

Strategic Investment Decisions in Oil Exporting Economies: The Effect of Government Savings Rule

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Abstract

Oil exporting developing countries have the common problem of transforming their valuable but depletable natural resource into a permanent flow of income for the future. Any development plan for these economies first and foremost must deal with the issues related to the extraction of the exhaustible resource, optimal level of private and public savings, and investment allocation of the investment funds. The government plays a central role in these economies and its savings strategy is a major factor in determining economy-wide investment level. Notwithstanding its pivotal role, the government strives to achieve societal objectives within the more realistic environment of a mixed economy in which market also plays an important role. The aim of this article is to describe the optimal actions of the government within the environment of a market economy and specifically explore the impact of government savings rule that determine the strategic investment composition of the economy. The paper presents and discusses results from a simulation experiment from applying a dynamic computable general equilibrium model to a typical oil economy.

Keywords: Strategic investment, oil exporting countries, economic development, government, modeling, simulation.

Introduction

Oil exporting developing countries heavily depend on a single commodity export -- oil -- to finance their development. Oil revenues are the main source of government revenue and foreign exchange earnings in these economies, accounting for more than 25 percent of gross domestic product and 90 percent of exports in most of the major oil exporting countries.

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These economies face the common problem of how best to transform their valuable but depletable oil reserves into a permanent flow of income capable of meeting their long term development objectives. Their principal, stated, goals include rapid economic growth, diversification of production base, expansion of non-oil economy, relative price stability, and social justice and equitable income distribution. Any development plan for these economies first and foremost must deal with the issues related to the extraction of the exhaustible resource, optimal level of private and public savings, and investment allocation of the investment funds.

The government plays a central role in these economies. Notwithstanding its pivotal role, the government does not work within the environment of a command economy. It strives to achieve societal objectives within the more realistic environment of a mixed economy in which market also plays an important role. Thus, the government could be perceived as an optimizing agent that faces the institutional constraints posed by the workings of a market economy, where producers and households independently pursue profit or utility maximization. The aim of this article is to describe the optimal actions of the government and specifically present the impact of government savings on national saving and investment using simulation results from applying a dynamic computable general equilibrium (CGE) model to a typical oil economy. The next section briefly introduces the modeling framework used in simulations of government savings and investment decisions presented in this paper and explains how these models differ from other models of energy management and economic performance. Section 3 characterizes the role and behavior of government within the model of oil economies and presents simulation results of different government saving rules that determine the strategic investment composition of the economy. Finally conclusions are in the last section.

1. The modeling framework

An extensive literature concerned with optimal depletion of an exhaustible resource, with only a few exceptions, ignores the economy-wide effects of resource depletion and government saving and investment decisions. Private and public consumption and savings decisions as well as the investment allocation mechanism of an economy directly affect its level of resource extraction and the long run economic performance of the economy. In these instances a general equilibrium approach that fully captures the economy-wide effects of resource depletion is the appropriate tool (Devarajan 1988). The modeling framework employed for simulations presented in this paper is based on a dynamic computable general equilibrium (CGE) model. The model links the underlying natural resource base to the economic performance of the country. It consists of an intra-temporal price endogenous multisectoral model of a market economy, embedded in an inter-temporal optimal growth and development model.

The model, benchmarked for a typical oil exporting economy, is used to examine the issues related to optimal extraction of an exhaustible energy resource, and optimal savings in the economy. Our interest here is with simulating the general equilibrium effects of government savings rule on the economy.

An important category of CGE models focuses on the relationship between the energy sector and the rest of the economy. These models offer a rich economy-wide picture but seldom consider optimal depletion of energy resources as detailed as the partial equilibrium models of exhaustible resources. The early references to this class of models include Hudson and Jorgenson (1974), Manne (1977), and Blitzer and Eckaus (1986). More recent examples include Jorgenson and Wilcoxon (1992 and 1993), and the MIT Emissions Prediction and Policy Analysis (EPPA) model described in Babiker et al (2001). General surveys of CGE models for energy are offered in Bergman (1988, 1990), Bhattacharyya (1996), and Bergman (2005) is a more recent survey of CGE modeling of environmental and resource management.

Bergman (2005) contends that very few CGE models focusing on resource management and policy issues are typically models of developing countries and traces models of economies that depend on a depletable resource to Devarajan (1988) survey in which he identifies three categories of models: 1- "Energy Management Models" that generally focus on energy-economy interactions; 2- "Dutch Disease Models" that study the effects of an export boom on the rest of the economy; and 3- "Optimal Depletion Models" that take into account the exhaustibility of the resource and establish optimal extraction of the resource in an economy-wide context. Devarajan sketches out the formal structure of a class of models called *optimal depletion CGE models* and presents some results from the application of these models. This category of models is extremely useful in the case of resource-based economies where the changes in prices, investment decisions, and environmental policies, or changes in the extraction levels of resources, have profound impacts on the workings of the domestic economy.

