

Is Resource Boom Harmful for Growth?

The case of oil windfalls in the MENA region

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This paper elaborates poor growth record of oil economies and particularly the adverse effect of oil booms on their growth performance. We tailor the Lucas growth model to suit characteristics of oil economies where the liquidation of natural resource finances capital deepening and boosts consumption, but leaves the quality of labor force almost intact.

Capital surplus may explain slowness of growth in oil economies. The cause of failure, however, is the high ratio of physical to human capital rather than over-accumulation of capital per se. Oil booms are, therefore, harmful for growth if they deteriorate imbalances between physical and human capital in favor of the former.

Oil-abundant economies in the Middle East and North Africa suffer from less developed human capital relative to their bulk of physical capital. They have also lost cross-country growth contest since the first oil shock. We link these two observations herein by introducing the former as cause of the latter.

Under plausible assumptions, an oil boom displaces the economy away from the steady state. The higher the magnitude of booms or shorter perceived their durations, the extent of displacement is larger. The paper relies on our findings that the high ratio of physical to human capital associates with low rate of economic growth when consumption smoothing is not strong enough. It moreover offers an explanation for high but unsustainable level of consumption in post-boom era.

Keywords: oil booms, growth failure, MENA region, capital imbalances

JEL classification: O41, O57, Q33

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1. Introduction

Oil economies are usually treated as outliers in cross-country growth comparisons and excluded from growth regressions; Mankiw et al.(1992). The reason is that a substantial part of their recorded GDP, being the result of extraction of existing resources, does not represent value added. This is why it is argued that “standard growth models are not expected to account for measured GDP in these countries”, *ibid.* Temple(1995), along this line, takes growth record of oil economies as observations that are highly *non-representative* of the *standard* growth theories.¹

Most countries that are relatively rich in natural resource have performed poorly in cross-country growth contest in recent decades. The negative association of natural resource abundance and economic growth is well documented e.g. by Sachs and Warner(1995, 97), and Auty(1999a,b). Oil economies, in particular, almost lost the growth contest in recent decades. For OPEC countries as a whole, Gylfason(2001) finds that “GNP per capital *decreased* by 1.3 percent per year on average during 1965-98 compared with 2.2 percent average per capital growth in all lower- and middle-income countries.”

The extent of loss for some oil abundant countries in the Middle East and North Africa, based on Summers and Heston(1991) calculations, in per capita terms, during 80s are as follows: Iraq (68 %), Kuwait (62 %), Nigeria (42 %), Saudi Arabia (71 %), and UAE (64 %). These figures require justification, as by simple intuition access to extra resources provides better opportunity for investment and stimulates growth. In addition, two other puzzling facts in the growth experience of natural resource-based economies call for explanation: slow down of growth in post-boom era relative to its pre-boom level and poor growth performance of mineral (in particular oil) economies within the whole category of resource-based economies. The purpose of this paper is not to propose a growth theory for oil economies, but to rationalize some aspects of the growth record in these economies that are not well captured in the literature. It is obvious that a great component of GDP in these economies represents the oil cycles rather than state of the underlying economies and their choice of policy as is usual in growth empirics. What is less obvious is the way in which non-oil part of GDP reacts to the oil cycles.

According to Hausmann and Rigobon (2002), “the empirical regularity” related to the poor performance of natural resource economies “seems to be in the data but understanding its causes has been a much harder task.” This supposed empirical regularity derives originally from the work of Sachs and Warner (1995) who, based on standard cross-section growth regressions, show that the curse of natural resource-ownership is substantial, manifested in such countries growing slower, on average, by about 1 percent per year during the period 1970–89. The more dependent performed remarkably poorly. The less oil-dependent did better.

