Natural Resource Booms in the Modern Era: Is the curse still alive?

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by Andrew Warner

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Natural Resource Booms in the Modern Era: Is the curse still alive?*

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Abstract

The global boom in hydrocarbon, metal and mineral prices since the year 2000 created huge economic rents - rents which, once invested, were widely expected to promote productivity growth in other parts of the booming economies, creating a lasting legacy of the boom years. This paper asks whether this has happened. To properly address this question the empirical strategy must look behind the veil of the booming sector because that, by definition, will boom in a boom. So the paper considers new data on GDP per person outside of the resource sector. Despite having vast sums to invest, GDP growth per-capita outside of the booming sectors appears on average to have been no faster during the boom years than before. The paper finds no country in which (non-resource) growth per-person has been statistically-significantly higher during the boom years. In some Gulf states, oil rents have financed a migration-facilitated economic expansion with small or negative productivity gains. Overall, there is little evidence the booms have left behind the anticipated productivity transformation in the domestic economies. It appears that current policies are, overall, prooving insufficient to spur lasting development outside resource intensive sectors.

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1 Introduction

This paper investigates whether countries that have experienced natural resource booms in recent years have managed to overcome slow growth, sometimes known as the curse of natural resources. This is a long-standing issue, with interest heightened by the large rise in global prices for metals and minerals over the past decade. Both price increases and new discoveries of minerals and hydrocarbons have spawned booming conditions in resource rich developing countries

The literature has yet to reach a consensus on whether the slow-growth syndrome persists, in particular for the recently-booming group of resource-intensive countries. Traditionally, it has been determined that a curse exists if total GDP growth per person in resource rich countries is significantly slower than other countries, all else constant, in a large cross section of countries. This paper argues that special circumstances of booming economies require a different approach. Setting aside some of the details, the proposal here has two parts. First, rather than examining total GDP growth which is likely to be dominated by a temporary surge in the resource sector, the proposal is to use non-resource GDP growth as the metric. Second, rather than using a large cross section of countries, which has its own controversial issues, the proposal is to use growth in the pre-boom period of the same country as a comparison period against which to see if growth during the boom period has been abnormally low or high.

The main argument in favor of this approach is that it offers a way to lift the veil of the booming sector and examine what are likely to be more sustainable growth trends. It is also intended to be simple to implement, and offers a country-specific test that can complement the cross-section approach. The method requires a choice of a time period, before the boom, which can serve as a comparison group, and this always has some arbitrary element. Nevertheless, the paper attempts to demonstrate that plausible comparison periods do exist for many countries; and that the results are sufficiently consistent across disparate cases so that conclusions can be drawn.

Turning to the previous literature, Van de Ploeg's (2011) review confirms that the tradition in the literature has been to examine growth in total GDP, including the sector that earns natural-resource rents, to test the curse hypothesis. Virtually all the empirical studies examine total GDP growth per-capita. In addition, this practice is universal in the sophisticated commentary. The Economist (June 30th 2012) considered Angola's growth in total GDP as proof of its success:

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> "Generally deemed wretched after a 14-year war for independence from Portugal followed by 27 years of civil war that only ended in 2002, Angola is now one of Africa's economic successes—thanks almost entirely to oil... Between 2004 and 2008 its GDP surged by an average of 17% a year."

The problem is that even the feeblest economy can show high total GDP growth during boom times, witness for example Equatorial Guinea in recent years. A boom means that the resource-intensive sector is growing; by definition this rules out a slow-growth curse, at least in that part of the economy. In countries where the resource sector is large, this effect dominates.

As previously stated, this paper's method is to divide the economy into two sectors, the non-resource part of the economy, for which the curse question is applicable, and the natural resource sector, for which the curse question is not particularly interesting [1]. Another way to frame the issue is that the current approach of examining growth in total GDP clouds matters by mixing these two together. Instead, this paper defines a curse as something that happens, or not, in the non-resource economy and conducts tests using empirical proxies for GDP in that part of the economy.

To summarize the main empirical result, using growth in per-capita GDP in the non-resource economy before the boom as the reference period, 11 countries had lower growth during the boom years, 7 countries had higher growth. In one case growth was actually statistically significantly lower during the boom. There were no cases where growth was statistically significantly higher during the boom. Simply put and possibly contrary to impressions, growth in value-added per-capita or labor productivity outside the hydrocarbon and mineral sectors remains sluggish in resource-intensive economies. The classic policy prescription to invest resource wealth to accelerate growth in non-resource sectors is not yet proving to be successful on average. What additional evidence there is suggests this is not down to lack of effort or lack of investment; but rather the low payoff of the investments.

Looking back over studies of earlier boom episodes, Gelb and Associates (1988) examined the experience of Algeria, Ecuador, Indonesia, Iran, Nigeria, Trinidad and Tobago, and Venezuela in the 1970's. The results here echo their previous findings: GDP growth over the period 1974-1981 was

[1] Non-resource GDP has been examined in previous studies, but not for the specific questions in this paper. Gelb and associates (1988) examine non-mining GDP growth during the late 1970's-early-1980's boom period. Arezki, Hamilton and Kazimov (2011) use growth in non-resource GDP as the dependent variable in their study on the impact of government spending.

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lower than would have been expected given the size of the booms and the amount of domestic investment. Although at the time of writing they could only comment up to the early 1980s, the further passage of time served to underline this conclusion, as the oil-rich states of the 1970s eventually experienced deep slumps which brought GDP per person back to pre-boom levels. The experience from the previous large boom in the 1970's provides little empirical basis to believe that further passage of time will reverse the results.

This paper starts in the next section with a model that defines the issues and points to ways of testing for a curse; the following section discusses how to implement these tests. Later sections report results of applying this approach to economies that have experienced significant booms in the decade of the 2000s.

1.1 Model

The model is offered to provide a specific definition and an associated test for the curse[2]. The framework is one of competing forces, both pro-and anti-curse, and a curse is said to exist when the former dominates the latter. The curse is not a iron law, nor is it an all or noting thing, but rather a matter of degree. To provide an explicit story, the model chooses Dutch disease as the pro-curse force and public capital investment or education as the anti-curse force. Of course, these specific mechanisms are not essential, as other mechanisms for the pro and anti curse forces would produce similar results.

Evidence supporting the Dutch disease idea that resource wealth depresses other traded activity can be found in a variety of sources. Harding and Venables (2010) report evidence that non-resource exports decreased by 35-70 percent in response to resource windfalls, using data for 137 countries from 1975-2007. Kareem Ismail (2010) reports evidence that oil windfalls were associated with a decline of 3.4 percent in value-added in manufacturing. Brahmbhatt, Canuto and Vostroknutova (2010) report evidence that countries with large resource sectors tended to have smaller traded sectors [3].

[2] The model builds on the model in Sachs and Warner (1995).

[3] Other possible mechanisms for the curse, such as the diversion of productive entrepreneurship into rent-seeking activities would affect growth in a similar manner to the dutch disease mechanism discussed here, by reducing accumulation of a kind of capital that enters the production function. The results in the paper do not hinge on the particular curse mechanism chosen for the model.

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The often-cited association between (non-resource) export growth and overall economic growth continues to hold. Using COMTRADE data from 1970-2008 for 98 countries, measuring non-resource exports by subtracting hydrocarbon and mineral exports from total exports, a regression of average annual growth in GDP per capita on non-resource export growth yields an R2 of 50 percent, an estimated coefficient of 0.34, with a t-ratio of 9.99. This is not a causal statement, but it does suggest where an important problem may lie if high resource wealth chokes off other export growth.

The anti-curse force proposed in the model is that the government can counteract the curse through public investment, including education. Infrastructure and human capital investments have been empirically significant expenditure items in resource rich countries. In their study of six resource rich economies, Gelb and Associates (1988) found that two-thirds of investment was directed towards either infrastructure or human capital (p. 137). Gylfason, Herbertsson, and Zoega (1999) and Bravo-Ortega and De Gregorio (2005) stress education as a way to overcome the curse.

Public capital accumulation is not the only possible antidote for forces pulling in the direction of a curse, but it may be the most often recommended. The idea that capital accumulation of some kind holds the key is so familiar that it has been dubbed "the fundamental economic problem faced by resource rich economies..", van de Ploeg and Venables (2011). The call for vigorous investment echoes Hartwick (1977): "Invest all profits or rents from natural resources in reproducible capital such as machines". Berg, Portillo, Yang and Zanna (2012) review a comprehensive set of policy options. Their conditional recommendation favors greater investment, provided the returns to public capital are sufficiently high. Gelb (2010) reviews policies to promote diversification, and endorses higher public investment along with caution and fiscal restraint[4].

For simplicity the model allows all forms of public capital investment to accumulate into a single stock of capital. It is denoted H for human capital but may also represent other forms of public capital. Accumulation depends on employment in the traded sector, representing the learning-by-doing mechanism behind the curse, and also investment out of resource revenues, as in the following equation.

$$H_t = H_{t-1}\left[1 + \theta_{t-1} + g((1-\alpha)R_{t-1}) - \delta\right] \tag{1}$$

[4] A full discussion of options to mitigate or counteract Dutch Disease would include offshore investment or spending (to lessen demand pressure on domestic non-tradeables), low taxes as in the GCC States (Gelb), low barriers to the use of foreign-born labor and and input subsidies.

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Accumulation of H is thus governed by several forces. The first is the share of labor in the traded sector (represented by θ), the second is the efficiency of government investment (represented by the function g(.)), the third is government policy regarding "α" the amount to distribute to the population as a dividend, and the fourth is the amount of natural resource rents, represented by R. These will be discussed further in the model presentation. Depreciation is represented by δ.

The government cannot borrow without limit on world capital markets to finance its public good investments. This is in part due to asymmetries in information. In addition, public good investments do not immediately yield a revenue stream for the government, so the private sector is likely to be a more cautious lender than it would be for private investments. This provides the rationale for public good investments being a function of the level of natural resource rents, as shown in the equation.

The government is not necessarily a social planner optimizing welfare. In choosing α it decides how much of the resource revenues to transfer to the population for consumption and how much to retain for investment in public goods. The case in which government decisions are the outcome of interest group bargaining could result in rule of thumb behavior, in which α may be a fixed parameter. Alternatively, if the government were to maximize the long run growth rate, it would select $\alpha = 0$, to maximize the amount invested. In either case however, the accumulation of H would be a function of R.

The model is an overlapping-generations growth model in which generations live two periods: working and receiving a wage in the first period; and retiring in the second period. The supply side is described first, followed by the demand side. This is followed by a section that describes the equilibrium and the dynamic solution of the model and finally a section with the main propositions about the effects of resource booms on growth and definitions of a curse.

1.2 Supply side

The production side of the model has three sectors: a traded manufacturing sector, which is identified by the superscript 'm', a non-traded sector, which is identified by the superscript 'n', and a natural resource sector that produces value-added equal to 'R' without employing domestic resources. The resource output can be sold on world markets at an exogenous price p^r, and units of R are chosen so that the price term does not appear explicitly. No distinction is made between resource booms that are discoveries versus rises

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in commodity prices.

In the two sectors that employ labor and capital, production functions are given by

$$X^m = M(L^m, K^m)$$

$$X^n = N(L^n, K^n)$$

The source of perpetual growth in this model is labor-augmenting technical change. A human capital variable, 'H', represents the stock of economically useful knowledge. The key assumption is that the accumulation of knowledge is generated as a by-product of employment in the traded manufacturing sector. The stock of knowledge raises the amount of effective labor by the same amount in both non-resource sectors: hence the variable H multiplies the employment variables in each of the production functions. Normalizing the total labor force to 1, and letting the variable θ represent the share of labor in the traded sector, the production functions may be written as follows.

$$X^m = M(\theta H, K^m)$$

$$X^n = N((1-\theta)H, K^n)$$

These functions are homogenous of degree one and can therefore be written in intensive form as

$$x^m = m(k^m)$$

$$x^n = n(k^n)$$

where lower case variables represent quantities in units of effective labor. Specifically,

$$k^m = \frac{K^m}{\theta H}, \; k^n = \frac{K^n}{(1-\theta)H}$$

Capital market equilibrium requires the employment of capital in each sector up to the point where the value marginal product of capital per effective worker equals the world real interest rate. There are no adjustment costs in achieving the desired capital stocks. Foreigners or domestic residents invest in capital to satisfy the following conditions:

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$$p^n n' \left(\frac{K^n}{(1-\theta)H} \right) = r$$

$$m' \left(\frac{K^m}{\theta H} \right) = r$$

1.3 Prices

The price of manufactures is the numeraire and is set equal to 1. The price p^n is therefore the ratio of the price of the non-traded good to the price of manufactures. Competition and free entry ensures zero profits. The zero profit conditions are written below with $b_i^j(w,r)$ denoting the unit cost functions for factor i in the production of good j. For given values of the world real interest rate, these equations solve for the wage rate, w, and p^n as functions of the real interest rate r (and the world price of the traded good, set to 1).

$$p^n = b_w^n(w,r)w + b_r^n(w,r)r \tag{2}$$

$$1 = b_w^m(w,r)w + b_r^m(w,r)r \tag{3}$$

1.4 Investment and Growth

There are two major sources of growth. One is labor-augmenting technical change. This occurs as a by-product of the structure of employment, as the accumulation of knowledge capital depends on the share of labor employed in the traded sector, θ. This renders the economy vulnerable to a resource curse. The second source of growth is that the government invests part of the resource revenue to further augment human capital accumulation. Given an amount R of natural resource revenue, a fraction α is distributed to the population. The rest $1-\alpha$, is invested by the government in human capital. A parameter Ψ is introduced to allow for an analysis of the impact of government investment efficiency.

