Review of Economic Dynamics 15 (2012) 72–93

Contents lists available at SciVerse ScienceDirect

Review of Economic Dynamics

www.elsevier.com/locate/red

International trade, exhaustible-resource abundance and economic growth ☆

Beatriz Gaitan [a], Terry L. Roe [b,*]

[a] Free University of Berlin, Garystrasse 21, 14195 Berlin, Germany
[b] University of Minnesota, 337h Ruttan Hall, 1994 Buford Av., St. Paul, MN 55108, USA

ARTICLE INFO

Article history:
Received 25 April 2006
Revised 12 July 2011
Available online 30 August 2011

JEL classification:
F11
F43
O13
O41
Q32

Keywords:
Growth
Exhaustible resources
Depletable resources
International trade
History dependent equilibria

ABSTRACT

Countries with oil and other natural resources have grown less rapidly than those countries without. This phenomenon is known as the "natural resource curse". We develop an infinite-horizon, two-country model of trade in which countries are identical, except that one country is endowed with deposits of an exhaustible resource and the other is not. Within the context of the model, we show that this phenomenon can be explained in part by an inelastic demand for the exhaustible resource that increases growth in trade revenues and induces the resource-abundant country to invest relatively less than the country lacking in exhaustible resources. These results are derived analytically and illustrated by an empirical analysis based on plausible parameters obtained from data.

1. Introduction

The economics of exhaustible resources received increased attention following Sachs and Warner's (1995, 2001) suggestion that countries with ample natural resources tend to grow less rapidly than natural resource-scarce countries. This apparent paradox led to a number of papers with conflicting findings. Sala-i-Martin (1997) and Doppelhofer et al. (2000) find the export share of primary products to be negatively correlated with economic growth. They also find, however, that the fraction of GDP in mining and GDP growth are positively correlated. Papyrakis and Gerlagh (2007) find economic growth among U.S. states to be negatively affected by their natural resource abundance. Empirical studies by Lederman and Maloney (2003), Stijns (2005) and Brunnschweiler (2008) either come to opposite conclusions or find that natural resource abundance does not affect growth. Brunnschweiler and Bulte (2008) conclude from their statistical analysis that the apparent paradox may be a red herring.[1]

Given this puzzling empirical evidence, the challenge is whether a theoretical model that posits a specific yet plausible economic structure can help us understand whether and how resource abundance affects economic growth, thus alleviating to some degree the red herring suggestion. Instead of focusing on the broader concept of natural resource abundance,

☆ We thank Timo Trimborn, Cees Withagen, Harris Dellas and anonymous referees for their helpful comments.
* Corresponding author.
E-mail addresses: beatriz.gaitan@fu-berlin.de (B. Gaitan), troe@apec.umn.edu (T.L. Roe).
[1] They find that resource abundance, constitutions and institutions determine resource dependence.

1094-2025/$ – see front matter
doi:10.1016/j.red.2011.08.002

we focus on analyzing the effects of *exhaustible* resource abundance on economic growth.[2] Since exhaustible resources are exported to countries deficient in these resources (referred to henceforth as resource-poor countries), we argue that resource-poor countries likely play a role in the growth performance of the endowed countries (referred to henceforth as resource-abundant countries). Further, the abundance of these resources must also influence the economic performance of resource-poor countries.[3] The main contribution of this paper is to show that country interdependence through trade can give rise to the resource curse under plausible conditions. This interrelationship is the key focus of this paper.

We consider a continuous-time, infinite-horizon two-country model of trade and analyze the conditions which lead a resource-abundant country to grow less rapidly than a resource-poor country—we call this the resource curse (henceforth RC). One country is endowed with deposits of an exhaustible resource (such as petroleum). The countries produce an identical final good with the same technology using a flow of the exhaustible resource and human and physical capital. At each instant of time, the resource-abundant country extracts and employs some of the exhaustible resource to produce the final good and exports the remainder to the resource-poor country. International borrowing is not allowed and trade between the two countries is balanced at each instant of time. Each country has a representative household that maximizes discounted instant utility from consuming the final good subject to a budget constraint. Consumers across countries have identical preferences. Thus, countries are identical and differ only with regard to their initial endowments of the exhaustible resource and possibly capital stocks.