Apart from the institutional impact of natural resources, discussed e.g. by Baland and Francois(2000), Torvik(2002) and Tornell and Lane(1996, 99), and the well know Dutch Disease effects, two other channels of causation from natural resource abundance to lower growth were identified in the literature. The First idea, proposed by Rodriguez and Sachs(1999), is *Over-accumulation of capital*. Resource economies, according to this theory, perform poorly in growth contest because they live beyond their means. An economy in the vicinity of its steady state, by

¹ Even in the cross-country income accounting, Hall and Jones(1999) exclude the value added of mining sector to neutralize the level effect of natural resource endowment.

experiencing a high enough resource boom, overshoots its steady state. It, therefore, exercises a level of consumption and capital which is unaffordable in the absence of resource endowment. In the post-boom era, the economy suffers from a gradual decline in its level of consumption and capital, presenting a negative rate of growth.

Gylfason(2001) finds that school enrolment at all levels tends to be inversely related to natural resource abundance. He believes that resource economies, because of confidence on their natural resource wealth, neglect to develop their human resources. They spend less on education leading to a lower rate of growth. Natural capital, according to this theory, crowds out the human capital.

Our theory accommodates these two explanations in a unified framework. It suggests that oil economies grow more slowly because they are likely to suffer from lack of development of their human capital relative to their stock of plant and equipment. According to this hypothesis, oil boom is harmful for growth so long as it lowers the ratio of human to physical capital. This explanation relies on our findings where high ratio of physical to human capital, in the Lucas-type growth models, associates with low rate of economic growth; Nili(2000). It further, based on Nili(2002)'s results, explains high but unsustainable level of consumption in post-boom era.

Using Benhabib-Spigel data set on physical capital and that of Barro-Lee on human capital, we show that the distribution of physical capital among oil economies is left skewed in comparison with other countries. The economies under question on the other hand, are densely located among countries that have failed to enhance their level of human capital. The period of comparison includes the first and second oil shocks that were described as “the largest transfer of wealth ever to occur without war” (Karl 1997). This reveals some regularity of oil-abundant economies that is not well covered in the literature. Linking this stylized fact with the poor growth performance of these economies lies at the very heart of this paper.

The paper proceeds as follows. Section 2 reviews empirical findings on the oil curse. In section 3, we explain transitional dynamics of the Lucas growth model as the backbone of the theory offered in section 4 for the growth failure of oil economies based on the augmented Lucas model. It also includes the transitory effect of oil boom on output growth and consumption. Section 5, then, offers some concluding remarks.

2. Empirical Evidence

2.1 Oil Abundant Economies

The Middle East and North Africa (MENA) region covers the enormous area extending from the Atlantic coast of Africa to the borders of Pakistan and Afghanistan in Central Asia and from the Mediterranean littoral to the southern boundaries of the Sahara desert. The region comprises 22 countries of which 10 countries are the main oil exporters. These are Bahrain, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen. While Algeria, Egypt, and Syria also export oil, this sector is less important at this time; see table 1.

2.2 The Extent of Failure

To compare performance of mineral economies and in particular oil exporters with the whole group of natural resource economies, we consult Auty(1999a) who divide the economies according to their level of GDP into large and small ones. The results are reported in table 2. As one considers from this table, oil exporters, with the highest

per capita income among developing countries, have substantially slowed down in growth contest after the first oil shock of 1973.

Table 1. Oil dependent countries across the world
(annual average of export data, 1992– 97)

50 - 100 percent of export earnings	20 - 49 percent of export earnings	10 - 19 percent of export earnings
Middle East		
Bahrain	Syria	Egypt
Iran, Islamic Rep.	UAE	
Kuwait		
Libya		
Oman		
Qatar		
Saudi Arabia		
Yemen, Rep.		
Africa		
Angola	Cameron	Algeria
Congo, Rep.	Equatorial Guinea	
Gabon		
Nigeria		
Latin America		
Venezuela	Ecuador	Colombia
	Trinidad and Tobago	Mexico
Europe, Asia, and the Pacific		
	Azerbaijan	Indonesia
	Brunei Darussalam	Kazakhstan
	Norway	Vietnam
	Papua New Guinea	
	Russia	

Source: Cashin et. al (2000)

Growth performance of oil economies in the 1970s and 80s, based on availability of data, are reported in table 3. According to their performance, countries can be classified into three categories: The *failures* including Algeria, Bahrain, Iraq, Kuwait, Mexico, Nigeria, Saudi Arabia, Trinidad Tobago and United Arab Emirates. The second group constitutes handful *successes*, namely Indonesia and Norway that exhibit an acceptable rate of growth in their per capita GDP. The third group finally includes those countries like Iran, Oman and Venezuela that achieved a positive but very moderate rate of growth since mid 1970s. Given this heterogeneity, explaining performance of the first group is the main question of this study. One may also observe from table 4 that per capita growth rate of oil economies, in comparison with other countries has declined since 1970s.