Human capital growth thus depends in part on the level of resource revenues and decisions about α, and in part on the endogenously determined share of labor in the traded sector θ.

$$H_t = H_{t-1} \left[1 + \theta_{t-1} + g(\psi(1-\alpha)R_{t-1}) - \delta \right] \tag{4}$$

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1.5 Demand side

Consumers solve an inter-temporal consumption problem. Each generation works and receives a wage when young. The government obtains revenue from sale of the natural resource and a fraction of this finds its way into the hands of the public, deliberately or otherwise. The fraction is denoted by α and the variable 'αR' measures the size of this transfer. Consumers save for retirement at the world rate of interest to distribute consumption across time.

$$MaxU = [\ln(c_t^m) + \beta \ln(c_t^n)] + \delta \left[\ln(c_{t+1}^m) + \beta \ln(c_{t+1}^n)\right]$$

$$s.t.\ c_t^m + p_t^n c_t^n + \frac{1}{1+r}\left(c_{t+1}^m + p_{t+1}^n c_{t+1}^n\right) = w_t + \alpha R_t$$

For convenience, define

$$\Phi = \frac{1}{(1+\beta)(1+\delta)}.$$

Consumers consume the two goods in two time periods (when young and old). This yields four demand functions:

$$c_t^m = \frac{C_t^m}{H_t} = \Phi\left(w_t + \alpha R_t\right) \tag{5}$$

$$c_t^n = \frac{C_t^n}{H_t} = \frac{1}{p_t^n}\beta\Phi\left(w_t + \alpha R_t\right) \tag{6}$$

$$c_{t+1}^m = \frac{C_{t+1}^m}{H_t} = \delta(1+r)\Phi\left(w_t + \alpha R_t\right) \tag{7}$$

$$c_{t+1}^n = \frac{C_{t+1}^n}{H_t} = \frac{1}{p_{t+1}^n}\delta(1+r)\beta\Phi\left(w_t + \alpha R_t\right). \tag{8}$$

A solution of the model requires calculation of total demand for the non-traded good. In any period this is the sum of demand of the young and demand of the old. Demand of the young is demand per (effective) worker times the number of workers (H_t) and demand of the old is demand per member of the older generation times the number of older persons (H_{t-1}).

$$D_t^n = c_t^{ny} H_t + c_t^{no} H_{t-1}$$

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1.6 Equilibrium

Equating aggregate demand and supply in the non-traded sector yields:

$$c_t^{ny} H_t + c_t^{no} H_{t-1} = N\left[(1-\theta_t)H_t, K_t^n\right]$$

Dividing through by the number of effective workers in period t yields

$$c_t^{ny} + c_t^{no}\frac{H_{t-1}}{H_t} = (1-\theta_t)n\left(.\right) \tag{9}$$

where $n(.)$ is production of the non-traded good per effective worker in that sector only. An adjustment factor $(1-\theta_t)$ is required to express both sides in common units of total effective workers.

Equation 9 is a difference equation in θ that will be used to solve for θ after substituting for the term H_t/H_{t-1} from equation 4. After doing this we have:

$$c_t^{ny} + c_t^{no}\frac{1}{\left[1+\theta_{t-1}+g(\Psi(1-\alpha)R_{t-1})-\delta\right]} = (1-\theta_t)n\left(.\right) \tag{10}$$

Note that $c_t^{ny}$and c_t^{no} are functions of α and R, so these variables affect θ through both the numerator and denominator of the left hand side. As illustrated in figure 1 this difference equation has a slope that is positive but less than one in θ_t, θ_{t-1} space[5]; hence the difference equation is stable. A rise in the natural resource dividend raises demand for non-traded products and shifts the equation down so that higher R is associated with a lower value of θ in the steady state.

1.7 Housekeeping - GDP

To keep track of alternative measures of GDP, note that GDP per-effective worker, measured in prices of manufactures, is given by:

$$GDP/H = \theta m(.) + p^n(1-\theta)n(.) + R/H$$

Total GDP is this expression multiplied by H, the number of effective workers:

$$GDP = H\left[\theta m(.) + p^n(1-\theta)n(.)\right] + R$$

[5] The slope equals the product of two terms: $\frac{c^{ny}}{n(.)}\frac{1}{[1+\theta+...]^2}$. The first is consumption of the young divided by total production of the non-traded good, which is a positive fraction. The second is one divided by something greater than one, which is also a positive fraction (depreciation is assumed not large enough to bring this below one). Hence the product of the two is a positive fraction.

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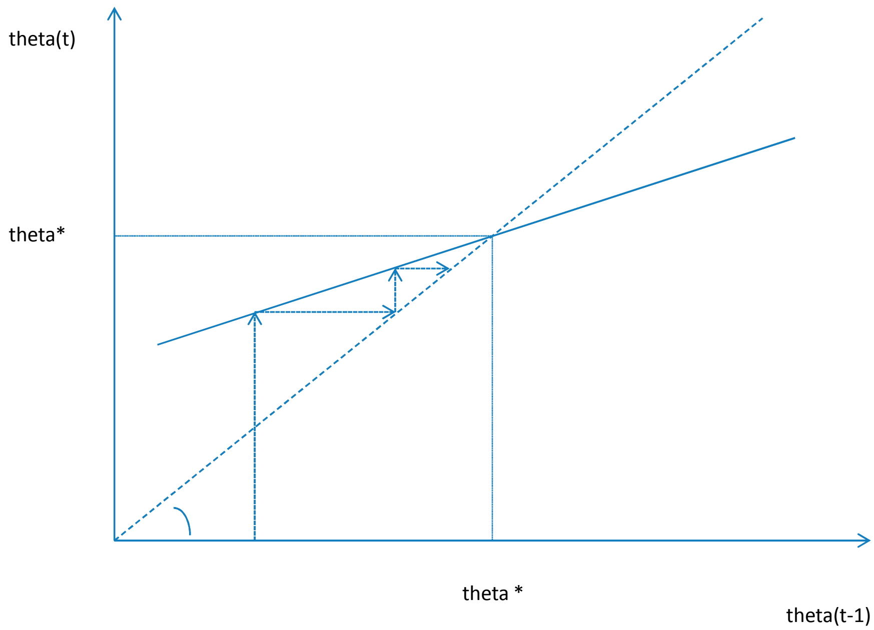

Figure 1: Difference equation illustrating dynamic adjustment of the labor share in Manufactures

Since population is normalized to 1, the equation immediately above also gives GDP per-capita. Within this equation, the first term, $H[.]$, gives GDP per-capita of the non-resource economy. In a steady state, non-resource GDP per-capita and total GDP per capita will grow at different rates. Non-resource GDP per-capita will grow at the same rate as H, but total GDP per capita will grow at a slower rate given by $\hat{H}(1-s^R)$, where $\hat{H}$ is the rate of growth of H and $1-s^R$ is the share of non-resource GDP in total GDP. A steady state will have a constant θ and thus also a constant growth rate of H.

1.8 Testing for the Curse - steady state growth

Two cases require a separate discussion: the impact of permanently high levels of natural resource production on long term growth; and the impact of temporary changes in natural resource production, either booms or busts, on levels and growth of GDP. These cases will be worked out with reference to the model in order to guide the selection of data and to clarify which

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observed outcomes would constitute a curse.

For the impact of permanently high levels of natural resource production on long term growth, consider the steady state equilibrium in which the flow of natural resources R is constant. With R constant, the share of employment in manufactures θ will adjust to a steady-state value. Once it does, the growth rate of human capital will also be constant, given by the expression

$$\theta + g(\Psi(1-\alpha)R). \tag{11}$$

This depends on R through two channels. One is that θ is a function of R, and the second is that investment depends on R through the second term on the right.

With human capital growing at a constant rate, the returns to physical investment will rise continuously, prompting investment in physical capital in the other sectors to maintain equality between the marginal value product of capital and the given world interest rate, for example: $m'\left(K^m/\theta H\right) = r$. This implies that the physical capital stock will also grow at the same rate as H. Therefore, along the steady-state growth path, output *per effective worker* will be constant in both non-resource sectors, but output *per-capita* will grow at the same rate as H. So the expression above gives the long-term growth rate of GDP per capita in each sector - and perforce the non-resource economy. A natural definition of a curse in this case would be that a curse exists when the long term per-capita growth of the economy is inversely associated with the level of resource abundance. In cross-sectional data the natural way to proceed would be to compare long-term growth of non-resource GDP to see whether this is inversely related to the level of R.

The condition for a curse may be examined explicitly. Differentiating the equation for steady state growth with respect to the resource endowment, R, shows two competing effects: one is that higher resource rents can reduce the share of labor in manufactures and thus reduce human capital growth; the other is that higher resource rents can raise human and physical capital accumulation to the extent that the rents are invested well. Formally, the condition for a curse is that the absolute value of the first effect, which is negative, exceeds the second, which is positive, so that the sum of the two is negative:

$$\frac{d\theta}{dR} + g'(.)\Psi(1-\alpha) < 0 \tag{12}$$

This condition may be further examined in terms of separate components. The more natural resource rents shift the structure of an economy away from sectors that foster human capital accumulation, the more nega-

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tive the term $d\theta/dR$ will be and the lower the growth in the non-resource economy. This negative effect can be counteracted through three channels. One (a) is to invest a high fraction of resource rents or "sow the seeds of oil" (represented by a high value of $1-\alpha$), another (b) is to keep corruption low (Ψ high), and a third (c) is to choose efficient investments ($g'(.)$ high). The model thus incorporates a standard set of policy prescriptions. Whether or not high resource rents will be associated with slower growth depends on the balance of these forces. According to this definition of a curse, it is meaningful to speak of a curse existing or not. It is also meaningful to speak of different degrees of a curse. Provided the condition above is satisfied, the severity of the curse can vary along a continuum.

Note that the curse is defined in terms of causality from the resource sector R to the *rest* of the economy. There really is no clear alternative. Defining the curse in terms of the whole economy, including the resource sector itself, is unnecessarily confusing and circular. Of course total GDP will rise if the natural resource sector booms, other things constant, but this is not an interesting result because it simply confirms that R correlates with itself. The interesting part of the hypothesis of a natural resource curse is about the relation between the resource rents and the performance of the economy outside the natural-resource sector.

So the curse is about causality from natural resources to the non-resource economy. And the general idea is that a curse exists when the two are negatively associated. The above provides an equation that summarizes the conditions for a curse in terms of the long-term growth rate, next we consider what observations would be consistent with a curse during periods of natural resource booms.

1.9 Testing for the Curse - resource booms

Figures 2 and 3 illustrate the case in which a curse does and doesn't occur, respectively. In figure 2, when the boom starts, total GDP will rise immediately by the amount of the boom. (To avoid clutter it is assumed that natural resource production is 0 before and after the boom.) However, the growth rate of the rest of GDP will slow, as illustrated by the line labeled “non-resource GDP”. After the boom ends, total GDP and non-resource GDP coincide, since natural resource production is back to 0. The thick lower line illustrates the path GDP followed with the boom, and the straight thinner upper line illustrates the path GDP would have followed without any boom.

