FEP WORKING PAPERS
FEP WORKING PAPERS

RESEARCH
WORK IN
PROGRESS

N. 377, MAY 2010

THE CONNECTION BETWEEN OIL AND ECONOMIC GROWTH REVISITED

NUNO TORRES [1]
ÓSCAR AFONSO [2] [3]
ISABEL SOARES [2]

[1] FACULDADE DE ECONOMIA DA UNIV. DO PORTO
[2] CEF.UP, FACULDADE DE ECONOMIA, UNIV. DO PORTO
[3] OBEGEF

U.PORTO
FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

The connection between oil and economic growth revisited

Nuno Torres,[a] Óscar Afonso,[b] and Isabel Soares[c]

[a] Faculdade de Economia, Universidade do Porto, Portugal.

[b] Faculdade de Economia, Universidade do Porto, CEFUP (Centro de Economia e Finanças da Universidade do Porto). Corresponding author. Email: oafonso@fep.up.pt; Address: Rua Dr. Roberto Frias, 4200-464 Porto, Portugal; Fax: 00351225505050; Phone: 00351919991111.

[c] Faculdade de Economia, Universidade do Porto, CEFUP. Email: isoares@fep.up.pt.

Abstract

This study shows that the cross-section "curse" result found with oil abundance indicators for producing countries disappears in a panel estimation considering the most important growth factors. This happens even excluding institutional quality, which is hindered by oil and ores abundance in several cross-section studies, causing the resource curse. In our estimations, neither of the oil indicators shows a significant impact on growth, but when we consider rig productivity there is a positive effect by capital efficiency in: (i) countries with medium and low income per head from East Asia & Pacific and Latin America & the Caribbean, all technological followers; (ii) countries with high income inequality. These results can reflect the broader scope for factor efficiency increases in less developed countries arising from the oil industry, which is described by a highly globalised know-how.

Keywords: Energy, Economic growth, Institutions, Natural resource curse, Panel data.

JEL classification: C23, O13, O47, O50, Q0, Q40.

May 2010

1. Introduction

This paper examines the impact of oil on the economic growth of crude producers after controlling for several relevant variables, namely institutional quality, in a panel-data analysis of the "resource curse" thesis using a factor-efficiency growth accounting framework.

In a series of cross-section studies initiated by Sachs and Warner [50, 51], countries' natural-resource abundance has been associated with lower economic growth, an unexpected result known as the "resource curse".[1] The first explanations were based on the not empirically confirmed structuralist theses of the 50s (*e.g.*, Dawe [21]) and Dutch Disease theories (*e.g.*, Sala-i-Martin and Subramanian [54]), where natural-resources booms hinder the industrial sector. Another thesis stresses the negative effect of rent-seeking activities related with natural resources (*e.g.*, Torvik [57]), which do not occur in all countries (Bulte *et al.* [12]) and the concern extends to any source of rents (Lederman and Maloney [36]).

There is now a growing consensus on the importance of institutions in explaining the resource curse (*e.g.*, Hartford and Klein, [32]). Mehlum *et al.* [43], for example, conclude that better institutions can avoid the resource curse, but they admit that natural resources can affect institutional quality. This is identified by recent endogenous-institutions explanations, where the kind of natural resources affects institutional quality (*e.g.*, Auty [5, 6]), which benefits growth (*e.g.*, Acemoglu *et al.* [1]). Isham *et al.* [34] and Sala-i-Martin and Subramanian [54] sustain that natural-resource abundance penalises growth only indirectly, by institutional quality, in the case of geographically concentrated resources, such as oil.

Following Sachs and Warner [50], the standard resource-curse studies measure natural-resource abundance as the share of merchandise exports or GDP. Other studies, which explore more direct measures of mining production or reserves, find distinct results on the effect of geographically-concentrated resources. Davis [19] shows that countries with a high share of

---

[1] Bleaney and Nishiyama [10] show that those findings are robust to the inclusion of other explanatory variables from growth models.

minerals in exports and GDP performed well in 1970-1989. The mining share in GDP is also a robust growth regressor in Sala-i-Martin *et al.* [53]. Brunnschweiler [14] shows that *per capita* mineral and fuel production in 1970 benefited growth until 2000, and Nunn [45] finds a positive effect of *per capita* gold, oil and diamonds production on GDP.

We focus on oil resources and assess the effect of several oil abundance indicators on growth: the weight of fuels in merchandise exports,[2] and also crude oil proven reserves and crude production. Reserves provide the best abundance indicator of the three alternatives, being a stock measure of oil resources. The weight of fuels in merchandise exports is an imperfect measure of abundance and dependence due to possibility of re-exportation and the use of flow variables, while crude production (also a flow) reflects abundance only partially, also relying on *e.g.*, political, technological and geological conditions for extraction.

In our model, the contribution of oil to growth includes the impact as a production factor and the potential effects on labour and capital efficiency.[3] The contributions of the most important growth factors, namely labour, capital, investment, trade, institutional quality, infrastructure and R&D are also estimated. Human capital is reflected in wages through the labour profit-maximizing condition (in a log-growth version, only requiring that wage follows productivity evolution) used to estimate the growth of unobserved efficiency levels.

The resource-curse possibility in a panel of oil producers is evaluated by the effect of oil abundance indicators, interpreted as oil windfalls, on factor efficiency. However, the impact of oil on growth may be positive, as pointed by several studies (*e.g.*, Brunnschweiler [14]). The effect of oil indicators is analysed by using several dummy variables, separating countries through level and inequality income, technological-knowledge clubs and geographical areas.

---

[2] As used by many resource-curse studies, such as Leite and Weidmann [37]. We also adjust for re-export distortion using net-export dependency ratios (in line with Wood and Owens [59]).

[3] This differs from the classic production function with exhaustible resources in Dasgupta and Heal [18].

Given our panel of oil producers, we would expect different impacts when comparing developed and developing countries, either in case of a resource curse affecting institutions (stronger in developed countries) or a positive effect on labour and capital efficiency (namely because of differences in economic structures).[4] By using panel data, we increase the estimation efficiency and control the presence of unobserved country and time effects, which, if not considered, can lead to inconsistent estimates, and we have evidence of those effects in a recent and rare panel study of the resource curse by Manzano and Rigobon [39].

By including institutional quality as a cause of labour efficiency, we can assess if the consensus explanation of the resource curse in cross-section studies is valid in our panel of oil producers. Unlike Manzano and Rigobon [39], we also assess institutional quality over time following the interpretation of institutions as reflecting policies (*e.g.*, Dodrik *et al.* [23]; Brunnschweiler and Bulte [15]). In line with, *e.g.*, Acemoglu *et. al.* [2], we consider that macroeconomic policy reflects the quality of institutions and focus on fiscal policy since several cases,[5] such as Norway, suggest it may be crucial in avoiding the curse result.[6] Our proxy is the budget balance share in GDP (*e.g.*, Burnside and Dollar [13]). To consider the deferred effect of policies and avoid endogeneity problems, we instrument our proxy by its own lags and then estimate using a 2SLS approach. The institutional approach of “deep and durable” features of societies followed by cross-section resource curse studies is also tested.[7]

We must also consider that the geographic concentration of oil-proved reserves is crucial in terms of investment flows. Much of the international investment in productive

---

[4] Particularly in the case of the crude production indicators, which, as mentioned above, they reflect several aspects other than abundance (namely technological and political).