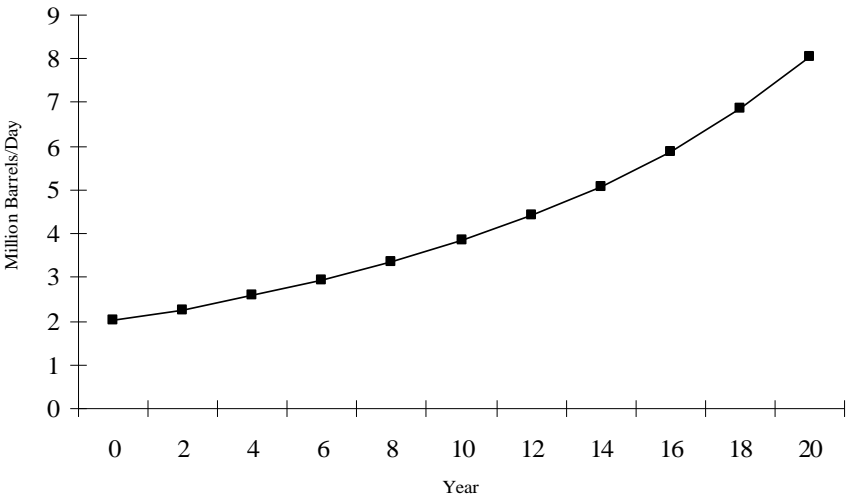
The model employed for the simulations presented in this paper belongs to the optimal depletion category of computable general equilibrium models. It combines elements from exhaustible resources and computable general equilibrium literatures to develop a dynamic computable general equilibrium model to link the natural resource base to the rest of the economy. It is an optimization model that determines the optimal development path of the economy, hence, an inter-temporal depletion problem subject to the workings of a multi-sector market economy. An overall description of the major components of the model and its mathematical structure and system of equations is fully described in Ghadimi (2006, 2012).

2. Government savings and investment simulation

The core of government's decisions in oil exporting economies is to determine the optimal rate of depletion of resource, optimal level of investment and investment allocation. The government as the owner of both physical and natural capitals in the oil sector receives returns to these factors. Oil revenues are the major source of government revenues and government investment decisions determine oil depletion level and affect activities in the rest of the economy. This section discusses how the government addresses these issues.

Despite the fundamental role of the government, the oil economies are characterized as a mixed economy rather than a command economy. The government pursues societal objectives acting as an optimizing agent within the environment of a market mechanism where autonomous producers and households independently pursue profit or utility maximization. Facing the institutional constraints of a market economy, the government is assumed to be a benevolent selfless entity that is motivated solely by social welfare. The optimizing producers and households through the price mechanism establish a one-period equilibrium, or more precisely, a sequence of one period equilibria. The government, on the other hand, with information on current and future prices determines the long-run dynamic behavior of the economy by maximizing an inter-temporal social welfare function subject to the total availability of the exhaustible resource, adjustment costs in the accumulation of capital, and constraints implied by the set of competitive within-period equilibria. The government with perfect foresight determines the private savings rate and the rate of investment in the oil sector to maximize social welfare. Given domestic prices, world prices of both imports and exports, the government, as the owner of the oil resource, at the intra-temporal level manages the oil sector as a short-run profit maximizing firm. At the inter-temporal level, however, the government determines how much to invest in the oil sector, hence, the rate of resource extraction. Figure 1 shows the optimal time path of oil extraction. This path represents the optimal extraction path subject to the constraints of a market economy.

Figure 1. Oil Extraction Profile



A distinguishing feature of the general equilibrium model in this study is that the oil sector is not isolated from the rest of the economy. The oil sector, like any other sector in the economy, faces prices for factors and output both in domestic and foreign markets and is subject to limitations of investable funds and absorptive capacity constraints. The model characterizes the depletion path subject to constraints and structure of a market economy.

The government's behavior is constrained by yearly balanced budgets. That is, the government revenues are either saved or consumed; hence, there is no possibility of government budget deficit or surplus. The government's total expenditures include purchases of goods and services from producing sectors and the net savings of the government is the residual of its revenues less its expenditures. The government expenditures are viewed as administrative input required for running the overall economy. However this does not mean that the government services have no effect on social welfare. On the contrary, the government by producing services such as health and education improves and increases factor productivity, hence, significantly affects the production. With the assumption of balanced budget, it can be said that the government consumes its revenues and government saving is found as a residual.