The contrasting case, in which the condition in equation 12 does not

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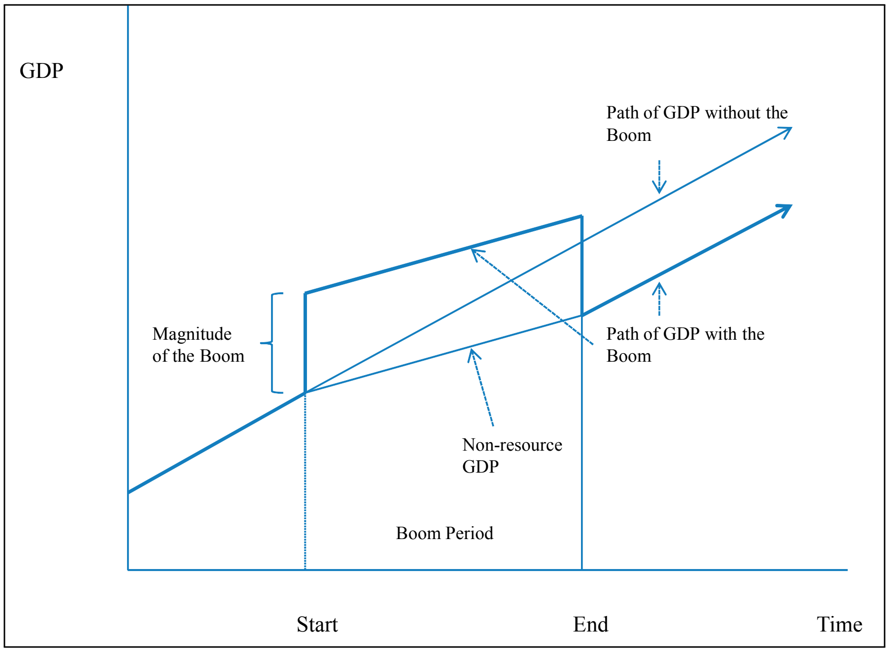

Figure 2: Case in which the economy succumbs to a curse of natural resources

hold, is illustrated in figure 3. Here non-resource GDP eventually grows faster than the counterfactual during the boom period, illustrated by the curved line, so that when the boom is over, and natural resource production drops to 0, total GDP is higher than it would have been without the boom; the opposite of the case of the curse.

An operational definition of a curse can once again be stated in terms of growth rates, but this time in terms of short term growth experienced during the boom period. A curse exists when there is a negative association between the size of the natural resource boom and growth of GDP per-capita in the non-resource economy during the boom period. Alternatively, a curse exists when the level of non-resource GDP after the boom has finished is lower than it would have been had the boom never occurred. Again a curse is something that either happens or it doesn't, and if it happens, is a continuous concept that can exhibit varying degrees of severity.

A summary the cases is illustrated in figure 4, and shows the way to test for a curse. If a curse exists, the resource rich countries would tend to have slow growth (points A to E) compared with other non-resource rich countries

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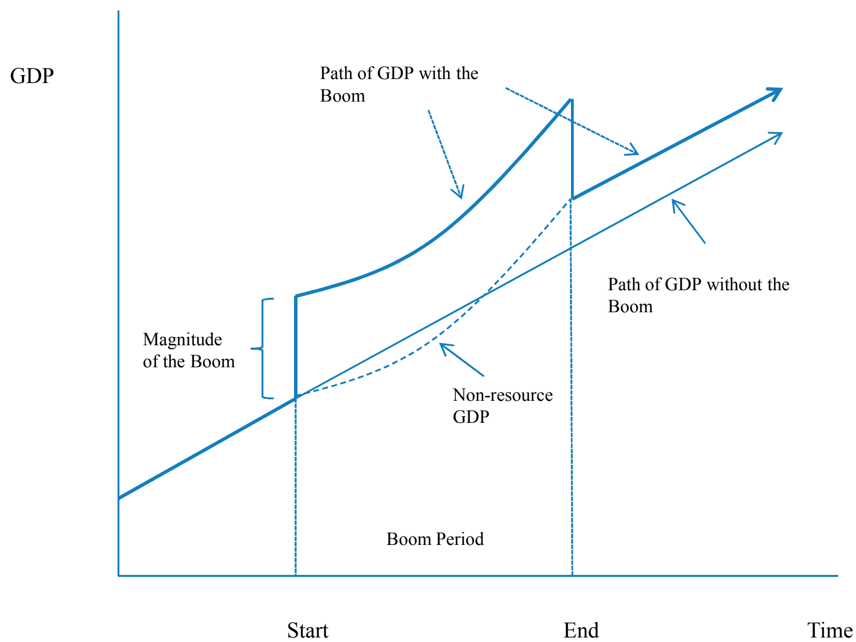

Figure 3: The economy overcomes the curse of natural resources

(points A to D). And if resource rents improved development they would tend to grow faster (illustrated by points A and C). It would be important not to mix into the sample countries that were still in the midst of a resource boom (with GDP measured at point B for example).

2 Results

To determine whether the curse is being overcome, the test is to compare growth of value-added in the non-resource economy during and before the boom (the counterfactual period). In terms of figure 4, this entails comparing the slope of non-resource GDP per person before point A with the slope after point A during the boom. Does it look like A to E, corresponding to the curse, or A to C, corresponding to no curse?

The estimating equation regresses mean growth rates of non-resource real GDP per-capita on a dummy variable d_{1i} that is 1 during the boom (0 during counterfactual period):

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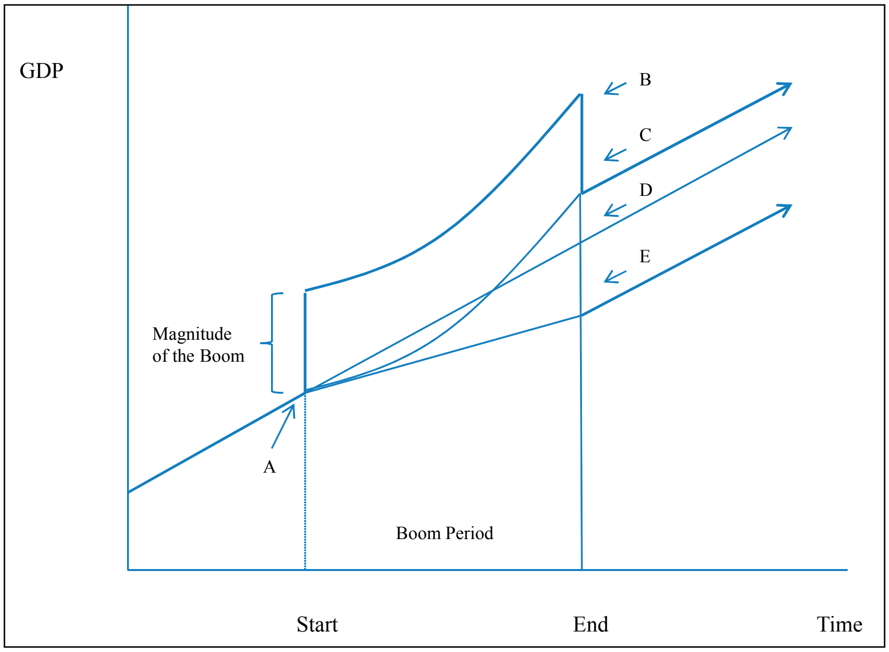

Figure 4: Illustration of testing for a curse of natural resources. A curse is said to exist if non-resource GDP follows a path such as A to E rather than A to C.

$$\ln(Y)_{it} - \ln(Y)_{it-1} = \alpha_{1i} + \alpha_{2i} d_{1i} + \epsilon_i \tag{13}$$

where the significance of the parameter of interest α_{2i} test whether growth was significantly higher during the boom. The variable Y is constant price GDP per person in the rest of the economy – the sum of value added in all sectors save those producing hydrocarbons or minerals.

For the post-Soviet and Eastern European countries a different specification is appropriate given the unique circumstances of GDP growth. Economies with one (state) sector declining and another new sector growing will tend to exhibit a u-shape pattern in overall GDP growth. Separate tests strongly supports that the path of GDP in those countries have followed a u-shaped pattern. Hence the test for those countries in this paper first controls for the common u-shape and asks if, over and above this, the countries with booms have experienced higher growth. This test is presented in the section on post-Soviet economies.

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2.0.1 Data

The data on exports of hydrocarbons and major metals and minerals were taken from COMTRADE (revision 1), using mirror imports from trading partners, and merged with IMF data on national accounts aggregates from the World Economic Outlook database. The COMTRADE data covers a maximum period 1962-2011 and less for many countries which imposes bounds on the time period that can be studied. Value-added from natural resources is taken from several sources. It is taken from national accounts data where possible. When this is not possible, but there are some years in which both national accounts and export data are available, the growth rates in the export data are used to extrapolate the national accounts data backwards in time. When no national accounts data on natural resource value added are available, value added is estimated as 95 percent of export value, based on separate analysis that showed that, for the years in which both kinds of data were available, value-added in natural resource production was approximately 95 percent of the value of export sales.

2.0.2 Selection method

The list of countries with natural resource booms after the year 2000 was determined according to the following steps. Countries were candidates if natural resource exports as a share of GDP exceeded 5 percent for at least one year in the sample and had population greater than 1 million in 1990. A backward and forward 5-yr moving average time series on natural resource production as a share of GDP was constructed for each remaining country. If the forward average exceeded the backward average by 6 percentage points of GDP, around or after the year 2000 for at least two years the country was retained for further examination, as this indicated a significant rise in natural resource revenue. Other series were examined to corroborate the findings using export data, including value-added in natural resources divided by GDP from the national accounts; value-added in natural resources divided by non-natural-resource GDP; and value-added in natural resources per head of population. In addition the threshold was altered between 5 percent and 7 percent of GDP. This procedure yielded a list of candidate countries but also a few borderline cases such as Iran and Chile and cases of inconsistent or implausible data.

Table 1 shows 32 countries that passed the initial selection criteria. As shown, six of these were dropped due to inadequate or implausible data: DR Congo, R Congo, Guinea, Papua New Guinea, Sudan and Togo. Even

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when using the better-measured mirror exports (trade reported by import partners) the trade data contained implausibly large jumps from year to year, missing values, and sometimes values that exceeded reported GDP.

2.0.3 Determining the dates for booms and counterfactual periods

The selection from the first stage left 26 countries for further analysis. To qualify for the analysis, countries require both a boom period and a previous counterfactual period to serve as a control. Furthermore, the counterfactual period cannot, of course, include an earlier boom episode or another event such as wars that would undermine its status as a control period. For each remaining country therefore, time was divided into three periods, the boom, the counterfactual, and possibly a further period that would not be used either as a boom period or a control period (due to wars or other disqualifying events).

A boom was defined in the way it is widely understood, as a significant and sustained rise in natural resource export revenues. The initial year of the boom was selected as the first year in which revenues started to rise in a sustainable fashion. The final year of the boom was selected to be the year in which revenues fell back to their level before the start of the boom. In several cases the booms have not ended and continue until the data end in 2011.

Counterfactual periods were adjusted to ensure that they included no major disqualifying events. In Chad the counterfactual period was adjusted to begin with the regime of Idriss Deby in 1990. This avoids the long-running civil war that began in 1965 and the unrest that continued during the dictatorship of Hissene Habre. Angola was found to have no suitable counterfactual period. A provisional counterfactual period, considering just natural resource production, would be 1979-1990. Yet this is a period of "hard control" of market forces, following the classification of economic regimes in Ndulu, O'Connell, Bates, Collier, and Soludo (2008, Appendix 1, p. 339), while the subsequent boom period (post-1990) is a period in which controls were greatly relaxed. Hence other things were not held constant comparing the pre-90 period with the post-90 period. In Algeria the counterfactual period was determined to begin in 1989, to avoid the sharp economic collapse that occurred just after the oil price decline of 1986. In Laos the counterfactual period was determined to start in 1990 after the cessation of Soviet aid in 1989 that marked the end of soviet-style socialist economic planning. In Mauritania the counterfactual period was determined to start in 1986

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to avoid the great Sahel droughts of the 1970s and the protracted war to annex part of Western Sahara. Following Ndulu et. al. (2008), 1986 was also the first year in which Mauritania was considered free of anti-growth syndromes. In Mongolia the counterfactual period was determined to begin in 1993, to avoid socialist planning and the disruptive transition during the period 1991-1992. In Mozambique the counterfactual period was determined to begin in 1993, again based on the assessment in Ndulu et al. (2008), and after the 1990 constitution established a market-based economy and the civil war ended in 1992. Sudan is not included at all in the analysis due again to the assessment in Ndulu et al. (2008) that it suffered from state-breakdown during the whole period. In Oman the counterfactual period was determined to begin in 1976, after the defeat of the Dhofar Rebellion.

The figures in appendix A display the selection of dates for each of the included countries. The boom period is identified as the shaded area to the right. The counterfactual period is the white (not-shaded) area immediately to the left of the boom period. And the rest of the period is the shaded area to the left of the counterfactual period.

