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Genuine saving and the social cost of taxation ☆

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ABSTRACT

Following the 1987 report by The World Commission on Environment and Development, the genuine saving has come to play a key role in the context of sustainable development, and the World Bank regularly publishes numbers for genuine saving on a national basis. However, these numbers are typically calculated as if the tax system is non-distortionary. This paper presents an analogue to genuine saving in a second best economy, where the government raises revenue by means of distortionary taxation. We show how the social cost of public debt, which depends on the marginal excess burden, ought to be reflected in the genuine saving. By presenting calculations for Greece, Japan, Portugal, U.K., U.S. and OECD average, we also show that the numbers published by the World Bank are likely to be biased and may even give incorrect information as to whether the economy is locally sustainable.

1. Introduction

Since the 1970s, a theory of welfare accounting has gradually evolved. One of the basic ideas behind the research in welfare accounting has been to provide a coherent framework for measuring changes in welfare in a dynamic economy, as well as understanding how the current procedures for national accounting ought to be modified with this particular objective in mind.[1] In this paper, we revisit the relationship between capital formation and the subsequent welfare change by presenting a measure of "genuine saving" for a second best economy where the public revenue spent on environmental policy is raised by distortionary taxes. We argue below that such a measure is not only interesting from a theoretical point of view; it has also bearing on statistics of relevance for environmental policy frequently published by the World Bank.

The genuine saving is an indicator of comprehensive net investment, i.e. the value of the net investment in all capital stocks of relevance for society. As such, genuine saving does not only reflect the social value of net investment in physical capital (the measure of net investment used in conventional national accounting); it also reflects the social value of changes in other capital stocks, such as natural and human capital. The remarkable feature with genuine saving is that it constitutes an exact measure of welfare change over a short time interval.[2] Following the 1987 report by The World Commission on Environment and Development, it has also come to play an interesting role as an indicator of sustainable development. The World Commission wrote that development is sustainable if it meets "the needs of the present without compromising the ability of future generations to meet their own needs" (Our Common Future, page 54). One possible interpretation is that sustainable development requires welfare to be non-declining.[3] This suggests, in turn, that the genuine saving is a local indicator of sustainable development, where the emphasis on the word "local" is due to that we are measuring the welfare change over a short time interval.[4] Another interpretation of

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[1] The seminal contribution to the theory of welfare accounting is Weitzman (1976), showing how a welfare-equivalent measure of net national product ought to be defined if the resource allocation is first best. Aronsson (1998, 2008) analyzes the corresponding welfare measurement problem in second best economies, where the public revenue is raised by distortionary taxes. See also the literature reviews by Weitzman (2003) and Aronsson, Löfgren and Backlund (2004).

[2] Although Weitzman (1976) did not attempt to analyze genuine saving, it shows up in the proof of his main result, i.e. we need Weitzman's welfare measure to relate the indicator of welfare change to the genuine saving. Standard references for genuine saving are Pearce and Atkinson (1993) and Hamilton (1994, 1996).

[3] This definition is used in Arrow et al. (2003).

[4] See also Asheim (1994) and Pezzey (1993), who show that a positive value of genuine saving does not give any information as to whether the current level of utility or consumption is sustainable forever.

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sustainable development is that the current (instantaneous) utility level must not fall short of the maximum level that can be sustained forever, in which case non-positive genuine saving indicates that the current utility level faced by the representative consumer exceeds the maximum sustainable level (Pezzey and Toman, 2002; Pezzey, 2004). As such, the genuine saving has become an important statistic underlying the environmental policy debate, and the World Bank regularly publishes numbers for genuine saving on a national basis for a large number of countries.[5]

However, the appropriate procedures for calculating the genuine saving have not received sufficient attention. In fact, the calculations that we have seen either assume that the resource allocation is first best, or that the resource allocation is suboptimal in the sense that society has not reached the best possible outcome given its objective and constraints (due to uninternalized market failures).[6] To our knowledge, there are no studies dealing with the measurement of genuine saving (or an analogue thereof) in economies where the resource allocation is second best optimal; a scenario that will arise if restrictions faced by policy makers prevent them from implementing the first best resource allocation. This gap in the literature is somewhat surprising considering that the revenue raised by the public sector in real world economies typically necessitates distortionary taxes, which are associated with an excess burden that may affect both the sign and magnitude of the welfare change that the economy experiences during a short time interval. Arguably, the principles for measuring genuine saving ought to be modified accordingly; at least if the welfare economic foundation is to be taken seriously. Therefore, the purpose of this paper is to present an analogue to genuine saving in a second best economy, where the government raises revenue through a distortionary tax (instead of a lump-sum tax).