[5] In addition, we can assume that the quality of different policies is correlated. According to Mauro [42], the measures of corruption and various aspects of bureaucratic efficiency are highly correlated, while Stein *et al.* [56] associates the quality of legislative capabilities, in general, to the quality of policies, namely fiscal.

[6] Davis [20], for example, shows the importance of stabilization funds for non-renewable resources in dealing with the challenges of high volatility and uncertainty of revenue streams.

[7] We use the Polity and Freedom House indicators as they are available across time for many countries. To avoid potential endogeneity problems, we test with lags of these indicators (instrumentation proved difficult in this case, as lags are not good instruments) and also with values in 1979.

capacity has been undertaken in countries where foreign direct investment has serious restrictions or faces considerable political risk. In prospective terms, this means that, unless there is a full change in policies, political institutions and attitudes, a greater proportion of the cash flow of producing countries will be needed for oil re-investment (Greenspan [29]).

In the last few years prior to the financial and economic international crisis, production among international oil (and gas) firms was stagnant, despite an increase in global energy demand. Political risk and serious concerns about security of supply are among the main causes of a lack of investment in oil (and gas) exploration and production recognized by the International Energy Agency (Osmundsen *et al.* [46]). While OPEC's market share and influence has been increasing, the production growth among major Western oil (and gas) firms has remained low. Since 1990 there has been a strong fall in Exploration and Production (E&P) investments, and according to certain authors (Stein [55]; Bertrand and Mullainathan [9]; Dobbs *et al.* [22]), an increasing share of oil investment has been directed towards short and medium-term development projects rather than long-term reserve development.

Therefore, poor institutional quality may reduce the flow of international oil investment and, indirectly, the total amount (and composition) of national investment. In this study, the effect of oil on growth is estimated and analyzed in a final panel of 21 countries from 1980 to 2003, taking into account national investment and institutional quality, as mentioned above.

The use of yearly observations is preferred to period aggregation traditionally used in growth studies (to account for economic cycles) to reflect the impact of fiscal-policy and oil rents variability on growth in a panel case,[8] requiring the consideration of differences in political cycles across countries. There is also evidence that volatility has a significant

---

[8] Fatás and Mihov [25, 26] challenge the claim of Acemoglu *et al.* [2] that macroeconomic policy is just a transmission mechanism for institutions by showing that fiscal policy volatility hinders growth after controlling for institutional variables. Bleaney and Halland [11] find that this negative effect is explained by changes in natural-resources exports weights (the curse result is reduced and affects both diffuse and concentrated resources) as institutional variables become insignificant. Following Bleaney and Halland [11], we deem that the access to natural-resource rents distorts fiscal policy and assess this thesis in our case.

negative effect on long-term growth (*e.g.*, Martin and Rogers [40]). Some of these factors may explain unexpected results we find with five-year panels, due to loss of information.

The paper is structured as follows. In section 2, we derive and present the model specification. In section 3, we discuss the main results, analysing the significant oil impacts on growth through several dummies, followed by estimated growth decompositions for some representative countries. Finally, concluding remarks are presented in section 4.

2. The effect of oil concentration on economic growth

This section presents the model specification used to estimate the impact of oil concentration on growth. The model is first derived for natural resources (subsection 2.1) and then modified to estimate and decompose the effect of oil on growth (subsection 2.2).

2.1 Growth accounting model

Production function with factor efficiency

We consider the following neoclassical Cobb-Douglas production function with constant returns to scale, at each time *t* (Table A1 in Appendix 1 shows the sources of all proxies):[9]

$$Y(t) = \left[L(t)f(t)\right]^{\alpha}\left[K(t)g(t)\right]^{\beta} e^{\int(\gamma Oil(t))dt}, \text{ where:} \qquad (1)$$

(i) Y is the real aggregate output; (ii) L represents labour; (iii) K is the capital stock; (iv) f (g) is the labour (capital) efficiency; (vi) *Oil* represents our oil indicators;[10] (vii) α and β (γ) are constant elasticities (semi-elasticities) of L and K (*Oil*) in relation to Y; and (viii) Lf (Kg) measures labour (capital) in efficiency units, whereas L and K are expressed in conventional units. Thus, quality advances in L and K are captured by f and g in (1).

From (1), we reach the following expression for the product real growth rate:

---

[9] The multi-sector approach (*e.g.*, Matsuyama [41]) is not used, thus Dutch Disease or rent-seeking theses, which do not account for the diversity of cases among natural-resource abundant countries (Auty [5]), are not tested in a curse scenario.

[10] *Oil* is included as production factor in Y, and also inside f and g to assess the effect on factor efficiency and the curse thesis. As explained below, we exclude the usual direct effect of windfalls in Y to maintain estimation procedures. However, the inclusion of oil windfalls inside f and g also boosts Y in the absence of a curse.

$$\hat{Y}(t) = \alpha\left[\hat{L}(t) + \hat{f}(t)\right] + \left(\beta\right)\left[\hat{K}(t) + \hat{g}(t)\right] + \left(\gamma Oil(t)\right), \tag{2}$$

in which the circumflex accent expresses the log growth rate. As *f* and *g* are unobserved, they are considered a function of several variables, including *Oil*. Equations for *f* and *g* allow us to evaluate Total Factor Productivity (TFP) and are in line with Coe and Helpman [17]. Thus, they are also built on endogenous growth models based on R&D (*e.g.*, Aghion and Howitt [3]; Barro and Sala-i-Martin [8]) and on human capital (*e.g.*, Lucas [38]; Mincer [44]).

Specification for labour efficiency

Assuming the functional form of constant elasticity, we propose the following expression for labour efficiency *per* worker at each time *t*:

$$f(t) = F\left(\frac{I(t)}{L(t)}\right)^{a_1}\left(\frac{T(t)}{L(t)}\right)^{a_2} e^{\int\left(a_3 IQ(t) + a_4\frac{Oil(t)}{L(t)}\right)dt} \text{, where:} \tag{3}$$

(i) *F* is a scale factor; (ii) *I* is investment; (iii) *T* is international trade; (iv) *IQ* is institutional quality, assessed with two approaches; (v) a_1 and a_2 are elasticities of *f* in relation to $\frac{I}{L}$ and $\frac{T}{L}$; (vi) a_3 and a_4 are semi-elasticities of *f* in relation to *IQ* and $\frac{Oil}{L}$; as *f* refers to the labour efficiency unit, variables were divided by *L*, except *IQ*. Variables are based on empirical studies, *e.g.*, Englander and Gurney [24] (*I*); Frankel and Romer [27] (*T*); Acemoglu *et al.* [1] (*IQ*), Isham *et al.* [34] (*Oil*). From (3), the growth rate of labour efficiency is:

$$\hat{f}(t) = a_1\left[\hat{I}(t) - \hat{L}(t)\right] + a_2\left[\hat{T}(t) - \hat{L}(t)\right] + a_3\, IQ(t) + a_4\,\frac{Oil(t)}{L(t)}. \tag{4}$$