Table 2. Resource endowment and growth record (developing countries)

Resource Endowment		Per capita GDP 1970 (\$)	Per capita GDP growth (percent per annum)				
			1970 -73	1974 -79	1980 -85	1986 -93	1970 -93
Resource poor	Large	196	2.8	4.9	3.1	3.5	3.7
	Small	343	3.1	4.1	0.7	1.7	2.1
Resource rich	Large	574	0.1	-0.2	0.1	0.0	0.0
	Non-mineral	250	2.0	1.7	-0.7	0.2	0.5
	Hard-mineral	304	2.2	0.2	-1.8	-0.8	-0.4
	Oil exporter	831	6.5	1.4	-1.7	-0.6	-1.0
All countries		362	2.7	2.0	-0.5	0.6	0.8

Source: Auty (1999a)

Table 3. Failures and successes among oil economies

Country	1965 – 80	1980 – 93
Nigeria	4.2	-0.1
Saudi Arabia	0.6	-3.6
Kuwait	0.4	-4.3
United Arab Emirate	0.6	-4.4
Mexico	3.6	-0.5
Algeria	4.2	-0.8
Venezuela	2.3	-0.7
Indonesia	5.2	4.2
Malaysia	4.7	3.5
Norway	3.6	2.7

Source: Baland and Francois(2000)

Table 4. Real per capital GDP and its rate of growth:

Oil economies vs. non-oil economies

	1950s	1960s	1970s	1980s	1990s
All Countries	2.1	3.0	2.5	1.2	1.4
Oil Economies	2.6	2.8	2.0	0.4	1.1

Source: Heston et al. (2002)

2.3 Capital Imbalances

In this section we focus on the extent of imbalances of human with respect to physical capital in oil-rich countries. To have a comparable measure of cross-country distribution of physical and human capital, we consult Benhabib and spigel(1994) and Barro and Lee(2000) respectively. In the latter study, the mean years of schooling in total population over fifteen are reported which is taken here as a proxy for human capital.

We take the ratio of mean years of schooling to the (logarithm of) per capita stock of physical capital as an indicator of imbalances between physical and human capital.² The scatter diagram of 75 countries (whose logarithm of real per capita physical capital in 1985 exceeds 7.5 US dollar and data for both measures of capital were available) is depicted in figure 1. The upward sloping continuous line displays the moving average which can be interpreted as the expected level of human capital for a given level of physical capital.

Imbalances in Stock of Capital Cross Country Comparison, 1985

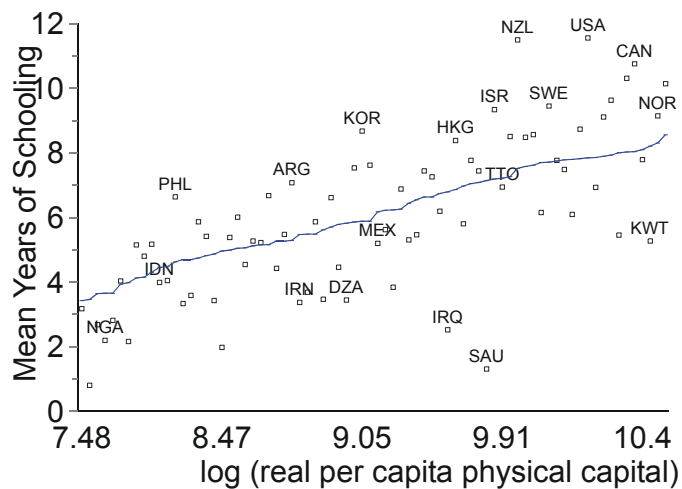


Figure 1 The extent of capital imbalances across countries

² To measure human capital across countries, Hall and Jones(1999) assume that human capital in country i , H_i takes the form $\exp[\Phi(E_i)]L_i$ where L_i and E_i are the number of workers and their average years of schooling in country i respectively, and Φ is a piecewise linear increasing function. According to this assumption, logarithm of physical capital is a more consistent measure to be compared with mean years of schooling.