Table 4 shows data on the size of the natural resource booms for 18 countries. The booms are measured as increases in natural resource value-added as a share of the economy. The table shows that on average natural resource production rose from 15 to 30 percent of the economy, comparing the boom period to the previous counterfactual period.

2.0.4 Regression Results

The main results are shown in Table 9, which reports estimates of equation 15 for each of the 18 countries. The column of interest, providing estimates of the change in growth during the boom period, shows that the majority of countries, 11 of the 18, have seen *lower* growth during the boom period than before. One of these is statistically significant (Bolivia). The remaining 7 countries have seen higher growth during the boom but none of these are statistically significant. Therefore the table shows that there is little compelling evidence to reject the null of no change during the boom period. If the presumption was that the Natural Resource bonanza would spark an economic boom in the rest of the economy, this expectation has been disappointed, as there is no statistically significant case of higher per-capita growth during the boom years than before. It is unlikely that this result is due to the short time period under consideration, as the average boom has by now lasted 11 years.

An alternative way to summarize this result is to aggregate across coun-

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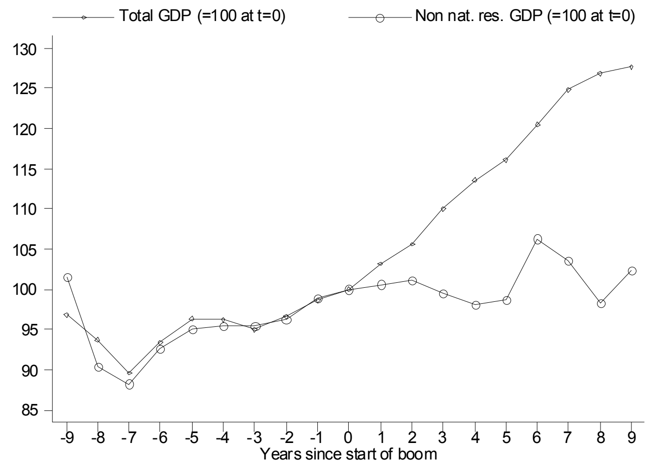

Figure 5: This Figure summarizes two empirical findings: (1) non-resource GDP has seen little positive growth during the boom period in which total GDP has surged, and (2) non-resource GDP growth has not been noticeably faster during the boom period than before the boom period. Figure shows median values across the group of countries of GDP indexed to 100.

tries. The data for all countries were synchronized not by calendar years but by years since the start of the boom. In Figure 5 each country's GDP was first scaled to 100 in the base year and then the median was plotted for both the whole economy and the non-resource economy. The figure shows that although total GDP rose strongly during the boom period, GDP for the rest of the economy has been essentially flat over the boom period. This is then a summary of the average result found in table 9. Furthermore, it is apparent from the figure that there has been no tendency for growth in non-resource GDP to accelerate during the later years of the boom, as would be expected had there been a lagged impact of investments made during the boom period. If overcoming the curse hinges on raising productivity in the rest of the economy, the data suggest that countries are not, as a rule, successfully overcoming the curse. Note that Appendix 2 shows the country-detail behind this graph.

How does this result compare to the earlier boom of the 1970's? Although data on non-oil GDP are often lacking, it is possible to track non-oil GDP in the 1970s for five countries: Saudi Arabia, Algeria, Bolivia, Libya, and Trinidad and Tobago. Figure 6 shows the path of mean GDP and non-

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oil GDP, indexed to 100 in 1973, for these five countries. The picture is quite different from that of the current booms. According to the data for those five countries, non-oil GDP surged at the start of the oil boom, along with total GDP. Both reverted to their pre-boom levels eventually, but this took 17 years to play out in the 1970s boom. According to this data, there is little evidence that the currently booming economies have performed better than their counterparts in the 1970s.

Some may argue that gestation periods are long, and that sufficient time has not been allowed for the positive effects to emerge. To reply, note first that some of the current booms have lasted 10 years. In addition, the 1970s experience does not support this idea. Consider 9 countries that had booms in the 1970s: Algeria, Bahrain, Kuwait, Libya, Oman, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. Setting 1986 non-oil GDP per person equal to 100, it emerges that median GDP per-person was only 123 by 2000 for this group, an average annual growth rate of 1.5 percent (0.58 percent for mean GDP per-person). Therefore, even starting at the lowest ebb for Oil prices after the 1986 collapse, subsequent growth in the Oil-rich countries long after the boom was not unusually high, undercutting the idea that impacts are large and positive but with long gestation periods.

Turning back to table 9, to what extent are the results driven by the comparison with the counterfactual versus simply slow growth, period? The data suggest that the latter is prevalent: it is simply rare to find a case of fast growth in the non-resource economy. Note that average non-resource growth during booms can be estimated as the sum of the coefficients in table 9. When this calculation is performed it emerges that only 5 of the 18 countries show growth over 2 percent per year. Hence slow growth in the rest of the economy continues to be the norm in resource-intensive economies, even during boom periods. An illustration of a case of relatively fast growth in the non-resource economy during the boom period but faster growth during the counterfactual period is Zambia, which has seen positive real pc growth in the rest of the economy at 1.9 percent per year during its boom period and 2.1 percent during the counterfactual period. Hence growth during the boom has not been significantly higher than the counterfactual period. A case that illustrates fast growth overall but slow growth in the non-resource economy is Saudi Arabia. As figure 7 shows, total GDP per-capita has been growing since the boom started in 2002 yet real GDP per-capita growth in the non-oil sector has not been rapid during the boom period, and not noticeably different than it was during the counterfactual period. The line in the figure is drawn for 2002, separating the counterfactual period to the left from the boom period to the right.

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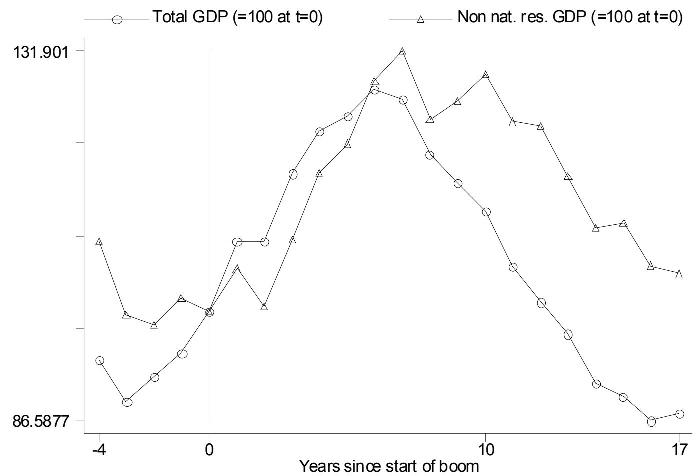

Figure 6: This Figure shows very different results for the five countries with available data during the 1970's boom (Algeria, Saudi Arabia, Bolivia, Libya and Trinidad and Tobago). For these countries real non-oil GDP per-person did rise strongly during the boom. But both total and non-oil GDP per person eventually fell back to pre-boom levels. Figure shows mean values of real GDP per person indexed to 100 at the beginning of the boom.

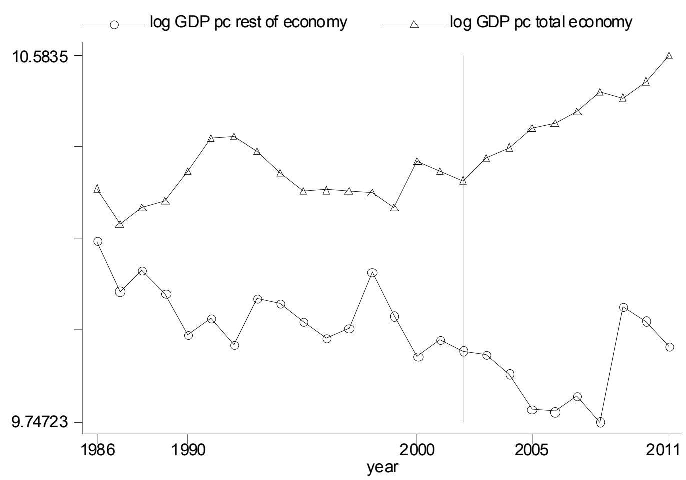

Figure 7: Saudi Arabia: comparing log GDP per-person in the whole economy and the non-oil economy-vertical line marks the start of the boom period.

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2.0.5 Possible bias from the method of selecting countries

One possible source of bias could be that the method of selecting countries has inadvertently omitted those that had positive growth in the non-resource economy during booms. To address this issue we discuss major reasons for exclusion and then examine specific cases[6].

For a country to be suitable for the test proposed in this paper, there must be a boom period but also a control period that can serve as a contrast. Some countries did not have a clear control period. Bahrain, Kuwait and Venezuela had high levels of natural resource production during the 2000's but no clearly defined boom and counterfactual period - what emerges from the data is simply a high amount of volatility throughout. The 2000s were not sufficiently different from the 1990s to discern a clear boom.

A further three countries also lacked a clearly defined counterfactual period before the boom – Angola, Chile, and Yemen - but for different reasons. In the case of Angola and Yemen, the data only exist for a very short period before the boom, so their exclusion is down to lack of data. For Chile the period of low copper prices during the late-1990s was deemed too short to qualify as a legitimate counterfactual period.

Most of the countries above, if they were included, would not show rapid growth in non-resource GDP during their ostensible boom periods. This is the case for Bahrain, Kuwait and Yemen. Yemen is illustrated in figure 8.

Chile is sometimes cited as proof that resource-intensive countries can overcome the curse. Nevertheless, using 1998 as the start of the boom given the rise in copper prices in that year, figure 9 shows that growth in non-Copper GDP per person in Chile during the boom was not faster than before the boom.

Thus the inclusion of these countries would not alter the overall conclusion of slow growth in non-resource economy. Next consider the cases of Botswana and Angola.

Botswana lacks both a clear boom in the 2000's and a clear counterfactual period. Although its data are not reported in the COMTRADE data used in this paper, they are available from its Central Statistics Office. Data on exports of diamonds and value-added in mining shows that Botswana did not experience a boom in the 2000s. If Botswana had a boom at all, it would be a very long boom going back to the late 1970's. Although it is stretching matters to call this a boom, if it were considered a boom Botswana would

[6] As a sidenote, some readers may be surprised that Iran and Egypt are not in the sample but in fact these countries did not experience large booms in the 2000's despite having done so in the 1970's.

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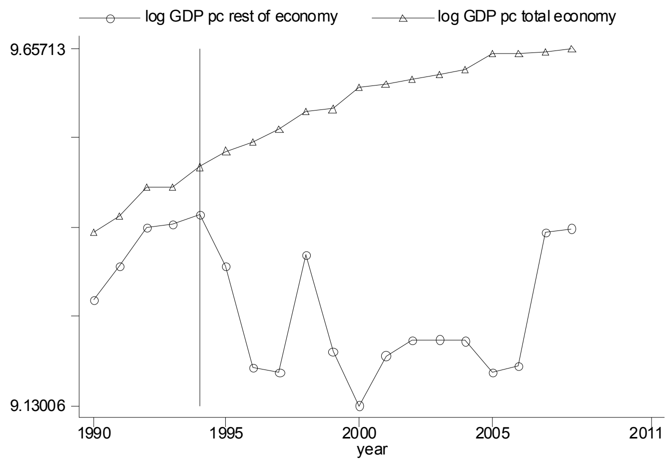

Figure 8: Yemen: comparing log GDP per-person in the whole economy and the non-oil economy (vertical line marks the start of the boom).

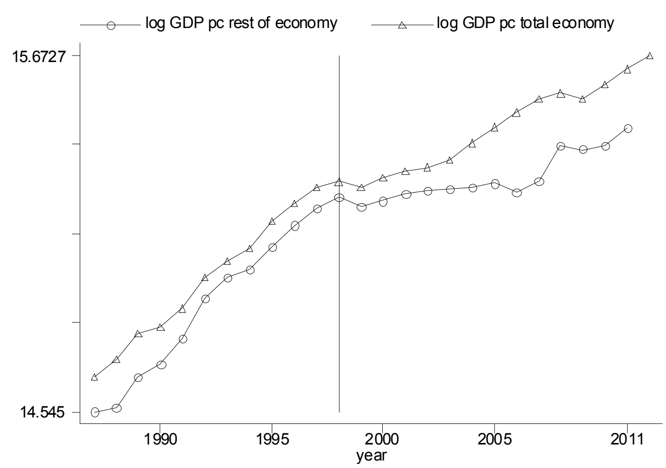

Figure 9: Chile: comparing log GDP per-person in the whole economy and the non-oil economy (vertical line marks the start of the boom).