An important question in oil economies is that whether oil revenues are being reinvested in productive uses or not. Therefore, the consumption-savings decision of government is a strategic and important determinant of the economy-wide investment level. Total savings in the economy, assumed to be equal to total investments, depends upon the level of savings in private, public and foreign sectors. The government influences private savings decision through its tax policies and other instruments.

Foreign savings are often assumed to be a fixed share of GDP. Public saving, the focus of this article, is found by subtracting government consumption from government revenues. Once the savings level is determined the next question is how investment funds are allocated among sectors. The government concerned with the long run social welfare decides the investment share of the oil sector. The remainder of the investment fund is distributed among non-oil sectors. The simulation experiment, reported here, explores what happens to the total savings or investment level in the economy if government adopts different consumption-savings strategies.

The following five alternatives, which are among plausible government policies in oil economies, are considered:

Alternative I. Government consumption is a fixed share of its revenues and government saving is found as a residual (base policy);

Alternative II. Government savings is a fixed share of GDP;

Alternative III. Government savings is a fixed share of oil revenues;

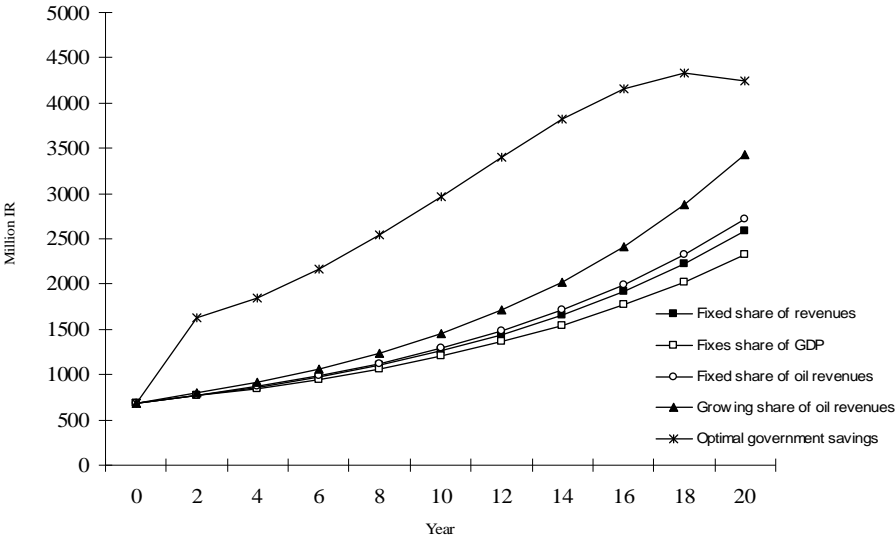
Alternative IV. Government savings is a growing proportion of the oil revenues; and finally

Alternative V. Government sets its savings optimally.

Alternatives I through IV use a behavioral rule for the government's consumption-savings decision while under alternative V government savings is determined optimally. The time paths of government savings under the five alternatives are given in Figure 2. The simulation results show that when the government determines its own saving (Alternative V), the highest level of government saving is reached. Alternative IV, assuming a progression of one percent per period, results in the next highest level of saving. Note that among behavioral rules Alternatives III and IV that link the government savings to oil revenues result in higher savings than other alternatives.

The variation in welfare values under any alternative is less than half percent. Of course the welfare values are in terms of discounted utility measures which are not meaningful cardinal measures. The utility measures derived from these runs, however, can be used to rank various alternatives but do not provide any information to what degree one alternative is better or worse than others. The Alternative V (optimal government savings) generates the highest level of welfare and alternative II where government's savings is a fixed share of GDP results in the lowest level of welfare among all alternatives. The welfare levels under alternatives I through IV are in a very close range. Among these behavioral rules the case where the government sets its savings as a fixed share of oil revenues (Alternative III) produces the highest level of welfare.

Figure 2. Government Savings Under Alternative Government Saving Rules



3. Conclusions

Oil exporting developing countries heavily depend on a single commodity export -- oil -- to finance their development. The government plays a crucial role in these economies and the consumption-savings decision of government is a strategic and important determinant of the economy-wide investment level. This paper highlighted the important role of government in addressing fundamental resource depletion and strategic investment in oil exporting countries and how these issues could be investigated within a general equilibrium modeling framework. It presented simulation results for five alternate government savings policies and compared welfare valuation under these alternatives. The results of simulation experiments provide important policy guidance by showing the relative valuation of government savings rule and its implication for economic performance. The government should formulate policies to increase the private savings rate but more importantly should raise its own savings rate to increase oil revenue reinvestment into reproducible capital at an acceptable level and to increase total economy-wide savings.

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