As one considers from this graph, all of the oil economies (except Norway) are located below the average line. Furthermore most of those oil abundant economies located in the MENA region, i.e. Nigeria (NGA), Iran (IRN), Algeria (DZA), Iraq (IRQ), Saudi Arabia (SAU) and Kuwait (KWT), lie at the very bottom of the diagram. This reveals one of the regularities of the oil-abundant economies that is not well covered in the literature. Linking this stylized fact with the poor growth performance of these economies lies at the very heart of this paper.

Owing to lack of balance between physical and human capital, the theory we are proposing is proved to be able to justify the adverse effect of oil boom on economic growth and also temporary boost in consumption and physical capital in the oil economies. The theory should also be consistent with the following witnessed facts. Asymmetric effect of imbalanced capital on dynamics of the economy; high levels of capital-output ratio in the economies under question; and finally positive income effect of oil endowment in general and oil boom in particular. We look for a theory that meets the above criteria in the realm of endogenous growth framework.

3. The Augmented Lucas Model

3.1 Basic Elements

Consider a two-sector endogenous growth model, slightly different from that of Lucas(1988), in which two distinct sectors coexist. One sector produces a homogenous good according to the Cobb-Douglas technology

$$Y = AK^\alpha (uH)^{1-\alpha}$$

where Y is the level of output, K and H are stock of physical and human capital respectively, $u \in [0,1]$ stands for the work effort, and $\alpha \in (0,1)$ is the elasticity of output with respect to the physical capital.

Another sector, using the amount of time out of working and the pre-accumulated stock of human capital H , produces human capital according to

$$dH / dt = B(1-u)H$$

where $B > 0$ is the productivity of learning. This indicates that development of human capital only depends on the fraction of time spent on education and the stock of human capital. In particular it does not require the units of final output and hence physical capital. Hence labor in efficiency units, uH , is reproduced in an unbounded fashion through education.

The composite good is either consumed or invested to accumulate physical capital, that is

$$dK / dt = (Y + R) - C$$

where C and R respectively denote consumption and the flow of a nonrenewable natural resource (e.g. oil) and $Y+R$ makes GDP . For simplicity we abstract from depreciation of human and physical capitals.

Agents live forever and set their consumptions and work efforts to maximize discounted sum of their common instant utilities

$$W = \int_0^{\infty} \frac{C(t)^{1-\sigma} - 1}{1-\sigma} e^{-\rho t} dt$$

where $\rho > 0$ is the discount rate, and $1/\sigma > 0$ is the intertemporal elasticity of consumption.

An optimal solution for this economy is a path, $\{C(t), K(t), H(t), u(t)\}$ which maximizes W subject to the law of motion of K and H , given values of $K(0)$ and $H(0)$ and transversality conditions corresponding to K and H .

Steady state is a situation where consumption, non-oil output and both types of capital grow at a common rate $g = B(1 - u^*)$ and the work effort remains constant. The steady state is completely specified by known parameters as

$$(z^*, \chi^*, u^*) = (B/\alpha, B/\alpha - g, 1 - g/B)$$

where $z = Y/K$, $\chi = C/K$, g is the balanced rate of growth of level variables, and stars refer to the steady state values of variables. Since the natural resource is exhaustible, it has no long run effect and the steady state is the same as that of Lucas.

3.2 Transitional Dynamics of the Lucas Model

3.2.1 Dynamics of Consumption, Physical Capital and Output Growth

In this section we rely on Nili(2002)'s findings on transitional dynamics of the model outlined in section 3.1 in no-resource case, that is when the flow of natural resources is ceased.