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be one of the few countries that avoided the curse according to the definition this paper, because non-mining GDP per-capita has grown at 4.7 percent per annum over this period.

That leaves Angola. Angola's export boom started around 1994, first with the diamond trade and later with the oil boom. The exact dates cannot be firmly established because Angola was in the midst of a civil war in 1994. The civil war lasted over the period 1975-2002, with some short peaceful interludes. The MPLA followed socialist planning until approximately 1990. The non-oil economy started to boom after 2000. Hence the timing of events suggests that the recovery was correlated with the end of the civil war rather than the commencement of the commodity boom. In addition there is no clear time to use as a counterfactual period in Angola because of the confounding factors of socialist planning and the civil war. By 2010 real per-capita GDP in Angola had recovered to the level it reached at independence in 1975. Hence if a determination must be made, the data encourage the idea that Angola's recent rapid growth was a bounce-back from decades of civil war rather than a case of overcoming the curse.

A further criticism of the results could be that insufficient allowance has been made for a lagged impact of the booms on non-resource growth. There are two elements to the reply. The first is that the evidence from the booms of the 1970's does not support this idea, as few of the rich Gulf States have experienced rapid growth in non-resource GDP since the 1970's. The second part of the reply is that examination of non-resource GDP during the booms of the 2000's reveals but a few cases where growth appears to have accelerated at the end of the boom period. The most prominent case is Angola, previously discussed, in which the end of civil war is a natural explanation for the growth recovery. A second notable case is Equatorial Guinea, where the boom started in 1994 and growth accelerated sharply upward in 2005, fully nine years after the start of the boom. A third case is Papua New Guinea, which showed a sharp recovery in 2006, long after its boom began. On average however, as shown above when the countries were aggregated, there has been no general tendency for non-resource GDP growth to accelerate late in boom periods.

2.0.6 Saving and Investment

This section examines the extent to which the previous findings can be attributed to a lack of saving, a lack of public or private domestic investment effort out of the saving or a lack of economic return from the investment effort.

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The evidence on saving rates shows that, for the 16 countries with available data, mean saving rates rose strongly in the boom period compared with the counterfactual period, from 16 percent of non-resource GDP to 27 percent (table 5). Furthermore, the current account shifted towards surplus by approximately 5 percentage points of GDP (table 6), so a significant part of the boom was saved in foreign assets. Chad is clearly an outlier, possibly suggesting problems with the Chad data. Without Chad, the results are more dramatic, as the mean saving rate rose from 0.17 to 0.32, and the current account shifted from a deficit of 0.06 to a surplus of 0.04 (table 5).

Nevertheless, despite the rise in saving and particularly saving in foreign assets, domestic investment effort remained constant or even rose during the boom period. Focusing on the 16 countries with booms in the 2000's, mean investment rates rose during the boom periods compared to the counterfactual periods from 22 to 27 percent of GDP (table 7). Two of the Gulf States do show a slight decline in the investment ratio (Saudi Arabia and UAE) and Malaysia shows a larger decline. But apart from these cases the investment ratios rose or stayed the same. Further, available evidence suggests that a large fraction of the investment effort during the booms in the 2000's was domestic public investment. This is the investment that the state controls directly, and the evidence is that public investment rates remained roughly constant, rising slightly from a mean of 9 percent of GDP during the counterfactual periods to 10 percent during the boom periods (table 8). Private investment also rose - from 14 to 18 percent of GDP. Since total GDP rose during the booms, this data suggests that, overall across the 16 economies, there remained a strong and significant effort to invest in the domestic economy. One possible caveat is that the data measure overall investment rather than investment in the non-resource part of the economy specifically. Although investment data are not broken out in this way, it would be a rare occurrence if none of the extra investment fell on the non-resource economy. Therefore, although it is theoretically possible that the low impact on non-resource GDP growth is down to low investment rates, the available data do not support this view. They appear instead to point to low returns from the investment that was made.

Is the recent experience different from the 1970s? Previous research on the major commodity booms of the 1970s found little positive effect on economic growth through 1981, when measured against what benchmark models would have predicted, in spite of the fact that much of the resource windfalls were invested in the domestic economy (Gelb & Associates, 1998). Furthermore, slow per-capita growth in the oil-rich Gulf states since the 1970's makes it clear that the passage of additional time has only served to

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underline this earlier conclusion.

Where it is possible to make the comparison, the available data suggests that investment rates during the current booms have been similar to the boom of the 1970s. A comparison of six countries that experienced booms in both periods, shows that mean domestic investment shares of GDP were approximately the same (23 percent vs. 21 percent)[7]. Within this total, the public investment share in GDP was also constant across boom periods (11 percent in both periods). Hence this evidence suggests that both in the post-2000 booms and the 1970's booms investment rates did not decline, so that poor results cannot be attributed to a decline in investment effort.

To summarize, mean domestic investment rates did not drop off during the boom periods, either when compared to the counterfactual periods just before the booms or when compared to the earlier booms in the 1970's. The same is true for the public investment share. What appears different in the booms of the 2000's compared to the 1970's is that saving rates have been higher. Current account surpluses have been therefore been higher - more saving is being held in offshore assets including sovereign wealth funds. But domestic investment rates have remained sufficiently high to expect to see some positive impact from investment on domestic growth.

2.1 Emirates and Qatar

Readers may be surprised that the evidence in table 9 does not show faster growth for the United Arab Emirates and Qatar that include the booming cities of Dubai, Abu Dhabi and Doha. Nevertheless, these results are supported by further evidence on labor productivity.

The United Arab Emirates and Qatar have seen rapid real GDP growth in recent years, and rapid real GDP growth in the non-hydrocarbon economy. Yet population growth has also been rapid, thanks to labor migration, so that growth in output per person has been much lower than raw GDP growth. This fact underpins the results in table 9. On top of this, although data on employment is limited to selected years in both countries, the data available show that employment growth has been even faster than population growth, so that growth in real value-added per worker has been even slower than growth in real GDP per-capita.

Facts which summarize the overall picture are shown in table 10. For the United Arab Emirates the table shows that annual real GDP growth in the non-Oil economy averaged 5.8 percent during the boom period (2002 to

[7] The six countries are Bolivia, Libya, Oman, Saudi Arabia, Trinidad and Tobago, and the United Arab Emirates.

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2011). Over the same period, the number of workers grew 9.5 percent per year, so that labor productivity declined at an average annual rate of -3.7 percent. In Qatar, data are available on the number of economically active persons by industry between 2006 and 2012, the later part of the boom period. This data shows 2006 to have been a peak in labor productivity and 2007 a trough. Hence the two are averaged together in the table. The results show that non-Oil GDP grew 14.2 percent per year while employment grew 12.9 percent, for an average growth of labor productivity in the non-oil sector of 1.1 percent per year. These results showing slow growth of labor productivity complement the results in table 9 showing slow growth in GDP per-person.[8]

2.2 Post Soviet Countries

The resource-rich countries of the ex-Soviet Union require a method for testing for a curse that incorporates the special u-shaped pattern of GDP over time during the transition period. The u-shaped profile of total GDP is a natural outcome of a two-sector model in which one sector declines sharply (the state sector) while another rises gradually from a small base (the new private sector), as happened in all European post-socialist-planned economies. The method followed here first tests, and confirms, that the evidence supports the common u-shape for the path of GDP over the transition period. Then, controlling for this, post-soviet economies with resource booms are compared against post-soviet economies without resource booms to assess whether the booming countries have grown faster than other post-soviet economies.

Empirical evidence confirming the u-shape is shown by estimating an equation explaining the log of non-resource GDP with a series of year-specific dummy variables:

$$\ln(Y)_{it} = \alpha_0 + \sum_{t=1994}^{t=2010} \alpha_t d_t + \eta_i, \tag{14}$$

where Y_{it} is non-resource GDP measured in constant-price local currency, normalized with 1994=100, d_t are dummy variables associated with years. Estimation for eleven post-soviet economies yields the result shown in table 11 (panel A) in which the estimated coefficients trace out a U-shape. A

[8] To determine whether a shift in the labor force towards low-productivity construction workers had a big influence on this result, labor productivity growth 2006-12 was also calculated with the labor share of construction held at the 2006 value. This showed only slightly higher growth of 1.37 rather than 1.22.

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more parsimonious representation of this pattern is given by a quadratic, as in the equation below, and shown in Table 11 panel B, which achieves similar explanatory power (same data and the same eleven countries).

$$\ln(Y)_{it} = \alpha_0 + \alpha_1 T_t + \alpha_2 T_t^2 + \eta_i \tag{15}$$

Empirical validation of the quadratic specification comes by noting the similarity in the adjusted R2's in the two regressions. Consider now empirical tests of the impact of natural resource booms. The post-soviet countries that experienced resource booms are Azerbaijan, Kazakhstan, Russia, and Turkmenistan. Azerbaijan has huge reserves of crude oil and natural gas. Kazakhstan produces crude oil, natural gas and possesses significant reserves of uranium, chromium, lead, zinc, manganese and copper. Russia exports crude and refined petroleum and natural gas.

The testing involves the addition of country-specific dummy variables interacted with the quadratic term so that α_2 may be country-specific. Since non-resource GDP is pegged at 1994=100 for all countries, a higher estimated α_{2i} for a particular country means that the country experienced faster growth than comparator countries. Countries that used the resource rents to invest and raise productivity in the non-resource economy would be expected to show a positive coefficient, indicating that natural resources allowed growth in the upswing of the U to be faster than in non-booming countries. The estimating equation is:

$$\ln(Y)_{it} = \alpha_0 + \alpha_1 T_t + \alpha_2 T_t^2 + \alpha_{2i} d_i T_t^2 + \eta_i \tag{16}$$

The results are shown in table 12. Against expectations, the results indicate that the five resource intensive countries experienced slower growth during their resource boom. Growth was statistically significantly slower than resource poor countries for all except Azerbaijan. This shows little evidence that the resource booms served to accelerate GDP growth above the levels experienced by other post-soviet economies. Based on this evidence it is difficult to claim that the resource booms served to raise the path of GDP above what it would have been without the booms.

3 Conclusions

The purpose of this paper has been to present a method for testing whether or not newly booming economies are overcoming the slow-growth syndrome known as the curse of natural resources. Since the booming sector inevitably

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tends to boost total GDP temporarily, testing for the curse requires removing the veil of the booming sector. Accordingly, the paper focuses on growth in the non-resource economy. It also uses the pre-boom period as a counterfactual against which to compare growth during the boom period. If growth in the non-resource part of the economy during the boom is higher than before the boom, the curse is said to have been overcome. If countries successfully "sow the seeds of oil", we should see non-resource GDP per-capita begin to grow faster during a period in which Oil revenues and investment is unusually high.

Implementing this approach requires counterfactual periods sufficiently similar to the boom periods, except for the presence of the boom. Pre-boom periods in the same country are a natural choice, but some care is required to ensure that such periods are sufficiently similar and are of sufficiently long duration. There is an inevitable grey area in making this assessment. In this paper the data were deemed sufficiently clean to conduct such tests for 18 booming economies. Of these 18 cases, 7 showed higher average (non-resource) growth during the boom than before; 11 showed lower growth. None were found in which the economy had overcome the curse in the strong sense of having statistically significantly higher growth during, compared to before, the boom period. In one case, Bolivia, growth was significantly lower. Further analysis of the year-by-year data might identify Equatorial Guinea and perhaps Papua New Guinea as exceptions – but their growth was too short lived to register as significant in the statistical tests. Post-soviet economies were examined separately and it was found that none of the five resource-rich countries showed significantly higher growth during their resource booms.

The paper confronts the potential critique that there could be selection bias in either the choice of which countries qualify for analysis or the dates chosen for the counterfactual period. It looked at this on a case by case basis and did not find evidence that the excluded countries were systematically different on the items that could be measured. Another possible critique is to claim that the non-resource economy would be expected to slump during a boom, and recover afterwards, so that the trend in the non-resource economy is a misleading guide to likely growth behavior after the boom. However, although a slump in some sectors (traditional traded sectors) might be expected, other sectors would boom (non-traded sectors) so there is no presumption of a slump overall. The data from the 1970s suggests that, if anything, the non-resource economy on average boomed during the Oil boom; so it doesn't support the notion that there would be a slump. A further possible critique is that non-resource growth might eventually ac-

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celerate if further time were allowed to pass. This wasn't the experience of the 1970's boom, since the passage of time never overturned the mid-80s conclusion that things had not gone very well. Nine Oil-rich countries were examined and it emerged that median GDP per-capita in the non-Oil economy grew by only 1.48 percent per year over 1986-2000, in other words even after starting at the low year of 1986. Further, many of the boom periods after 2000 have already lasted ten years, and there is no evidence within these episodes of higher growth overall at the end than the beginning.