Since, after controlling for corruption, Sachs and Warner (1995) find that resource abundance negatively affects economic growth, we first consider a setting in which capital stocks across countries are equal as a way to abstract from corruption and institutional effects. The model suggests that even under these circumstances, the RC can occur. We analytically characterize the conditions causing the rate of growth of the resource-abundant country's gross domestic product (GDP) to be transitionally smaller than that of the other country. This "growth gap" solely depends on technological and preference parameters. Specifically, the size of the elasticity of intertemporal substitution and the exhaustible resource demand's own price elasticity play a crucial role in determining whether such a gap occurs. In particular, given an elasticity of intertemporal substitution equal to or less than unity, the more own price inelastic is the derived demand for the exhaustible resource, the larger the growth gap, that is, the stronger the RC.

This result may seem counterintuitive. In the process of growth, an inelastic demand for a flow resource mined from an exhaustible resource tends to generate a growing income stream to the resource-abundant country which, one may incorrectly conclude favors the country's relative income growth. An intuitive explanation is the following. An inelastic own price elasticity of demand for the resource is associated with a factor of production that accounts for a relatively small share in the value of total output, as is the case with petroleum. In the process of economic growth, the stock of the resource is depleted, the price of the flow resource increases in transition, and the inelastic own price elasticity causes the total revenue remunerated to the resource-abundant country to increase. Households in the resource-poor country obtain a higher discounted value of utility by saving to increase their human and physical capital stocks (and income) to remunerate the increasing cost of the flow resource, thus causing trade to be balanced. The growing income stream from exports of the exhaustible resource induces households in the resource-abundant country to invest relatively less than those in the other country, and thus, at the expense of future income growth. This effect is reinforced the stronger incentives are to smooth consumption over time. Our empirical exercise helps to confirm our analytical results and shows that our model can explain about one-fourth of the average GDP growth gap between resource-poor and resource-abundant countries observed in the data.

Several hypotheses have been put forward to explain why resource-abundant economies grow less rapidly than resource-poor countries. Tornell and Lane (1995) argue that it may be explained by the struggle of groups attempting to extract natural resource rents. Sachs and Warner (1995) argue in favor of Dutch Disease effects (see Corden, 1984 for a survey on this literature). Rodríguez and Sachs (1999, p. 278) argue that "resource-rich countries may grow more slowly because they are likely to be living beyond their means …". We argue that the interaction of resource-abundant and resource-poor countries through international trade plays a role in the growth performance of resource-abundant countries.

The structure of our model draws upon early well-known literature on exhaustible resources.[4] While many studies focus on single economies (e.g. Rodríguez and Sachs, 1999, and Kemp and Long, 1982), only few address international trade issues associated with exhaustible resources. Among these are Asheim (1986) and Hartwick (1995), who study a two-country world and investigate whether constant consumption paths are achievable when rents accruing to exhaustible resources are invested in new capital. Kemp and Long (1980) analyze monopsonistic behavior in a two-country model with exhaustible resources, absent of physical capital. Brander and Taylor (1998) and Jinji (2007) investigate the effect of international trade on welfare using Ricardian models of trade with renewable resources.

[2] Sachs and Warner's (1995) initial paper measures natural resource abundance as the ratio of agricultural, mining and fuel exports to GDP. Their follow-up paper (Sachs and Warner, 2001) shows that excluding agricultural commodities from their measure of resource abundance does not alter their earlier findings.

[3] For example, there is a strand in the economic literature that associates the productivity slowdown in the U.S., which started in the 1970s, to oil price shocks (see, for example Rotemberg and Woodford, 1996).

[4] Hotelling (1931) characterizes the behavior of the prices of exhaustible resources. Dasgupta and Heal (1974), Hartwick (1977), Solow (1974) and Stiglitz (1974) provide the foundation for modeling exhaustible resources employed in final good production where agents optimize over an infinite horizon. They address issues of sustainability and inter-generational equity, which are also embedded in our model. Chiarella (1980a) and Cigno (1981) introduce endogenous technological progress and endogenous population growth, respectively, to the model developed by Stiglitz, and focus on stability properties. Pezzey and Withagen (1998) analyze the dynamic behavior of consumption in the model developed by Dasgupta and Heal.