Our study is based on a model developed by Chamley (1985), which is an extension of the Ramsey model in the sense of adding a public sector and assuming that the public revenue is raised by using a linear, yet time-varying, labor income tax. We show that the marginal excess burden of taxation affects the second best analogue to genuine saving via the accumulation of public assets. Finally, we exemplify by adjusting the World Bank numbers for genuine saving and show that neglecting the social costs of taxation (as the World Bank does) may give rise to biased estimates of genuine saving and, in some cases, alter our conclusions as to whether the economy is locally sustainable.

2. The model

The model presented below contains consumers, firms and a government. We start by describing the decision problems faced by agents in the private sector and then continue with the policy problem facing the government. Following much earlier literature, the second best problem will be described as a Stackelberg game, where the government is acting leader and the private agents are followers.

2.1. Consumers and firms

The model developed in this section largely resembles the Ramsey-type models used in earlier literature on welfare accounting with the modification that the public revenue is raised by a labor income tax.[7,8] Following the convention in earlier literature, we assume that the economy is populated by a fixed number of identical consumers normalized to one. The preferences are described by a time-separable utility function. The objective function facing the consumer is represented by the present value of future utility,

$$U(0)=\int_0^{\infty} u(c(t),z(t),q(t))e^{-\theta t}dt, \tag{1}$$

where c is the consumption of a private good, z leisure and q the quantity of a public good decided upon by the government, while the parameter θ denotes the utility discount rate (i.e. the marginal rate of time preference). The public good is a state variable and may be thought of as public capital that leads to higher environmental quality (e.g., environment-friendly infrastructure, public parks, publicly provided carbon sinks, etc.). This is clearly a somewhat naïve description of environmental quality; by focusing solely on the public sector contribution to such quality, it leaves out a number of vital relationships between production, consumption and damages to the environment. Yet, this simplification is analytically convenient and is of no practical importance for the qualitative relationship between genuine saving and tax distortions, which is the main focus in this paper. As a consequence, we abstract from other aspects of environmental quality. The determination of the public good is discussed below. Leisure is defined as a fixed time endowment, $\bar{l}$, less the hours of work, l. The instantaneous utility function, $u(\cdot)$, is increasing in each argument and strictly concave.

The consumer holds two assets; capital, k, and government bonds, b, which are assumed to be perfect substitutes. If we define $a=k+b$, the asset accumulation equation can be written as

$$\dot{a}(t)=r(t)a(t)+w_n(t)l(t)-c(t) \tag{2}$$

with $a(0)=a_0$, where $w_n(t)=w(t)[1-\tau(t)]$ is the marginal net-of-tax wage rate, in which w is the gross wage rate and τ the tax rate. The variable r is the interest rate. The price of the private consumption good has been normalized to one.

The consumer chooses his/her consumption of the private good, c, and hours of work, l, at each instant to maximize the present value of future utility subject to Eq. (2), the initial condition, and a No Ponzi Game condition (which is a restriction on the present value of the terminal asset). The consumer also treats the factor prices and policy variables at each point in time as exogenous. By using the first order conditions, one can write the demand for the private good and labor supply as functions of the net-of-tax wage rate, the marginal utility of wealth and the public good, respectively,[9]

$$c(t)=c(w_n(t),\phi(t),q(t)) \tag{3}$$

$$l(t)=l(w_n(t),\phi(t),q(t)). \tag{4}$$

The marginal utility of wealth obeys, in turn, the differential equation

$$\dot{\phi}(t)-\theta\phi(t)=-\phi(t)r(t). \tag{5}$$

Finally, by substituting Eqs. (3) and (4) into the instantaneous direct utility function, we obtain the instantaneous indirect utility function

[5] See also Hamilton (2010) for an overview of research on genuine saving.

[6] See, e.g., Aronsson and Löfgren (1998) and Löfgren and Li (2011).

[7] Adding another distortionary tax will not affect the principal findings below. See Chamley (1986) for a dynamic representative agent model with linear taxes on labor income and capital income.

[8] Aronsson (2008) uses a similar model to derive a second best analogue to Weitzman's (1976) welfare measure (i.e. a second best analogue to the comprehensive net national product) when public revenue is collected through distortionary taxes, as well as analyzes the role of public goods in welfare accounting.

[9] Note that the current value Hamiltonian implied by the consumer's decision problem can be written as (if the time-indicator is suppressed)

$J=u(c,z,q)+\phi\dot{a}$

where the marginal utility of wealth in current value terms appears as the costate variable attached to wealth. Eqs. (3) and (4) are derived from the first order conditions $u_c(c,z,q)-\phi=0$ and $-u_z(c,z,q)+\phi w_n=0$.