From the first order condition (FOC) for maximizing profit in relation to *L* ($\frac{\partial Y(t)}{\partial L(t)} = w(t)$):

$$\alpha\left[L(t)\right]^{\alpha-1}\left[f(t)\right]^{\alpha}\left[K(t)g(t)\right]^{\beta} e^{\int(\gamma Oil)dt} = w(t), \tag{5}$$

where *w* is the real wage per worker. Then, we derive $\hat{f}$ as a function of $\hat{w}$, $\hat{L}$, $\hat{K}$, *Oil* and $\hat{g}$ (which, in turn, depends on a set of other variables, as shown further below):[11]

---

[11] This was preferred to the FOC in relation to *K* since, as we explain later on, wages also reflect human capital.

$$\hat{w}(t) = (\alpha - 1)\,\hat{L}(t) + \alpha\,\hat{f}(t) + \beta\,\hat{K}(t) + \beta\,\hat{g}(t) + \gamma Oil\,. \qquad (6)$$

The omission of human-capital advances in (3) and thus in (4) is justified by the profit-maximizing condition since, to some extent, wages reflect human capital,[12] in line with endogenous-growth models (*e.g.*, Lucas [38]; Romer [49]) and with empirical studies supported by them (*e.g.*, Barro [7]; Englander and Gurney [24]). However, we stress that perfect competition in the labour market, a very strong assumption for developing countries, is not needed to satisfy (6), from which we derive our estimation forms. We can relax the assumption in (5) considering that wages are not paid their marginal productivity (i.e., the expression is satisfied with inequality), provided that the differential is constant over time or averages to zero. The assumption can be further relaxed as we consider below different hypotheses for unobserved country effects in our panel estimation forms.[13]

In addition to human capital, the other crucial factor of long-run productivity growth is R&D (*e.g.*, Romer [48, 49]; Aghion and Howit [3]; Englander and Gurney [24]), which is included below in the specification of *g*.

Specification for capital efficiency

Considering also the functional form of constant elasticity, we propose for *g*, at each time *t*:

$$g(t) = G\left(\frac{RD(t)}{K(t)}\right)^{b_1}\left(\frac{Inf(t)}{K(t)}\right)^{b_2} e^{\int\left(b_3\frac{Oil(t)}{K(t)}\right)dt}\text{, where} \qquad (7)$$

---

[12] This allowed us to preserve a single-panel estimation approach as yearly education indicators are unavailable for the entire period, and determined the exclusion of *Oil* as a pure windfall in (1) to avoid differences between wage and productivity growth. A limitation of assuming factor prices reflect their quality is that it relies on markets working properly and, in turn, on good institutions, which, as stressed by recent-curse theses, may not be present in all natural-resource abundant countries. However, we should expect low levels and improvement in education and wages in those countries if institutional quality remains low.

[13] In particular, we may consider that the difference between the growth rates of wage and productivity is included in a fixed or random country effect, thus accounting for idiosyncrasies in labour markets or even measurement errors if they can be accounted by fixed or random effects.

(i) G is a scale factor; (ii) RD is R&D; (iii) Inf measures infra-structures;[14] (iv) b_1 and b_2 are elasticities of g in relation to RD and Inf; (v) b_3 is a semi-elasticity of capital efficiency in relation to $\frac{Oil}{K}$; as g refers to the capital-efficiency unit, variables, based on several studies (*e.g.*, Coe and Helpman [17] (*RD*); Roller and Waverman, [47] (*Inf*).), were divided by K.

All explanatory variables in f could also be used in g and vice-versa. We included variables other than Oil where they are expected to have the greatest impact, in order to preserve the usual functional form of constant elasticity. Indeed, due to perfect collinearity, this functional form does not allow a separate estimation of the variables' effects in f and g, as will become clear later on. Since we want to analyse oil effects in f and g, coefficients are included as semi-elasticities to avoid collinearity problems.[15] As oil affects IQ through labour efficiency in several recent resource-curse studies (*e.g.*, Torvik [57]; Isham *et al.* [34]; Sala-i-Martin and Subramanian [54]), its coefficient is only included as semi-elasticity in f.

From (7), the capital-efficiency growth rate is:

$$\hat{g}(t) = b_1\left(\hat{RD}(t) - \hat{K}(t)\right) + b_2\left(\hat{Inf}(t) - \hat{K}(t)\right) + b_3\frac{Oil(t)}{K(t)}. \tag{8}$$

Substituting $\hat{g}$ in (6), we have:

$$\begin{aligned}\hat{w}(t) = {} & \delta_1\left[\hat{I}(t) - \hat{L}(t)\right] + \delta_2\left[\hat{T}(t) - \hat{L}(t)\right] + \delta_3 IQ(t) + \delta_4\frac{Oil(t)}{L(t)} + \delta_5\hat{K}(t) + \delta_6\hat{L}(t) + \\ & + \delta_7\left[\hat{RD}(t) - \hat{K}(t)\right] + \delta_8\left[\hat{Inf}(t) - \hat{K}(t)\right] + \delta_9\frac{Oil(t)}{K(t)} + \delta_{10}Oil + u(t),\end{aligned} \tag{9}$$

where: $\delta_j = \alpha\, a_j$ if $j = 1,2,3,4$; $\delta_5 = \beta$; $\delta_6 = \alpha - 1$; $\delta_j = \beta b_{j-6}$ if $j = 7,8,9$; $\delta_{10} = \gamma$; $u(t)$ is white noise. Equation (9) allows us to obtain estimates for α, β, γ_1, γ_2, a_1 up to a_5 and b_1 up to b_4. We can then use these values to estimate $\hat{f}$ in (4), $\hat{g}$ in (8) and $\hat{y}$ in (2). Since the wage equation is based on the FOC for maximizing profit in relation to L, it expresses labour-

---

[14] Notice that the direct impact of physical infrastructures on growth is already captured by K – here we evaluate the effect on overall capital efficiency.

[15] In addition, since merchandise exports appear as denominator in one of our oil indicators and are also included in T, they could somehow cancel out when we take growth rates. This was the main reason for also including the coefficient of production factor Oil as a semi-elasticity in (1).

productivity growth. Hence, the impact of oil and other variables on GDP growth can be assessed directly in (9), to find if there is an oil curse or bonus.

In the analysis we will assume constant returns to scale assumption in *Lf* and *Kg* $(\alpha+\beta=1)$ and test if the oil impact as a productive factor is significant (*i.e.*, if $\gamma=0$).[16] We also assess the effect of oil on *f* and *g* considering *IQ*. Although this effect appears negative in a cross-country analysis (the curse), the case of some countries shows that these resources can be well managed (*e.g.*, invested in human and physical capital) and thus benefit growth.