The dominant finding overall is really no change in growth rates of non-resource GDP per-capita during the recent boom years. This is surprising when measured against the common presumption that the booms would be beneficial, when the huge sums of money available in booming economies is taken into account, and when investment rates and particularly public investment rates have not declined and in fact have risen in several countries. Two of the countries that may be exceptions to the average finding (Equatorial Guinea and Papua New Guinea) are not hugely convincing cases, due in part to unusually volatile GDP data. Another, Botswana, is a long-standing success case: its fast non-resource GDP growth in the 2000's is not a new and unusual phenomenon that only appeared during the recent boom. Nevertheless, even if these three are deemed success cases, the overall record is still unsupportive of the notion that money from booms accelerated per-capita growth in non-resource sectors.

Of course, growth in per-capita GDP is not the same as growth in welfare. In several countries, money from the booms has been invested abroad, has funded other social expenditures and has been used to subsidize education, transportation and health spending or indirect transfers to citizens. Although there is no settled methodology for valuing these items, such a valuation would constitute part of a complete assessment. Nevertheless, having said this, leaders in resource rich societies are virtually unanimous in their declared aim to create modern, diversified, thriving economies outside the resource sectors, and few endorse the goal of becoming rentier societies. The per-capita growth or productivity growth story outside of the resource sector is part, but not all, of the overall assessment.

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Table 1: List of countries that pass the first screening and reasons for elimination from the final sample

		Implausible Data	Inadequate Counterfactual Period	Final Sample
1	Algeria			1
2	Angola		1	0
3	Bahrain		1	0
4	Bolivia			1
5	Chad			1
6	Chile		1	0
7	Rep Congo	1		0
8	Dem Rep Congo	1		0
9	Ecuador			1
10	Egypt		1	0
11	Equatorial Guinea			1
12	Guinea	1		0
13	Guinea Bissau	1		0
14	Iran		1	0
15	Kuwait		1	0
16	Lao PDR			1
17	Libya			1
18	Malaysia			1
19	Mauritania			1
20	Mongolia			1
21	Mozambique			1
22	Oman			1
23	Papua New Guinea			1
24	Qatar			1
25	Saudi Arabia			1
26	Sudan	1	1	0
27	Togo	1		0
28	Trinidad and Tobago			1
29	United Arab Emirates			1
30	Venezuela		1	0
31	Yemen		1	0
32	Zambia			1
	Total	6	9	18

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Table 2: Dates for Counterfactual and Boom periods

		Counterfactual Period	Boom period
1	Algeria	1986-1997	1998-2011
2	Bolivia	1987-1998	1999-2011
3	Chad	1990-2002	2003-2011
4	Ecuador	1979-1997	1998-2011
5	Equatorial Guinea	1980-1991	1992-2011
6	Lao PDR	1991-1999	2000-2011
7	Libya	1986-1998	1999-2010
8	Malaysia	1993-2001	2002-2011
9	Mauritania	1987-2002	2003-2011
10	Mongolia	1992-2005	2006-2011
11	Mozambique	1993-1998	1999-2011
12	Oman	1986-1997	1998-2011
13	Papua New Guinea	1976-1990	1991-2011
14	Qatar	1987-1997	1998-2011
15	Saudi Arabia	1986-2001	2002-2011
16	Trinidad and Tobago	1983-1997	1998-2011
17	United Arab Emirates	1995-2001	2002-2011
18	Zambia	1997-2002	2003-2011

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Table 3: Adjustments to dates of Counterfactual periods due to: poor data; existence of previous boom periods; incomparability in economic regime; and civil wars

1	Algeria	Period with previous booms (through 1985) not included in counterfactual
2	Bolivia	Period with previous booms (through 1986) not included in counterfactual
3	Chad	Counterfactual period limited to post-1990 period of relatively stable policy under Idriss Deby
4	Ecuador	Beginning of counterfactual period is 1979 - chosen to avoid inclusion of earlier 1970's boom
5	Equatorial Guinea	Counterfactual period excludes period of state breakdown prior to 1979
6	Lao PDR	Counterfactual period excludes socialist state planning prior to 1991
7	Libya	Period with previous booms (through 1986) not included in counterfactual. Also implausible trade data in 1960-1970.
8	Malaysia	Beginning of counterfactual period is 1993 - chosen to avoid inclusion of earlier boom
9	Mauritania	Following Ndulu et. Al. (2008), counterfactual period limited to post 1986 regime of Ould Taya, which they rate as "syndrome free"
10	Mongolia	Counterfactual period excludes socialist state planning prior to 1991
11	Mozambique	Following Ndulu et. al. (2008), counterfactual period limited to post-civil war, "syndrome-free" regime of Joaquim Chissano, 1992-
12	Oman	Counterfactual period excludes period of the Dhohar rebellion prior to 1976 and boom through 1986
13	Papua New Guinea	Counterfactual period starts with independence in 1976
14	Qatar	Period with previous booms (through 1986) not included in counterfactual. Also implausible trade data in late 1960s.
15	Saudi Arabia	Period with previous booms (through 1986) not included in counterfactual.
16	Trinidad and Tobago	Earlier period boom periods through 1982 not included in the counterfactual period
17	United Arab Emirates	Period with previous booms (through 1986) not included in counterfactual.
18	Zambia	Following Ndulu et. Al. (2008), counterfactual period limited to post 1992 "syndrome free" period, and period of low commodity exports post-1997.

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Table 4: The Increase in Natural Resource Rents during the Boom Period (estimates of value-added in natural resources divided by total GDP, period averages)

	country	Counterfactual Period	Boom Period	Difference (Boom - Counterfactual)
1	Algeria	0.214	0.319	0.105
2	Bolivia	0.050	0.110	0.060
3	Chad	0.001	0.294	0.293
4	Ecuador	0.075	0.119	0.044
5	Equatorial Guinea	0.156	0.815	0.659
6	Lao People's Dem.Rep	0.051	0.103	0.051
7	Libya	0.275	0.505	0.230
8	Malaysia	0.126	0.172	0.046
9	Mauritania	0.191	0.326	0.135
10	Mongolia	0.015	0.114	0.099
11	Mozambique	0.007	0.163	0.156
12	Oman	0.335	0.422	0.087
13	Papua New Guinea	0.044	0.228	0.184
14	Qatar	0.382	0.492	0.110
15	Saudi Arabia	0.296	0.383	0.087
16	Trinidad and Tobago	0.200	0.379	0.179
17	United Arab Emirates	0.238	0.291	0.053
18	Zambia	0.111	0.189	0.079
	Mean	0.154	0.301	0.148

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Table 5: Saving rates, fraction of GDP, period averages

country	Counter-factual Period	Boom Period		Change in saving ratio
Algeria	0.28	0.45		0.17
Bolivia	0.09	0.19		0.10
Chad	-0.01	-0.52		-0.51
Ecuador	0.15	0.21		0.06
Equatorial Guinea	0.10	0.38		0.28
Lao People's Dem.Rep	n.a.	n.a.		n.a.
Libya	0.19	0.56		0.36
Malaysia	0.36	0.34		-0.03
Mauritania	0.16	0.16		0.00
Mongolia	0.22	0.40		0.18
Mozambique	0.14	0.09		-0.05
Oman	0.13	0.31		0.18
Papua New Guinea	n.a.	n.a.		n.a.
Qatar	0.08	0.51		0.43
Saudi Arabia	0.13	0.37		0.24
Trinidad and Tobago	0.18	0.32		0.14
United Arab Emirates	0.31	0.29		-0.02
Zambia	0.03	0.19		0.17
Mean	0.16	0.27		0.11
ex-Chad	0.17	0.32		0.15

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Table 6: Current Account, fraction of GDP: period averages

country	Counter-factual Period	Boom Period		Change in current account
Algeria	0.02	0.19		0.17
Bolivia	-0.06	0.03		0.09
Chad	-0.16	-0.80		-0.64
Ecuador	-0.01	0.01		0.02
Equatorial Guinea	-0.44	-0.31		0.13
Lao People's Dem.Rep	n.a.	n.a.		n.a.
Libya	0.07	0.26		0.18
Malaysia	0.01	0.13		0.11
Mauritania	-0.05	-0.19		-0.14
Mongolia	-0.01	0.01		0.02
Mozambique	-0.07	-0.12		-0.05
Oman	-0.03	0.06		0.09
Papua New Guinea	n.a.	n.a.		n.a.
Qatar	-0.16	0.22		0.38
Saudi Arabia	-0.06	0.20		0.26
Trinidad and Tobago	-0.01	0.13		0.14
United Arab Emirates	0.07	0.09		0.02
Zambia	-0.13	-0.03		0.11
Mean	-0.06	-0.01		0.06
ex-Chad	-0.06	0.04		0.10

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Table 7: Investment Rates, fraction of GDP, period averages

country	Counter-factual Period	Boom Period		Change in investment ratio
Algeria	0.26	0.26		0.00
Bolivia	0.15	0.16		0.01
Chad	0.15	0.28		0.13
Ecuador	0.16	0.20		0.04
Equatorial Guinea	0.54	0.69		0.15
Lao People's Dem.Rep	n.a.	n.a.		n.a.
Libya	0.12	0.30		0.18
Malaysia	0.35	0.21		-0.14
Mauritania	0.21	0.35		0.14
Mongolia	0.23	0.39		0.16
Mozambique	0.21	0.21		0.00
Oman	0.16	0.25		0.09
Papua New Guinea	n.a.	n.a.		n.a.
Qatar	0.24	0.29		0.05
Saudi Arabia	0.19	0.17		-0.02
Trinidad and Tobago	0.19	0.19		0.00
United Arab Emirates	0.24	0.20		-0.04
Zambia	0.16	0.22		0.06
Mean	0.22	0.27		0.05
ex-Chad	0.23	0.27		0.05

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Table 8: Public Investment Rates, period averages

country	Counter-factual Period	Boom Period		Change in Public Investment
Algeria	0.07	0.12		0.04
Bolivia	0.04	0.07		0.03
Chad	0.00	0.06		0.06
Ecuador	0.00	0.05		0.05
Equatorial Guinea	0.30	0.17		-0.13
Lao People's Dem.Rep	n.a.	n.a.		n.a.
Libya	0.10	0.20		0.10
Malaysia	0.12	0.11		-0.01
Mauritania	0.06	0.07		0.01
Mongolia	0.07	0.07		0.00
Mozambique	0.12	0.11		-0.01
Oman	0.11	0.13		0.02
Papua New Guinea	n.a.	n.a.		n.a.
Qatar	0.06	0.07		0.01
Saudi Arabia	0.07	0.07		0.00
Trinidad and Tobago	0.05	0.09		0.03
United Arab Emirates	0.10	0.08		-0.03
Zambia	0.10	0.05		-0.04
Mean	0.09	0.10		0.01
ex-Equatorial Guinea	0.07	0.09		0.02

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Table 9: Country-by-Country Regression Estimates: Was non-resource growth faster during the Boom?

Estimated Equation: $$\ln(Y)_{it} - \ln(Y)_{it-1} = \alpha_{1i} + \alpha_{2i} d_{1i} + \epsilon_i$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Algeria	Bolivia	Chad	Ecuador	Equatorial Guinea	Lao PDR	Libya	Malaysia	Mauritania
Growth Before the Boom (counterfactual) (a1)	-2.122	2.384***	0.704	0.503	-3.681	3.261***	-2.469	3.731*	-0.393
	(-1.619)	(4.955)	(0.240)	(0.557)	(-0.222)	(4.485)	(-0.572)	(1.816)	(-0.237)
Change in Growth During Boom (a2)	2.970	-2.496***	-1.560	0.156	20.958	1.428	-1.762	-1.686	-2.338
	(1.635)	(-3.670)	(-0.376)	(0.110)	(0.895)	(1.456)	(-0.276)	(-0.580)	(-0.778)
Observations	25	24	16	32	24	20	24	18	23
R-squared	0.104	0.380	0.010	0.000	0.035	0.105	0.003	0.021	0.028

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Table 9. (Continued): Country-by-Country Regression Estimates: Was non-resource growth faster during the Boom?

