. As a general rule and contrary to our analysis, these papers are mainly concerned with the fundraising capabilities of given mechanisms and not with designing efficiency inducing mechanisms.

Bergstrom et al. (1986) analyze public goods provision through private contributions and demonstrate how tax financing of the public good crowds out private contributions. Morgan (2000) is the first to study various lottery-like fundraising mechanisms for the purpose of supplying a public good.[8] He shows that these mechanisms are generally inefficient but can outperform voluntary contributions. If the lottery prize is fixed in advance, then the degree of efficiency obtained is a function of the prize size. Thus, with a sufficiently large prize (and correspondingly large individual monetary endowments) the mechanism comes arbitrarily close to, but never reaches, efficiency. If the prize is a percentage of contributions, then the lottery does not perform better than voluntary contributions. Franke and Leininger (2013) extend Morgan (2000) in discussing a biased, 'unfair,' indirect contribution game

[2] http://en.wikipedia.org/wiki/Uniform_Invoice_lottery. Puerto Rico introduced a similar system in 2011; its official site is http://loteriaelectronicapr.com/. The state of São Paulo returns through its *Nota Fiscal Paulista* tax lottery program up to 30% of proceeds as a rebate, and, unrelated to that, 30% of proceeds in the form of cash prizes; see http://www.nfp.fazenda.sp.gov.br/. A similar system, *Nota Fiscal Paulistana*, is run by the city of São Paulo; see http://nfpaulistana.prefeitura.sp.gov.br/. An empirical study of *Nota Fiscal Paulista* is that of Mattos et al. (2013).

[3] For details see, for instance, Wan (2010) or Gordon and Li (2009). Arbex and Mattos (2013) is a theoretical study of the use of sales tax rebates to buyers in order to facilitate tax evasion. Maeda (2008) analyzes the entertainment aspect of the issued lottery tickets.

[4] Examples of 'designed' lotteries, that is, of lotteries where the winning probabilities are not just the number of tickets bought over the total number of tickets, are the German or Austrian Klassenlotterien and the United Kingdom Premium Bonds. For details see, for instance Schöenbein (2008) or http://www.nsandi.com/products/pb.

[5] For a thorough discussion see, for instance, Myles (1995).

[6] "A Lottery is a Taxation, Upon all the Fools in Creation; And Heav'n be prais'd, It is easily rais'd, Credulity's always in Fashion; For, Folly's a Fund, Will never lose Ground; While Fools are so rife in the Nation." Henry Fielding, *The Lottery* (London: J. Watts, 1732), Scene 1, quoted in Clotfelter and Cook (1989, 219). Earlier still, according to Karoshi (2008), Keno lottery slips from the Chinese Han Dynasty (205–187 B.C.) are believed to have helped finance the construction of the Great Wall of China.

[7] This idea has found numerous applications and extensions, for instance in the work of Green and Stokey (1983), Nalebuff and Stiglitz (1983), Dixit (1987), Moldovanu and Sela (2001), or Siegel (2009). A series of recent contributions investigate uncertainties in the contest success function (Grossmann, 2014), destructive efforts (Amegashi, 2012), private costs (Ryvkin, 2010), cost-based size effects (Lee, 2007), and size effects (Egger and Kolmar, 2006), respectively. For a detailed) survey of the contest literature see the comprehensive Konrad (2008) or the recent Van Long (2013) study.

[8] Morgan (2000) points out weaknesses of different forms of possible mechanisms, e.g., mixed experimental evidence of the theoretical predictions or the requirement of coercive power, and stresses the informational requirements on the designer's side.