Panel estimation model

Panel data improves estimation efficiency through variability across time and countries, and allows the control of unobserved individual heterogeneity (Wooldridge [60]). The estimation requires the choice of several assumptions to deal with the possibility of an unobserved individual element, which, in our case, can be a country and/or a time effect. Denoting:

$$X_j=\left\{\left[\hat{I}-\hat{L}\right],\left[\hat{T}-\hat{L}\right],IQ,\frac{Oil}{L},\left(\hat{K}-\hat{L}\right),\left[\hat{RD}-\hat{K}\right],\left[\hat{Inf}-\hat{K}\right],\frac{Oil}{K},Oil\right\},$$

(9) in a panel case with constant δ_0 and considering constant returns in *Lf* and *Kg* is either:[17]

$$\hat{w}_{it}=\delta_0+\theta\,GNIpc79_i+\sum_{j=1}^{9}\delta_j\left(X_j\right)_{it}+\varphi_{it}, \tag{10}$$

in case of the Pooled OLS and the REM with time and country effects, where $\varphi_{it}=c_i+d_t+\omega_{it}$ (being *i* the country, c_i the country effect, d_t the time effect and ω_{it} a white noise); or

$$\hat{w}_{it}=\rho_{it}+\theta GNIpc79_i+\sum_{j=1}^{9}\delta_j\left(X_j\right)_{it}+\omega_{it}, \tag{11}$$

for the FEM with time and country effects, where $\rho_{it}=\delta_0+c_i+d_t$.[18]

---

[16] This means we can aggregate $\delta_5\hat{K}(t)+\delta_6\hat{L}(t)=\beta\hat{K}(t)+(\alpha-1)\hat{L}(t)$ into $(1-\alpha)\left[\hat{K}(t)-\hat{L}(t)\right]$ in (9). Thus, we lose a coefficient in (9) and it becomes $\delta_5=1-\alpha$; $\delta_j=\beta b_{j-5}$ if $j=6,7,8$; $\delta_9=\gamma$.

[17] We also considered lagged variables, not included in vector *X*, but only *RD* lags produced significant results (see the next section), besides the use of budget-balance lags as instruments for the *IQ* policies' proxy, which is explained with more detail in section 3.

[18] The FEM asks how group and/or time affect the intercept, while the REM analyses error variance structures affected by group and/or time. In both, slopes are assumed unchanged. The pooled OLS is based on the idea that

By including GNI *per capita* in 1979 for each country *i* ($GNIpc79_i$), in (10) and (11), we assess the conditional-convergence hypothesis of countries: $\theta < 0$ (> 0) conveys a smaller (higher) productivity growth in richer countries and thus the convergence (divergence) of countries. In general, the FEM produces more robust results as it ensures the consistency of estimates without loss of observations. However, if we are interested in the impact of a time-constant variable in a panel-data study, such as $GNIpc79_i$, the robustness of the fixed-effects estimator is useless (Wooldridge [60]) as the coefficient cannot be estimated in a FEM.

2.2 The analysis of oil impact on labour and capital efficiency

Finally, we decompose the coefficients of $\frac{Oil}{K}$ and $\frac{Oil}{L}$ using several multiplicative dummy variables to explain the possible significant impacts on growth (see section 3):

- Income: *HIC*=1(0) and *LIC*=0(1) for High (Low and Middle) Income Countries (World Bank classification, 2007). This dummy evaluates whether the impact of oil differs between rich and middle/low-income countries. If there is a resource curse, rich countries may not be affected by oil abundance in the presence of strong institutions. If the oil impact is positive, however, we can expect a higher impact in poor countries, with lower efficiency levels;
- Technology Clubs: *A*=1(0) and *FM*=0(1) for Advanced (Follower/Marginalised) countries. The empirical analysis of Castelacci [16] identifies the three technology clubs aforementioned, all showing markedly different levels of technological-knowledge development. Considering the possibility of a resource curse and the institutional approach, stronger institutions should prevent a probable negative impact of oil abundance on R&D effort. On the other hand, if there is a positive impact on capital and labour efficiency, it should occur in countries with low levels of technological-knowledge development;

---

countries would react in the same way to changes in explanatory variables and that intercepts are the same for all countries. The choice of the adequate estimation model is made in view of proper test statistics.

- Geographic groups: *EAP*/*ECA*/*LAC*/*MNA*/*SAS*/*SSA*=1(0) if country *i* is from East Asia & Pacific/Europe & Central Asia/Latin America & the Caribbean/Middle East & North Africa/South Asia/Sub-Saharan Africa (otherwise). This dummy follows the World Bank (2007) geographic classification for *LIC*, but we also apply it to *FM* countries. Thus, our area dummies identify differences in oil impacts which can result from variations in income, technological-knowledge levels, and also distinct exploration conditions associated with varied local crude oil characteristics (*e.g.*, Law [35]; Grace [28]);
- Inequality: *GL*=1(0) and *GH*=0(1) if Gini Index$_i$ <(≥)40. In case of a resource course, countries with worse institutions should have higher inequality due to a bad distribution of oil wealth. If, however, there is a positive effect of oil, it should be higher or only occur in countries where the sector can induce wage inequality due to a productivity advantage over the rest of the economy, typically in developing countries (*e.g.*, Sachs and Warner [51]). The usual threshold of 40 is used to split high from low and medium inequality countries.

Consequently, the vector X_j in our panel specification (10) and (11) is redefined to include the multiplicative dummy variables (which are combined as shown in section 3):

$$X_j = \left\{ \begin{array}{l} \left[\hat{I}-\hat{L}\right],\left[\hat{T}-\hat{L}\right], IQ, \frac{Oil}{L}, \left(\hat{K}-\hat{L}\right), \left[\hat{RD}-\hat{K}\right], \left[\hat{Inf}-\hat{K}\right], \frac{Oil}{K}; HIC\times\frac{Oil}{K,L}, LIC\times\frac{Oil}{K,L}; A\times\frac{Oil}{K,L}, FM\times\frac{Oil}{K,L}; \\ HIC\times\frac{Oil}{K,L}, LIC\times\frac{Oil}{K,L}\times\left[EAP, ECA, LAC, MNA, SAS, SSA\right]; \\ HIC\times\frac{Oil}{K,L}, FM\times\frac{Oil}{K,L}\times\left[EAP, ECA, LAC, MNA, SAS, SSA\right]; GL\times\frac{Oil}{K,L}, GH\times\frac{Oil}{K,L} \end{array} \right\}.$$

3. Results

Table 1 shows descriptive statistics of the data for the main variables in our unbalanced panel of 48 oil producers from 1980 to 2005.[19] We stress the high standard deviations of most variables, namely oil indicators, expressing a high diversity of situations among oil producers.

---

[19] Our panel excludes oil producers from former USSR and Yugoslavia because they are aggregated in OPEC data, and the same does not happen in the remaining data.

Table 1 – descriptive statistics of main variables for oil producers (1980-2005)

	Mean	S.D.
GDPpc growth	0.971	7.280
$\hat{w}$	0.431	8,411
$(\hat{I} - \hat{L})$	1.530	17.628
$(\hat{T} - \hat{L})$	4.166	12.317
IQ: budget balance in % of GDP	-2.570	4.961
IQ: Polity [a)]	1.243	7.940
IQ: Freedom [b)]	4.229	2.117
Oil: crude production (thousand barrels a day)	1059.621	1609.555
Oil: proven crude reserves (million barrels)	28839,287	49828.366
Oil: number of rigs	84,120	325.574
Oil: number of wells	2618.268	3840.835
Oil: weight of fuels in merchandise exports	31.150	34.012
Oil: net weight of fuels in merchandise exports + 100	20.941	38.302
$\hat{L}$	1.718	4.939
$\hat{K}$	3.109	3.406
$(\widehat{Inf} - \hat{K})$	9.846	14.205
$(\widehat{RD} - \hat{K})$	-1.771	25.559

Notes: percent values except for *Oil* and *IQ* indicators; results based on non-missing observations; [a)] Revised combined Polity score (Polity IV), ranging from -10 (strongly autocratic) to +10 (strongly democratic); [b)] Freedom classification (from The Freedom House) combining average ratings for Political Rights and for Civil Liberties – countries rated 3 or less are classified as Free, between 3 and 5 (5,5 since 2003) are Partially Free, and between 5 (5,5 since 2003) and 7 are Not Free.