VARIABLES	(10) Mongolia	(11) Mozambique	(12) Oman	(13) Papua New Guinea	(14) Qatar	(15) Saudi Arabia	(16) Trinidad and Tobago	(17) United Arab Emirates	(18) Zambia
Growth Before the Boom (counterfactual) (a1)	1.133	4.754**	1.014	-1.838	1.169	-0.086	-0.873	0.206	2.454
	(0.689)	(2.400)	(0.400)	(-1.430)	(0.297)	(-0.054)	(-0.369)	(0.074)	(1.357)
Change in Growth During Boom (a2)	-0.966	-1.552	-1.025	2.759	-1.283	0.280	3.085	-2.469	-0.591
	(-0.301)	(-0.640)	(-0.291)	(1.622)	(-0.240)	(0.106)	(0.888)	(-0.662)	(-0.247)
Observations	19	18	25	35	24	25	28	16	14
R-squared	0.005	0.025	0.004	0.074	0.003	0.000	0.029	0.030	0.005

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Table 10. Labor Productivity Growth in the United Arab Emirates and Qatar

United Arab Emirates

	GDP at constant 2007 Prices (Million Dirhams)			Workers			Labor Productivity ('000 Dirhams per Worker)		
	Oil	Non Oil	Total	Oil	Non Oil	Total	Oil	Non Oil	Total
2002	265728	402889	668618	27197	2149103	2176300	9771	187	307
2011	315410	667316	982725	53580	4855551	4909131	5887	137	200
Ave. Annual Growth	1.9%	5.8%	4.4%	7.8%	9.5%	9.5%	-5.9%	-3.7%	-5.1%

Source: Department of Economic Statistics

Qatar

	GDP at constant 2004 Prices (Million Qatari Riyal)			Economically Active (15+ years)			Labor Productivity ('000 Riyals per Worker)		
	Oil	Non Oil	Total	Oil	Non Oil	Total	Oil	Non Oil	Total
2006/7	77662	93089	170750	35594	644032	679626	2182	145	251
2012	147726	192919	340646	83111	1258082	1341193	1777	153	254
Ave. Annual Growth	12.4%	14.2%	13.4%	16.7%	12.9%	13.2%	-3.7%	1.1%	0.2%

Source: Ministry of Development Planning and Statistics and Qatar Statistics Authority

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Table 11. Regressions showing evidence of the common U-shaped path followed by GDP in Post-Soviet Countries since the transition

Panel A				Panel B			
Dependent Variable: log of GDP in non-resource economy (Index, 1994=100)				Dependent Variable: log of GDP in non-resource economy (Index, 1994=100)			
	Coef.	Std. Err.	T		Coef.	Std. Err.	T
year 1994	-0.178	0.11	-1.57	year	-0.187	0.047	-3.990
year 1995	-0.344	0.11	-3.03	year ^2	0.0038	0.0007	5.100
year 1996	-0.259	0.11	-2.28	Constant	6.884	0.729	9.440
year 1997	-0.241	0.11	-2.12				
year 1998	-0.231	0.11	-2.03				
year 1999	-0.214	0.11	-1.89				
year 2000	-0.160	0.11	-1.41				
year 2001	-0.091	0.11	-0.8				
year 2002	-0.034	0.11	-0.3				
year 2003	0.056	0.11	0.49				
year 2004	0.137	0.11	1.21				
year 2005	0.212	0.11	1.87				
year 2006	0.305	0.11	2.68				
year 2007	0.419	0.11	3.69				
year 2008	0.499	0.11	4.39				
year 2009	0.452	0.11	3.97				
year 2010	0.524	0.12	4.52				
Constant	4.783	0.09	53.81				
N =	193			N =	193		
Adj R-squared =	0.58			Adj R-squared =	0.57		
F(17,175) =	16.52			F(2,190) =	135.19		
Prob > F =	0.00			Prob > F =	0.00		

Note: In panel B year is rescaled to year-1970

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Table 12. Regressions showing that, of the Post-Soviet countries, the five resource-rich countries did not experience faster economic growth

Dependent Variable: log of GDP in non-resource economy (Index, 1994=100)

	Coef.	Std. Err.	T
year	-0.184	0.044	-4.140
year^2	0.00376	0.00070	5.380
year^2* AZE	-0.00004	0.00005	-0.820
year^2* KAZ	-0.00013	0.00005	-2.450
year^2* TAJ	-0.00025	0.00006	-4.360
year^2* RUS	-0.00017	0.00005	-3.230
year^2* TUR	-0.00006	0.00005	-1.140
Constant	6.838	0.688	9.930
N =	193		
Adj R-squared =	0.62		
F(7,185) =	45.3		
Prob > F =	0.00		

Note: Since the dependent variable is indexed to 1994=100, a negative coefficient on the quadratic term interacted with the country dummy shows that growth was slower for that country compared to the Post-Soviet countries that were not resource rich.

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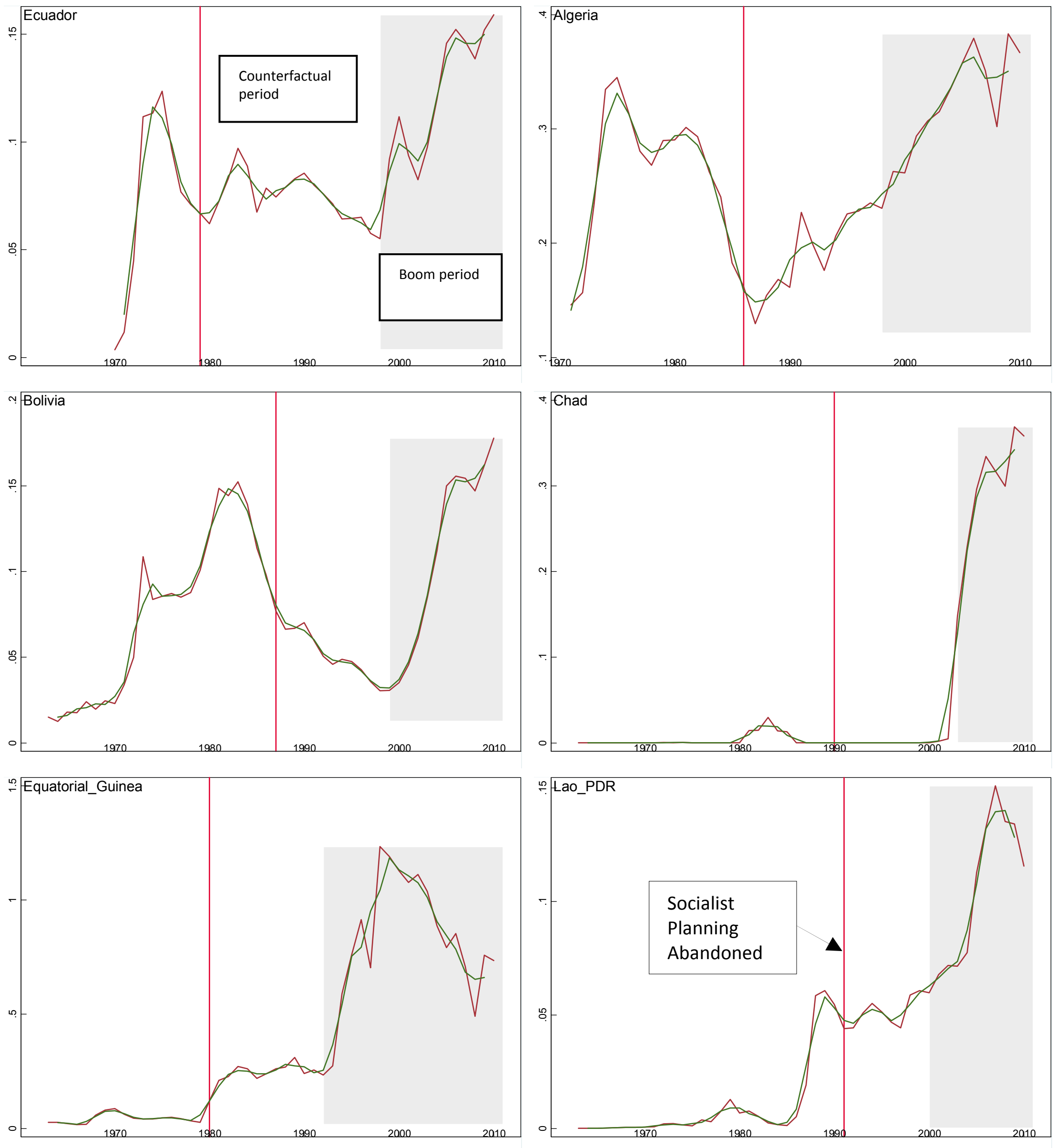
Appendix 1: Graphs showing boom periods and counterfactual periods for the 18 countries retained for analysis. The plotted lines show natural resource exports as a share of GDP, both USD, one is raw data the other smoothed. The area to the right of the vertical line is the period used in the analysis, with the shaded area the boom period and the rest the counterfactual period.



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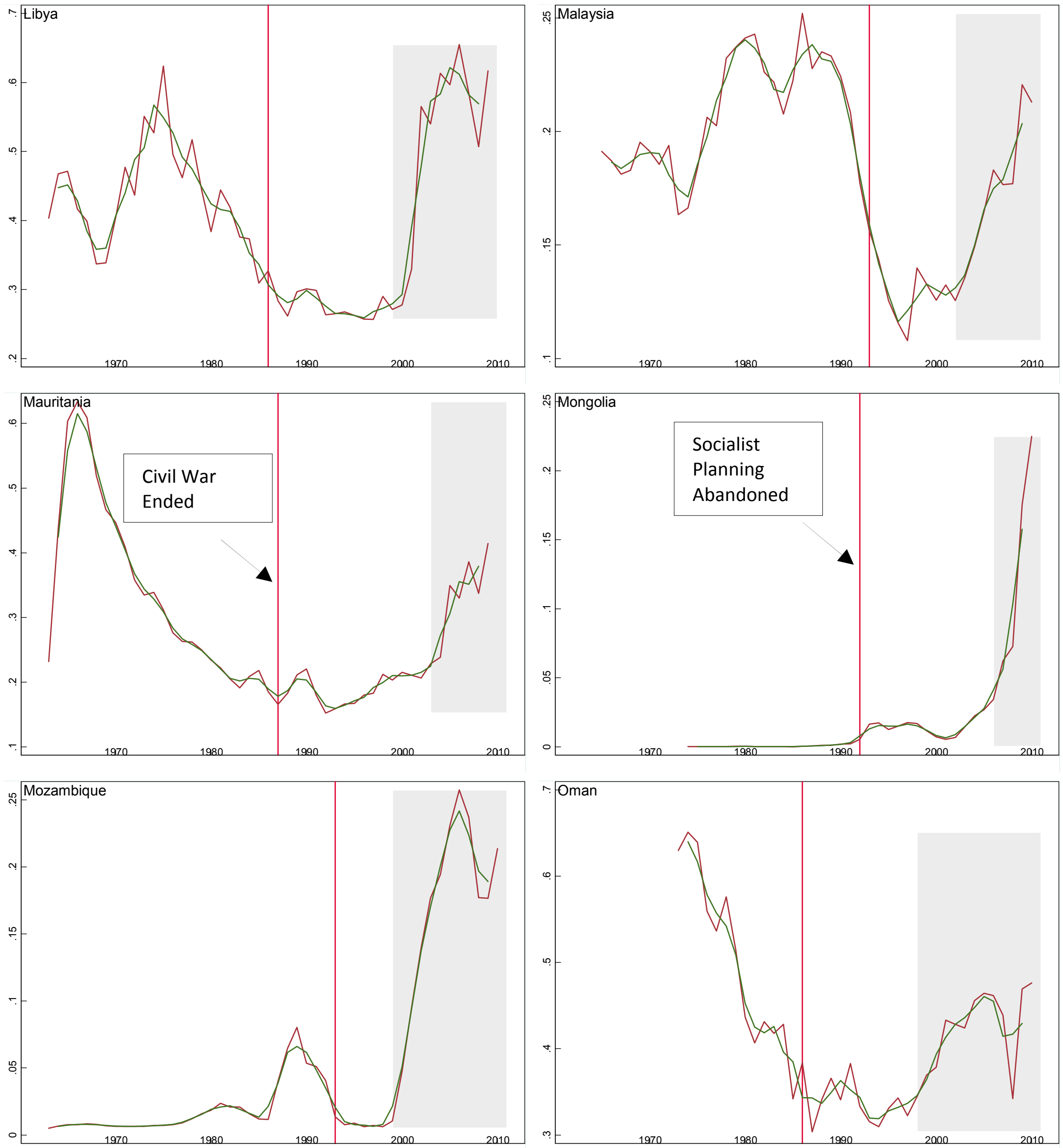

