Resource Taxation and Sustainability: A CGE Model of the Czech Republic

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Resource use by a country is considered in the context of a production relationship. Resources include natural, produced, and human capital. The taxation of each of these resource groups has an impact on the efficient use of these inputs through changes in the relative prices. A computable general equilibrium model (CGE) of the Czech Republic is used to evaluate the impact that various revenue neutral tax structures have on the allocation of economic activity throughout the economy. A Hicksian welfare measure is used to determine the impact on society's welfare of revenue neutral shifts in taxes. The results demonstrate that the change in the tax structure will result in a welfare improvement by as much as 5% for the Czech Republic. The results provide insight into the role that "getting the prices right" has on sustainability.

KEY WORDS: Sustainability; sustainable development; computable general equilibrium; Hicksian welfare; resource taxation.

INTRODUCTION

Sustainable development has received considerable attention in the popular, as well as academic press, since the publication of the Brundtland Commission report in 1987. The motivation for framing the development discussion around the term "sustainable development" is to recognize the importance of the conflicting views of development associated with the North/South dialog. Developing countries in the South are generally most interested in developing without the constraint of restrictive environmental controls, whereas, the more developed countries of the North are generally interested in environmentally constrained economic development (Bhaskar and Glyn, 1995).

There are a number of definitions of sustainable development used in the literature, however, they generally focus on some form of the definition contained in the Brundtland Commission report (Jamieson, 1998; Bromley, 1998; Solow, 1992; OECD, 1998; Panayotou, 1997). The commission's definition is essentially that development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

An interesting dimension to the sustainable development debate is how to treat nonrenewable resources and environmental assets. By their very definition nonrenewable resources can only be used once and are, therefore, not sustainable in the same sense as renewable resources (i.e., a steady-state use is not obtained). A similar situation exists with many types of environmental assets where the costs of using the asset currently is passed on to the next generation and the benefits accrue to the current generation. The general

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3 Although the term "sustainable development" was first introduced in a report by the International Union for the Conservation of Nature and Natural Resources in 1980 it did not gain significant notoriety until the Brundtland Commission report in 1987. For a more detailed discussion see Jamieson, 1998.
answer proposed to this dilemma is to frame the discussion as endowing the next generation with a sufficient stock of capital, in whatever form (natural, man-made or human), so as to be at least as well off as the current generation in a Pareto sense. In order to achieve this goal it is critical that the scarcity value of the resources be accurately reflected by their prices or to “get the prices right” (Solow, 1992).

As Bromley (1998) points out, getting the prices right is not enough to truly achieve sustainability. However, although it is not a sufficient condition, it is a necessary condition. The focus of this paper is on the importance of getting the prices right or more accurately, on the benefits of moving in the correct direction. The model and the application to the Czech Republic presented here will not focus on the optimal taxation policy. Instead, we will look at the impact of a revenue neutral shift in taxation from the labor to the energy sector. Such a shift in the tax burden will address both the issue of the use of a depletable resource (nonrenewable energy) and the mitigation of environmental externalities (emissions from electricity generation) and reducing the distortionary tax on labor. To determine the “optimal” tax structure one would need to know the magnitude of the external costs associated with the pollutants and then be able to place the appropriate tax on the pollutant and not the product (electricity).

A significant literature has evolved on the so called “double dividend” of such revenue neutral shifts in the tax burden (see, for example, Oates, 1995; Goulder, 1995; Jorgenson and Wilcoxen, 1990; Bovenberg and DeMooij, 1994). The computable general equilibrium method used here to evaluate the changing tax structure is consistent with other studies of revenue recycling (Hazilla and Kopp, 1990; Parry, 1995; Goulder, 1995). The CGE approach allows the analyst to consider the effects of the changes in the tax structure on all sectors of the economy. Such a modeling approach helps to address the issue of “getting the prices right.” If the prices more accurately reflect the scarcity value of the resource (renewable or nonrenewable), then the economic activity will more likely be sustainable in the long run.

The next section will present the details of the model used to evaluate the impact of the revenue neutral tax shift. This will be followed by a discussion of the application of the model to the Czech Republic. The model is applied to the Czech economy as represented by the national accounts in 1992, the only year that relatively complete information is available. A concluding section will then be presented.

THE MODEL

This model is based on the traditional Arrow–Debreu general equilibrium formulation (Arrow and Hahn, 1971). The economy is characterized by two sets of commodities: a factor market and a goods market. The number of consumers is specified by a set \( H_i \) where \( i = \) capital owners, labor, and government. Each consumer has an initial factor endowment and a set of preferences, resulting in demand functions for each commodity. Market demands are the sum of each consumer’s demands. Commodity market demands depend on all prices, and are continuous, nonnegative, homogenous of degree zero (i.e., no money illusion), and satisfy Walras’ law (i.e., that at any set of prices, the total value of consumer expenditures equals consumer incomes).

On the production side, technology is described by either constant-returns-to-scale activities or nonincreasing-returns-to-scale production functions. Producers are assumed to maximize profits. The zero homogeneity of demand functions and the linear homogeneity of profits in prices (i.e., doubling all prices doubles money profits) imply that only relative prices are of any significance in such a model.

Consumers and producers are characterized by inputs (demand), represented by negative numbers, and outputs (endowments and supply), represented by positive numbers. Equilibrium is characterized by a set of prices and levels of production in each industry such that the market demand equals supply for all commodities (including disposal if any commodity is a free good). Since producers are assumed to maximize profits, this implies that in the constant-returns-to-scale case, no activity does any better than break even at the equilibrium prices.

The traditional formulation of a general equilibrium problem is to maximize some objective function, e.g., society’s welfare (utility), subject to technology, income, and supply constraints as follows (for the 2 good, 2 input case):

Maximize:

\[ U = U(X, Y) \]

Subject to:

Technology \( X = X(L_x, K_x) \)

\( Y = Y(L_y, K_y) \)

Income \( I = wL^* + rK^* = P_xX + P_yY \)