Proposition 1 (Nili ,2002) In the Augmented Lucas model, described in section 3.1, if $R=0$:

1. For $z_0 < \rho/\alpha$, consumption and physical capital display U-shaped profiles on their transition paths. They fall for a finite period and then rise. Stronger the consumption smoothing effect, i.e. larger σ , shallower is the U-path.
2. Contrary to the Ramsey model, here there are two different thresholds determining whether consumption and physical capital fall during the adjustment process.
3. The minimum of consumption always occurs before that of physical capital.

Proposition 2 (Nili, 2000) In the Augmented Lucas model, described in section 3.1, if $R=0$ dynamics of the rate of growth of non-oil output along the transition path, depends on the magnitude of intertemporal elasticity of consumption. When $\alpha < \sigma \leq \alpha/(1-\alpha)$, rate of output growth, $g_y(z)$, is increasing in z , while for $\sigma > \alpha/(1-\alpha)$, it is U-shaped. The larger σ , the minimum of $g_y(z)$ occurs at the higher level of z .

3.3 Exogenous and paradoxical Regimes

[In this section we classify the dynamics of the economy according to the extent of patience represented by intertemporal elasticity of consumption. This helps us to elaborate the impacts of booms on the consumption and other macro variables.]

4. Capital Imbalances as the Cause of Failure

Our discussions in the previous section shows that a Lucas economy does not react to the relative shortage of human to physical capital in a symmetric way. An economy that is relatively affluent in terms of plant and equipment, but whose labor force are not well educated is likely to experience a decline in the level of consumption during its adjustment period to the steady state. This, with a lag, follows with a situation where investment in physical capital does not cover the depreciation of old capital leading to falling of stock of physical capital too. The asymmetric macroeconomic effect may also include the dynamics of output growth if the consumption-smoothing is not strong enough.

The idea outlined here can be applied to the case of oil abundant economies where oil windfall induces a bias in their composition of wealth in favor of physical capital. In this section we explain how this findings can shed light on some of the puzzling facts of the oil economies and in particular their growth collapse.

We also apply the idea of growth regimes, presented in section 3.2.2, to the effect of windfall spending on consumption in natural resource economies. We consider the transitional dynamics of a Lucas economy that by a sudden increase in the level of physical capital is deviated from the steady state. We show that in the paradoxical case, where an injection of the physical capital into the economy causes less education and attainment of lower steady state, the voracity effect may take place. Beside its theoretical contribution, this may explain how deterioration of the relative scarcity of human capital due to windfall spending is consistent with a lower steady state.

4.1 The Transitory Effect of Booms

We suppose that the economy stays at the steady state when it receives a windfall in terms of an oil boom. The windfall is available in units of final output which according to Eq. () is either consumed or invested in physical capital.

Endowment of natural resources provides a new source of income for the producing economies which is expected to have both level and growth effects. To be more specific, we consider only the effect of resource boom that is treated as an unexpected gift of nature to the economy, in GDP units, lasting only for a finite period.

As long as boom has not occurred, dynamics of the economy is determined as what has been explained in section 3. When an unexpected boom occurs people realize that they have been offered a new and temporary source of wealth.

Both the magnitude and duration of boom are assumed certain and common knowledge. In a perfect foresight environment, two sets of time profile for the variables of the model should be identified: one in the absence of boom and another when boom is present. We call these two non-boom and booming situations respectively.

To analyze transitory effect of resource boom, we apply the similar logic as temporary reduction of government expenditure in the Ramsey model. A temporary injection of resources into the economy accordingly brings about a temporary boost in consumption in a static fashion. Its dynamic effect however acts through intertemporal consumption decision of agents who perceive boom as temporary. To offset the arbitrage between high level of current consumption with low level of future consumption, the interest rate should fall. This governs the dynamics of the economy in the post-boom era so long as the after-effect of boom lasts.

Suppose the economy stays at the steady state when an unexpected boom, with known magnitude and duration, occurs. People then realize that they were offered a new source of wealth temporarily. A temporary injection of resources into the economy brings about a temporary boost in consumption in a static fashion. Its dynamic effect however acts through the intertemporal consumption decision. To offset the arbitrage between high level of current consumption with low level of future consumption, the interest rate should fall. This governs the dynamics of the economy in the post-boom era so long as the after effects of boom last.