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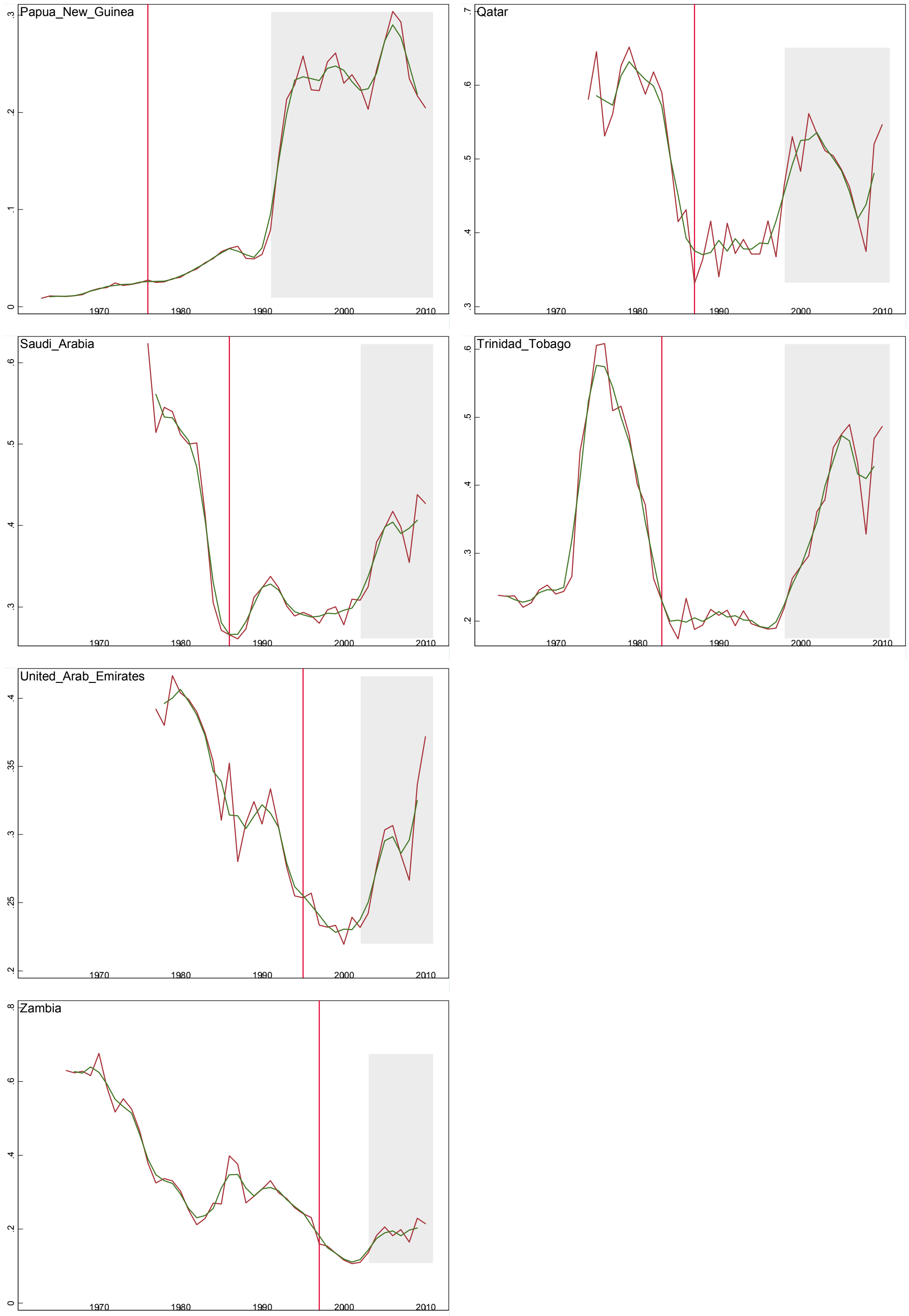

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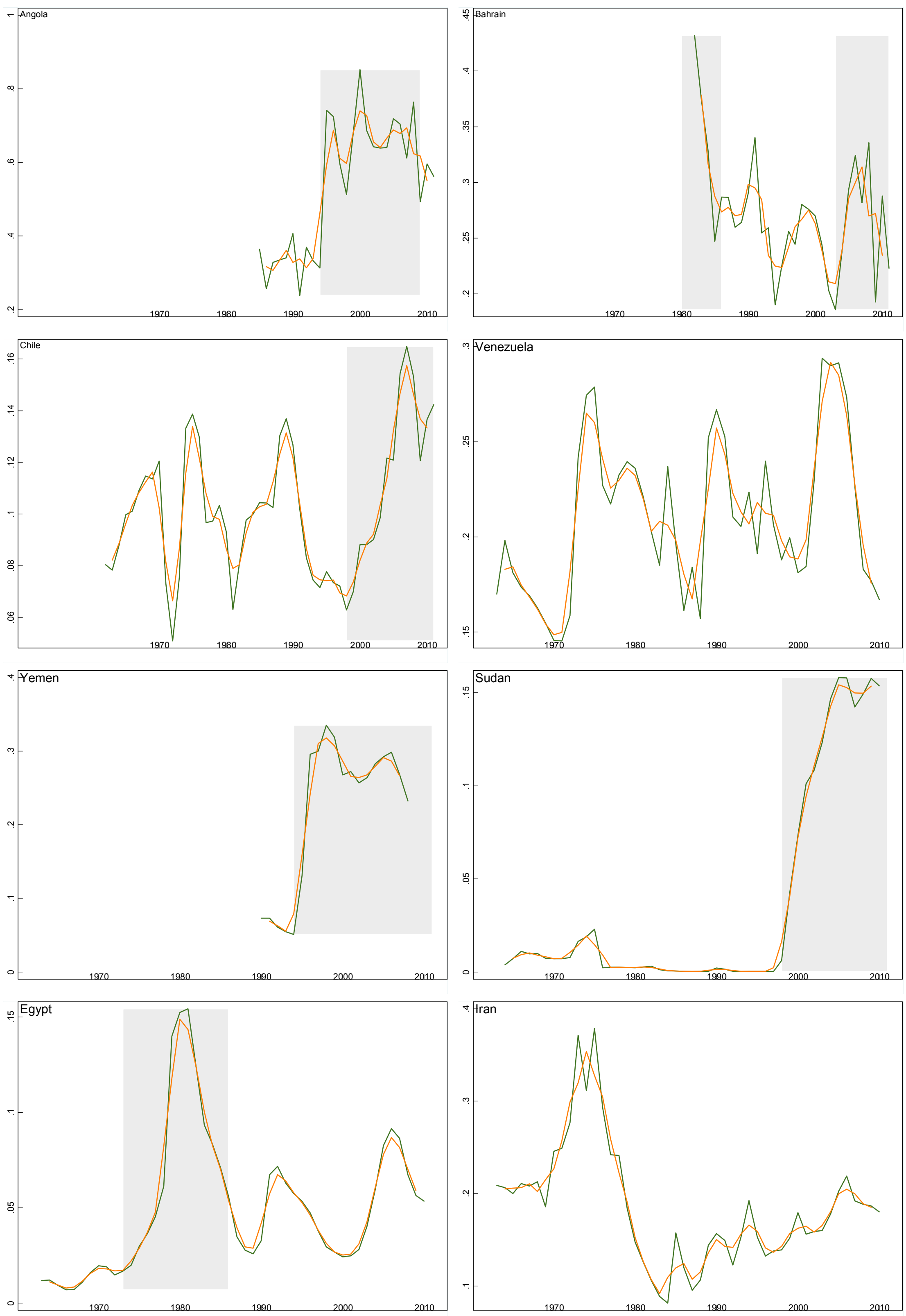
Graphs showing boom periods for 9 countries not used in the analysis



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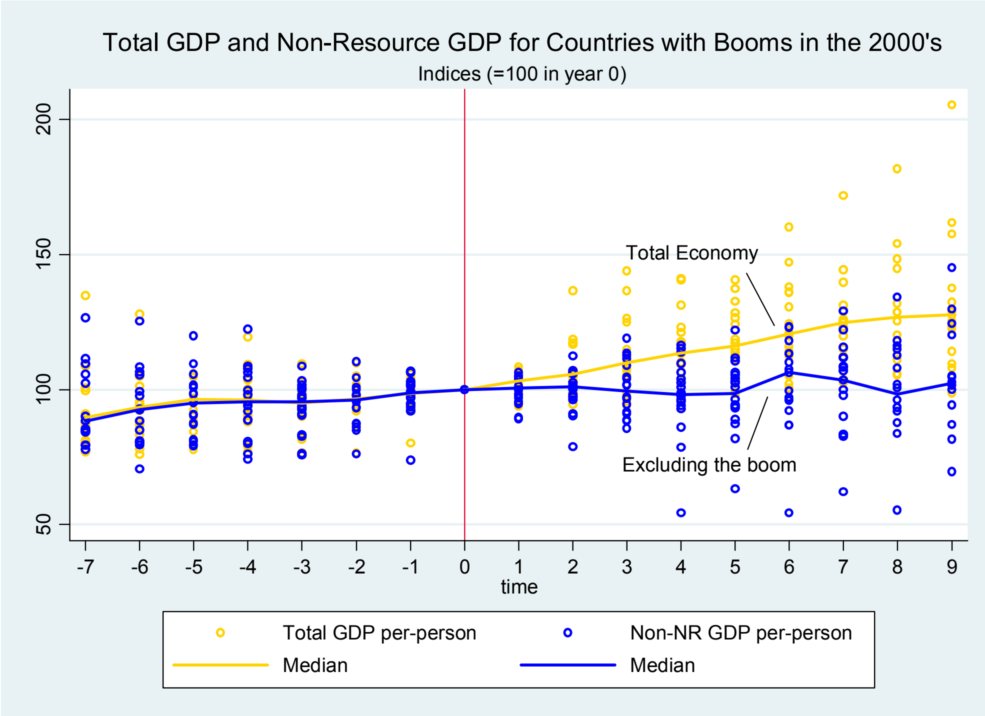
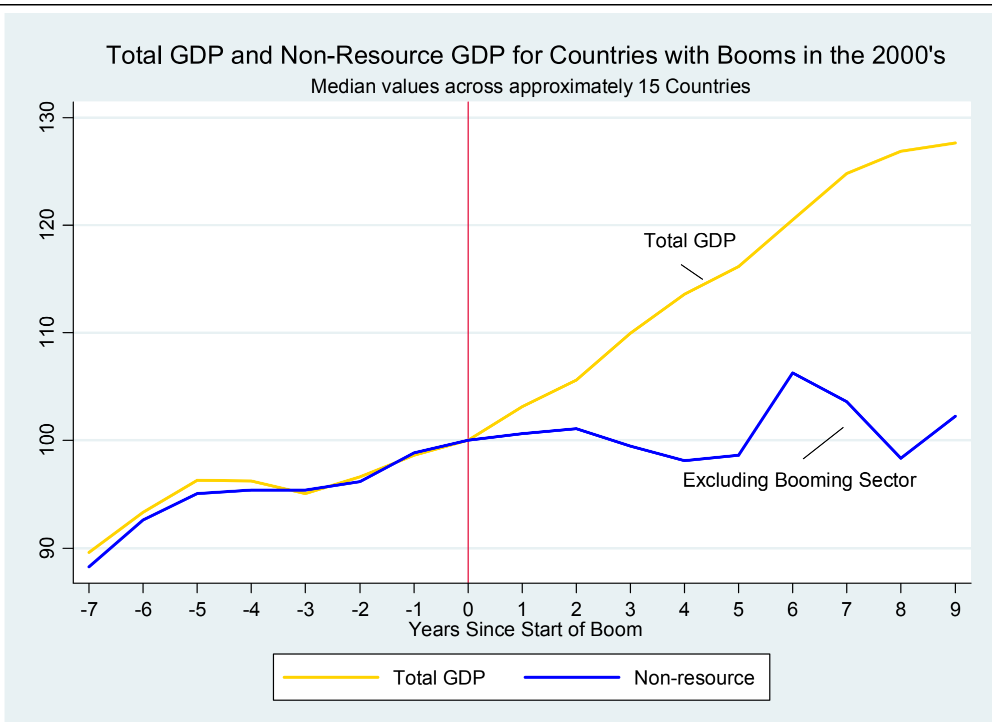
Appendix2: Further detail on total and non-resource GDP per person, before and after the boom years.

Panel 1



Source: Authors Calculations

Panel 2.



Source: Authors Calculations

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