Figure 1 depicts a negative correlation between the weight of fuels in merchandise exports (in 1979), one of the most used indicators of oil abundance in cross-section resource curse studies, and real GDP per capita growth from 1979 to 2005 in our panel of oil producers, illustrating the curse result for oil.[20] The inverse relation is also found with crude oil reserves (Figure 2),[21] a better indicator of oil abundance, and with crude production (Figure 3), which reflects abundance only partially, also depending on other aspects such as technological and geological conditions for extraction.[22]

---

[20] We also found a negative correlation adjusting for re-exportation distortion (net export dependency ratio).

[21] The correlation is less intense than in the previous case, and it still prevails without the outlier Saudi Arabia.

[22] Crude reserves and production are only available beginning in 1980.

Figure 1 - GDPpc average growth rate from 1979 to 2005 and fuel export dependence in 1979 (unadjusted proxy)

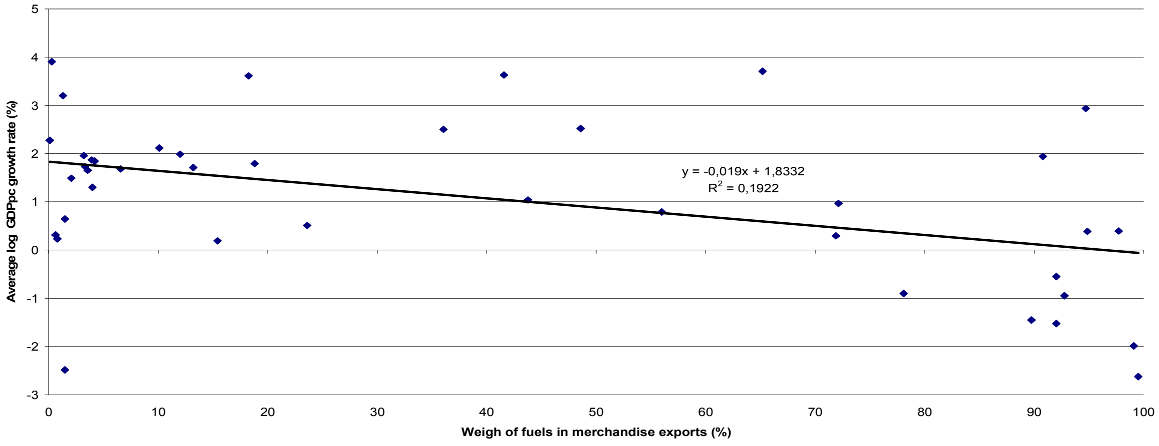


Figure 2 - GDPpc average growth rate from 1979 to 2005 and crude oil proven reserves in 1980

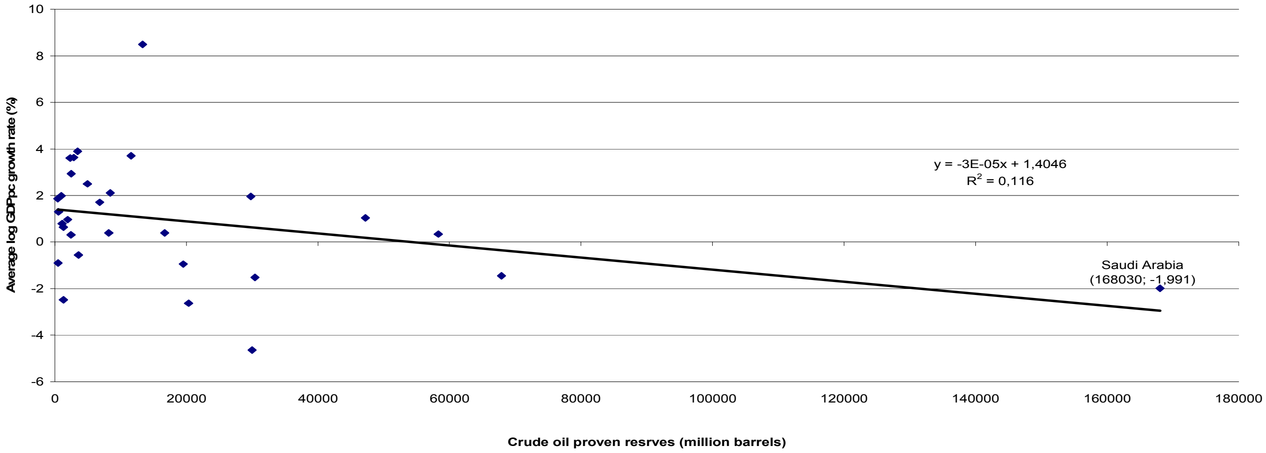


Figure 3 - GDPpc average growth rate from 1979 to 2005 and crude oil production in 1980

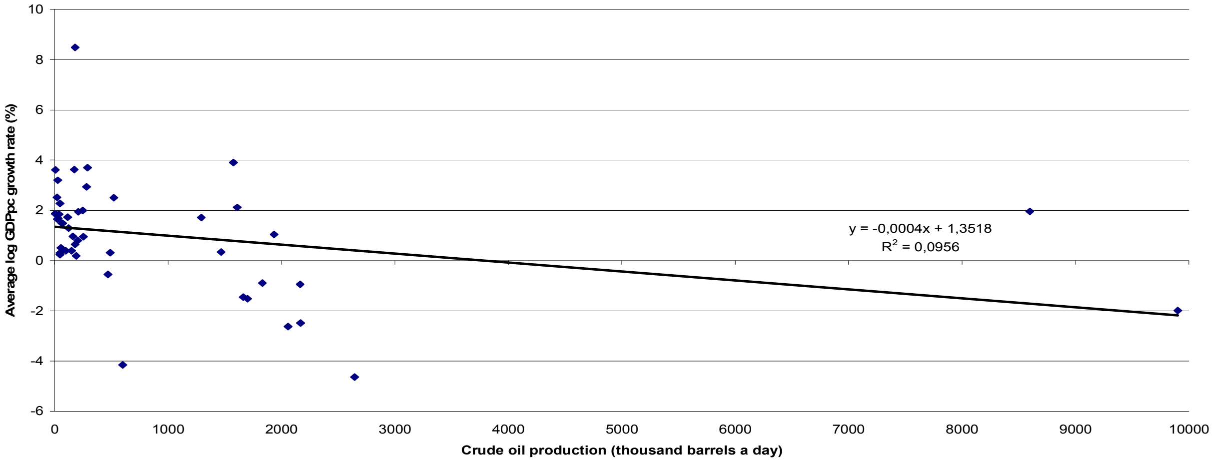


Table 2 shows estimations of (10) without dummy variables in a REM (the appropriate model according to test statistics in all cases), considering the different alternatives for oil and institutional quality indicators. To take into account the deferred impact of fiscal policy (*IQ* 'policies' approach) on growth, we first instrument our proxy (the budget balance), with a two-period lag of the variable and then run the main regressions using a 2SLS approach, which means that the years 2004 and 2005 are not estimated.[23] We do not find any significant (at 10%) negative effect of oil indicators on factor efficiencies (coefficients of $\frac{Oil}{L}$ and $\frac{Oil}{K}$) in our estimations, even excluding *IQ* indicators, thus dismissing an oil curse in our case.