By bringing a new source of income, boom introduces disequilibrium into the product market. It partially boosts consumption and investment in physical capital. The shorter it last, its dynamic effect will be stronger. In particular a permanent boom has no dynamic effect and only boosts consumption one for one. The shorter people perceive the boom, they treat it with increasing of their saving and hence the share of investment will be higher.

Further physical capital deepening reduces interest rate. In a Cobb-Douglas world this is equivalent with falling of z . Along the divergent path of the booming economy z , χ and u fall until their path crosses the stable saddle path of the non-booming economy. This is the main mechanism through which the transitory effect of boom operates.

The transitory effect of boom is explained through three stages. Firstly, boom has no immediate effect on z and only boosts consumption instantaneously. As a result, the economy jumps from (z^*, χ^*, u^*) to $(z^*, \chi^* + \Delta\chi, u^* + \Delta u)$ where $\Delta\chi$ and Δu increase both with size and duration of boom. If boom lasted forever, the economy would experience a discrete jump from non-boom saddle path to the booming one. At this state the representative consumer enjoys a high level of consumption. She, however, realizes that this does not last for a long time. To make her satisfied with high current level of consumption in the face of low level when boom terminates, interest rate should go down. The stronger is the willingness for consumption smoothing this tendency will be more effective. By gradual decline of interest rate, the economy evolves in the second stage along the divergent path by lowering her consumption and work effort. In this stage, one can say that the economy *lives beyond its means* because it exercises levels of consumption that in the absence of oil rent was not affordable. Finally, in the third stage the economy moves along the non-booming saddle path toward the steady state.

4.2 Windfall Spending and the Voracity Effect

The analysis just carried out, shows that receiving windfall, in terms of a sudden increase in the stock of physical capital, introduces disequilibrium into the product market and affects the ratio of human to physical capital in favor of the latter. This shock, in a Lucas economy, is equivalent with being displaced to a situation where

output-capital ratio, z is short of its steady state. The higher the magnitude of the boom and/or the shorter perceived its duration, the extent of displacement is larger.

Section 3.3 on the other hand reveals that the reaction of the economy to a sudden increase in physical capital can be classified into three different regimes. Beside the convergence effect that governs the economy toward the steady state, there are two other forces determining the transitory effect of a positive physical capital stock. These two are consumption-smoothing effect and the effect of imbalances between physical and human capital on the wage rate and work effort.

Growth regimes can be attributed into the extent of boosts in consumption resulted from a sudden increase in physical capital. Caballé and Santos(1993, theorem 3) show that the elasticity of consumption with respect to physical capital at the steady state is less than, greater than or equal to one in the normal, paradoxical and exogenous case respectively.

In the normal case, the booming economy reacts to a sudden increase in the physical capital by faster accumulation of human capital. This leads the economy to a higher steady state. Consumption increases but less proportional than the size of physical capital increment in this regime.

In the exogenous case, consumption-capital ratio is constant implying that the boost in consumption is proportional with the size of windfall.

Finally in the paradoxical regime, people react to a physical capital stock increase by more consumption and less saving. The wage rate in the booming economy is high enough to discourage people from allocating more time to schooling. Consumption as a result, grows more proportional than the size of windfall itself.

4.5 Why Oil Economies Spend Too Much on Physical Capital

[Political economy of human capital accumulation in oil economies to be discussed here.]

5. Conclusion

This paper provides an apparatus for analyzing the effect of a resource boom on economic growth. We link the asymmetric effect of capital imbalances, in a multi-sector endogenous growth model, with growth failure of natural resource-abundant economies.

Our empirical investigation reveals that oil-abundant economies, and in particular those in the MENA region, cluster a group of countries that suffer heavily from low ratio of human to physical capital. They performed poorly at the same time in the growth contest. We propose a theory herein to link this two observations where the former is introduced as the cause of the latter.

Beside growth effect of the boom, which hinges on magnitude of the intertemporal elasticity of substitution, our theory rationalizes the high but unsustainable consumption boost that oil-abundant economies have experienced in the post-boom era.

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