Results also show that the oil effect as a productive factor is insignificant for all indicators (we do not reject, at 10%, that *Oil* coefficient $\gamma = 0$). As an additional robustness test, we conducted estimations with five five-year panels form 1980 to 2005 and also found no evidence of a resource curse, but these results were not satisfactory as some variables were insignificant or showed unexpected coefficients, maybe due to loss of yearly information.

The first regression in Table 2, using the weight of fuel merchandise exports as the oil abundance indicator, shows that the convergence variable is not significant (at 10%),[24] while most growth econometrics provide support for conditional convergence (*e.g.*, Sala-i-Martin

---

[23] The instrumentation results are not shown but they are available upon request. Given the similarity of results with instrumented and uninstrumented explanatory variables, we exclude endogeneity problems (raised by, *e.g.*, Brunnschweiler and Bulte [15]) and keep this procedure only for the budget balance to consider the deferred effect of fiscal policy and avoid further loss of observations. Since Polity and Freedom could not be instrumented, we used instead one-year lags and values in 1979. Instrumentation dilutes the positive correlation of our fiscal policy proxy with the oil-resource proxies admitting that the state saves parte of the associated rents. If the state spends in advance of expected future rents, endogeneity could come instead from instrumented fiscal policy (similarity of results also dismisses this), but the possibility is discouraged by the volatility of those rents. As for the introduction of time lags in other explanatory variables, they only produced significant results in *RD*.

[24] The convergence variable is insignificant even excluding oil indicators. Since we do not have evidence of resource course in our estimations, the problem of endogeneity concerning the initial income is not crucial to our results. The question was raised by Alexeev and Conrad [4] and Herb [33], who argue that natural-resources exports depends on domestic consumption, and both consumption and income may be correlated with democracy, thus the inclusion of the initial level of income introduces endogeneity if measured after oil discovery. The authors remove the oil component from the initial income level and the oil curse disappears. However, Tsui [58] stresses that fuel is a noisy measure of natural resource and, as a flow variable, it also understates the oil wealth of the swing producers who produce below their full capacity.

[52]), although usually in larger country samples. We excluded the convergence variable in the rest of regressions as it is always insignificant and does not allow the Hausman Test.[25]

Table 2 – Wage equations (1980-2003)

Regression	1	2	3	4	5	6
Model	REM G&T $^{(a)}$	REM G&T	REM G&T	REM G&T	REM G&T	REM G&T
F $^{(b)}$	2.127	2.133	2.101	2.452	2.242	2.711
LM $^{(b)}$	15.91	17.06	18.27	9.53	17.41	15.52
Hausman $^{(b)}$	n.a.	6.51	6.89	7.04	6.51	8.26
Oil proxies	Fuel exp. weight	Fuel exp. weight	Fuel net exp. weight	Oil reserves	Oil production	Rig productiv.
IQ proxies	Fisc.Policy, Polity$_{-1}$	Fisc.Policy, Polity$_{-1}$	Fisc.Policy, Polity$_{-1}$	Fisc.Policy, Polity$_{-1}$	Fisc.Policy, Polity$_{-1}$	Fisc.Policy, Polity$_{-1}$
	Dependent variable, $\hat{w}$					
Constant	1.339 (0.642)	0.277 (0.171)	-0.496 (-0.143)	0.666 (0.204)	0.282 (0.192)	0.239 (0.160)
GNIpc79USD	-0.000 (-0.829)					
$(\hat{I}-\hat{L})$	0.083* (3.132)	0.083* (3.148)	0.082* (3.095)	0.081* (2.411)	0.087* (3.270)	0.070* (2.553)
$(\hat{T}-\hat{L})$	0.085 (1.323)	0.073 (1.167)	0.075 (1.188)	-0.051 (-0.597)	0.065 (1.038)	0.062 (0.875)
IQ: F. Polity	0.385*** (1.811)	0.350*** (1.668)	0.345*** (1.659)	0.237 (0.881)	0.279 (1.359)	0.401*** (1.772)
IQ: Polity$_{-1}$	0.110 (0.952)	0.077 (0.708)	0.067 (0.594)	-0.173 (-0.580)	0.066 (0.620)	0.049 (0.389)
Oil	0.010 (0.279)	0.018 (0.531)	0.011 (0.408)	0.000 (0.130)	-0.000 (-0.147)	
$\frac{Oil}{L}$ (c)	-0.117 (-.0.634)	-0.160 (-.0.931)	-0.037 (-.0.650)	0.001 (0.823)	-0.000 (-0.005)	-0.007 (-0.440)
$\frac{Rigs}{L}$ (c)						0.037 (1.117)
$\frac{Oil}{K}$ (c)	1.612 (0.560)	2.298 (0.860)	0.544 (0.601)	-0.007 (-.0.321)	-0.021 (-0.127)	0.150*** (1.913)
$\frac{Rigs}{K}$ (c)						-2.596 (-0.998)
$(\hat{K}-\hat{L})$	0.321* (5.797)	0.328* (5.977)	0.330* (6.007)	0.157 (1.597)	0.326* (5.968)	0.292* (5.496)
$(\hat{Inf}-\hat{K})$	0.129* (2.585)	0.136* (2.797)	0.139* (2.832)	0.272** (3.253)	0.141* (2.922)	0.126** (2.415)
$(\hat{RD}-\hat{K})$	0.011 (0.909)	0.011 (0.901)	0.010 (0.829)	0.014 (0.926)	0.011 (0.921)	0.022 (1.600)
$(\hat{RD}-\hat{K})_{-1}$	0.024*** (1.860)	0.026** (2.034)	0.026** (1.997)	0.008 (0.497)	0.025*** (1.918)	0.014 (0.992)
$(\hat{RD}-\hat{K})_{-2}$	0.011 (0.797)	0.014 (0.968)	0.014 (0.994)	-0.010 (-0.546)	0.015 (1.031)	-0.015 (-0.948)
Observations	343	348	348	197	350	284
R^{2} $^{(d)}$	0.472	0.471	0.472	0.507	0.467	0.523
Adjusted R^{2} $^{(d)}$	0.357	0.358	0.359	0.342	0.354	0.406

Notes: T-ratios below the coefficients' estimates. Significance levels of 5% (*), 10% (**) and 10% (***). $^{(a)}$ G&T stands for a joint Group (country) and Time effect. $^{(b)}$ The F/LM/Hausman tests choose between *Pooled* OLS and FEM/Pooled OLS and REM/FEM and REM; G&T effects are chosen over individual effects if significant; $^{(c)}$ To avoid values close to zero, ratios with *L* were multiplied by 10^3 and ratios with *K* by 10^9, expressing in all cases indices of oil abundance *per* factor unit; $^{(d)}$ From the FEM G&T; estimations obtained with Limdep 8.0 software.

---

[25] For the same reasons, we also do not present results with the *IQ* proxies Polity79, Freedom79 and Freedom$_{-1}$, showing only the estimations with the instrumented proxy for fiscal policy and also Polity-$_{1}$. Estimations with indicators based on wells were not possible due to lack of observations, thus they are also not present in Table 2.

Excluding the variable in Regression 2, we have similar results. We stress the positive significant effects of *I* and fiscal policy through *f*, and *Inf* and RD_{-1} through *g*, which also occur in regression 3 (with the exception of RD_{-1}, which is insignificant) using fuel net export dependency ratio as an *Oil* indicator to adjust for re-export distortion. Results become hampered in regression 4, where we use oil proven reserves, as the number of observations drops to less than 200 (compared to almost 350 in the previous regressions). Only *I* and *Inf* remain significant. The capital share,[26] which is near the usual one third reference value in the first three regressions (significant at 1%), is insignificant at 10%. The number of observations goes up again to 350 in regression 5, using crude production, which bears no significant effect (at 10%) on *f* or *g*, as it happened with reserves in the previous regression. Fiscal policy and the capital share are again significant (but not RD_{-1}), besides *I* and *Inf.*

In regression 6, we exclude the impact of oil as a production factor (insignificant in all our estimations) and disaggregate production into rig productivity and the number of rigs inside *f* and *g*. [27] Results show that rig productivity has a significant positive effect on *g*, while the effect by *f* and rigs impacts are insignificant (at 10%). The positive effect on capital efficiency arising from rig productivity, which can be interpreted as an indicator of oil concentration in space, may reflect capital and technological intensity owing to the exploitation of those resources, in addition to economies of scale, as the spatial concentration allows the dilution of high fixed costs. The coefficients of *I*, fiscal policy and *Inf* still show significant positive effects on growth, while the capital share is almost 30% (significant at 1%), but *RD* is insignificant.[28] As in the other five regressions, *T* is (surprisingly) insignificant

---

[26] The coefficient of $(\hat{K} - \hat{L})$, $1-\alpha = \beta$.

[27] Remember that that we are disaggregating crude production inside efficiencies per factor unit, thus we will have four components: $\frac{Oil}{L}$, $\frac{Oil}{K}$, (where *Oil* is rig productivity), $\frac{Rigs}{L}$ and $\frac{Rigs}{K}$. This disaggregation would be more precise if we used logs instead of absolute values, but the conclusions are similar.

[28] The use of *RD* lags captures a (deferred) positive impact of R&D. However, the associated coefficients are not always significant in our regressions, maybe due to some limitations of the proxy (see Appendix 1).

at 10%, and the same goes on with $Polity_{-1}$, showing that the (durable) institutional indicators are less suited than the (more variable in time) *IQ* 'policies' approach in a panel study.

The significant impact on capital efficiency arising from rig productivity is decomposed and explained in Table 3 through the use of dummy variables.[29] Since the panel estimation only considers the years with data for all variables in each country, we obtained just over 280 observations in these regressions considering all variables, corresponding to 21 countries from 1980 to 2003. In Appendix 2 (Table A2), we present the number of years with complete data for each of the 46 oil producing countries together with the corresponding categories, in view of our dummy variables. An inspection of the estimation panel shows enough variability to carry our estimation and exclude selectivity bias problems in most cases.[30]

According to test statistics, the REM with Group and Time Effects is still the adequate model for all regressions in Table 3 – estimation form (10). In the first regression, we confirm the positive impact of rig productivity on g (coefficient of $\frac{Oil}{K}$), significant at 10%, and a negative but not significant effect through f. The variables I, IQ and Inf also benefit growth in oil producers, with similar estimates to regression 6 in Table 2, where the impacts of rigs and $Polity_{-1}$ were considered. T and RD are also not significant at 10%, whereas the estimate of capital elasticity is slightly higher (30.4%, significant at 1%).

The second regression in Table 3 shows that the impact of rig productivity is higher (and significant at 5%) when we exclude the *IQ* variable (fiscal policy). Thus, it seems that a higher budget balance reduces the positive effect of oil on growth, maybe due to less public re-investment in the oil sector, although foreign investment could increase corresponding to the increase in institutional quality (smaller country risk).

---

[29] Regressions exclude the insignificant effects of rigs on f and g found in Table 2, but include the effect of rig productivity on f. We also exclude $Polity_{-1}$ (insignificant), leaving fiscal policy as the only *IQ* proxy in Table 3.

[30] Considering our dummies, only Sub-Saharan countries (SSA) are not estimated in our regressions due to data constraints. Middle East countries are also clearly misrepresented in our dummy MNA (only one observation from Iraq) due to data availability.

Table 3 – Wage equations (1980-2003)

Regressions		1	2	3	4	5	6	7
Dummies		None	None	Income	Income; Geogr.(LIC)	Tech. Clubs	T.Clubs; Geogr.(FM)	Inequality
Oil proxies		Rig productiv.	Rig productiv.	Rig productiv.	Rig productiv.	Rig productiv.	Rig productiv.	Rig productiv.
IQ proxies		F.Polity	Absent	F.Polity	F.Polity	F.Polity	F.Polity	F.Polity
Model		REM G&T						
Test Statistics	Hausman	5.55	7.94	5.76	9.73	6.53	10.81	5.91
	LM	15.29	21.19	15.44	15.08	15.12	14.94	15.58
	F	2.883	2.598	2.869	3.036	2.916	3.097	2.861
Dependent variable		$\hat{w}$						
Constant		0.405	1.000	0.443	0.173	0.272	-0.079	0.459
		(0.343)	(0.094)	(0.376)	(0.100)	(0.223)	(-0.046)	(0.389)
$(\hat{I} - \hat{L})$		0.064^{**}	0.071^{**}	0.063^{**}	0.067^{**}	0.065^{**}	0.069^{*}	0.063^{**}
		(2.353)	(3.154)	(2.314)	(2.493)	(2.399)	(2.587)	(2.311)
$(\hat{T} - \hat{L})$		0.069	-0.009	0.070	0.075	0.070	0.075	0.070
		(0.991)	(-0.166)	(1.000)	(1.076)	(1.002)	(1.081)	(1.000)
IQ		0.420^{***}		0.431^{**}	0.417^{***}	0.402^{***}	0.401^{***}	0.432^{**}
		(1.944)		(1.983)	(1.866)	(1.845)	(1.785)	(1.989)
$\frac{Oil}{L}$		-0.006	-0.017	-0.002	-0.001	0.034	0.046	-0.001
		(-0.355)	(-1.138)	(-0.090)	(-0.078)	(0.754)	(0.977)	(-0.070)
$\frac{Oil}{K}$		0.142^{***}	0.168^{**}					
		(1.833)	(2.277)					
Income Dummies	$HIC \times \frac{Oil}{K}$			0.105	0.138			
				(1.089)	(1.228)			
	$LIC \times \frac{Oil}{K}$			0.192^{***}				
				(1.771)				
Tech.Clubs Dummies	$A \times \frac{Oil}{K}$					-0.230	-0.306	
						(-0.572)	(-0.731)	
	$FM \times \frac{Oil}{K}$					0.091		
						0.948)		
Geogr. Dummies for LIC; FM	$EAP \times \frac{Oil}{K}$				32.758^{*}		32.906^{*}	
					(3.097)		(3.116)	
	$LAC \times \frac{Oil}{K}$				0.193^{***}		0.103	
					(1.731)		(1.012)	
	$MNA \times \frac{Oil}{K}$				-0.461		-0.416	
					(-0.228)		(-0.205)	
	$SAS \times \frac{Oil}{K}$				6.271		7.511	
					(0.204)		(0.244)	
	$ECA \times \frac{Oil}{K}$						11.253	
							(0.399)	
Inequality Dummies	$GL \times \frac{Oil}{K}$							0.101
								(1.051)
	$GH \times \frac{Oil}{K}$							0.197^{***}
								(1.815)
$(\hat{K} - \hat{L})$		0.304^{*}	0.317^{*}	0.302^{*}	0.300^{*}	0.303^{*}	0.302^{*}	0.302^{*}
		(5.855)	(6.433)	(5.799)	(5.841)	(5.845)	(5.892)	(5.795)
$(\hat{Inf} - \hat{K})$		0.143^{*}	0.040	0.135^{*}	0.127^{**}	0.146^{*}	0.135^{*}	0.134^{**}
		(2.803)	(1.008)	(2.588)	(2.423)	(2.851)	(2.634)	(2.567)
$(\hat{RD} - \hat{K})$		0.022	0.019	0.023	0.023	0.021	0.022	0.023
		(1.550)	(1.409)	(1.623)	(1.575)	(1.514)	(1.524)	(1.627)
$(\hat{RD} - \hat{K})_{-1}$		0.014	0.004	0.017	0.017	0.014	0.015	0.017
		(1.001)	(0.336)	(1.121)	(1.146)	(0.989)	(1.047)	(1.138)
$(\hat{RD} - \hat{K})_{-2}$		-0.014	-0.016	-0.013	-0.014	-0.013	-0.015	-0.013
		(-0.864)	(-1.078)	(-0.829)	(-0.891)	(-0.832)	(-0.913)	(-0.821)
Observations		284	327	284	284	284	284	284
R^2		0.518	0.466	0.518	0.546	0.522	0.551	0.518
Adjusted R^2		0.407	0.353	0.404	0.432	0.409	0.435	0.404

Notes: the estimation period was determined by available data for rig productivity (from 1980 to 2005) and for the remaining variables (from 1976 to 2003 with uninstrumented *IQ*); same notes of Table 2.

The other regressions in Table 3 decompose the impact of rig productivity using the multiplicative dummy variables selected in section 2. Regression 3 shows that a higher rig productivity increases growth (by *g*) only in low and middle income countries (the coefficient of $LIC \times \frac{Oil}{K}$ is positive and significant at 10%, while the estimate for $GL \times \frac{Oil}{K}$ is insignificant), as expected. This positive effect originates in low and middle-income East Asia & Pacific and Latin America & Caribbean countries, as we can see in the fourth regression (the coefficients for *EAP* and *LAC* are significant at 1% and 10%, respectively). In the case of *EAP*, only Malaysia is represented, showing the highest contribution of rig productivity to growth in the estimated panel (an average of 52.3%) despite the low levels of this indicator (an average of 4.374 in the estimated period, much smaller than sample value) and also per unit of *K*.[31]

In regression 5, the impact of $\frac{Oil}{K}$ is decomposed between technological-knowledge clubs, but neither *A* nor *FM* groups are significant. When we apply the geographical dummies to *FM* countries in regression 6, we find that only *EAP* is significant (again, only Malaysia is represented), at 1%. The *LAC* group is not significant for *FM* countries**,** due to the inclusion of Trinidad and Tobago, a high income country. All estimated countries in these two area groups are followers in terms of technological-knowledge convergence.[32]

Finally, in regression 7 we find that an increase in oil concentration benefits growth by *g* only in countries with high inequality (the coefficient of $GH \times \frac{Oil}{K}$ is positive and significant at 10%, while the estimate of $GL \times \frac{Oil}{K}$ is insignificant). We stress that all high inequality countries in our estimated panel belong to the *LIC* group**,** with the notable exception of the United States, which reduces the significance of $GH \times \frac{Oil}{K}$. The decomposition of $GH \times \frac{Oil}{K}$ according to area groups did not produce significant results. No major differences were found concerning the estimates of the other growth determinants vis-à-vis the first regression.

---

[31] We find a mild positive correlation between the series rig productivity (in level and also divided by *K*) and estimated growth contribution.

[32] Algeria, Egypt (*MNA*) and India (*SAS*) are the only marginalized countries included in our estimated panel.

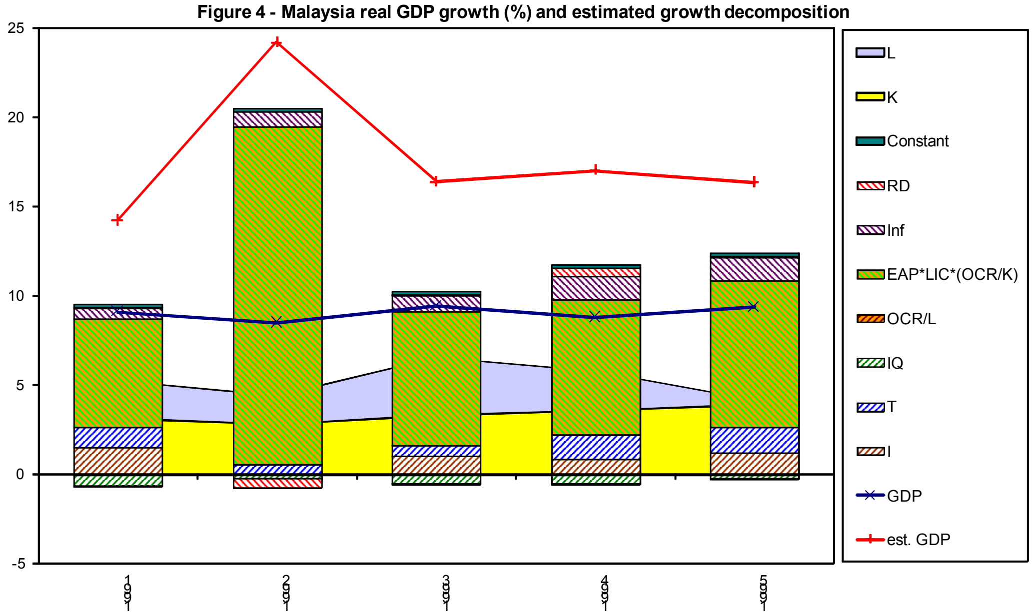
Estimated growth decomposition

Based on the fourth regression in Table 3, where two area dummies are significant, we now analyse the evolution of real GDP growth and the estimated GDP growth decomposition for some representative countries, taking into account the highest contributions arising from rig productivity. We chose Malaysia and Colombia because they show the highest contributions in *EAP* and *LAC*, the two significant *LIC* area groups, respectively. Despite the insignificant coefficients associated with rig productivity in *HIC*, we also found important contributions in New Zealand and Norway, thus we included them in our growth decompositions. In Appendix 3, we explain in detail how the first decomposition chart should be interpreted.

(i) Malaysia decomposition (Figure 1 from 1991 to 1995)

The impact of rig productivity by *g* in the column of TFP explains most estimated growth, followed by *K* and *L* contributions. We also stress the positive impact of *T* and *I* (by *f*), and *Inf* (by *g*). Apart from the year 1992, estimated GDP growth captures relatively well the magnitude and evolution of actual product growth in the estimation period.

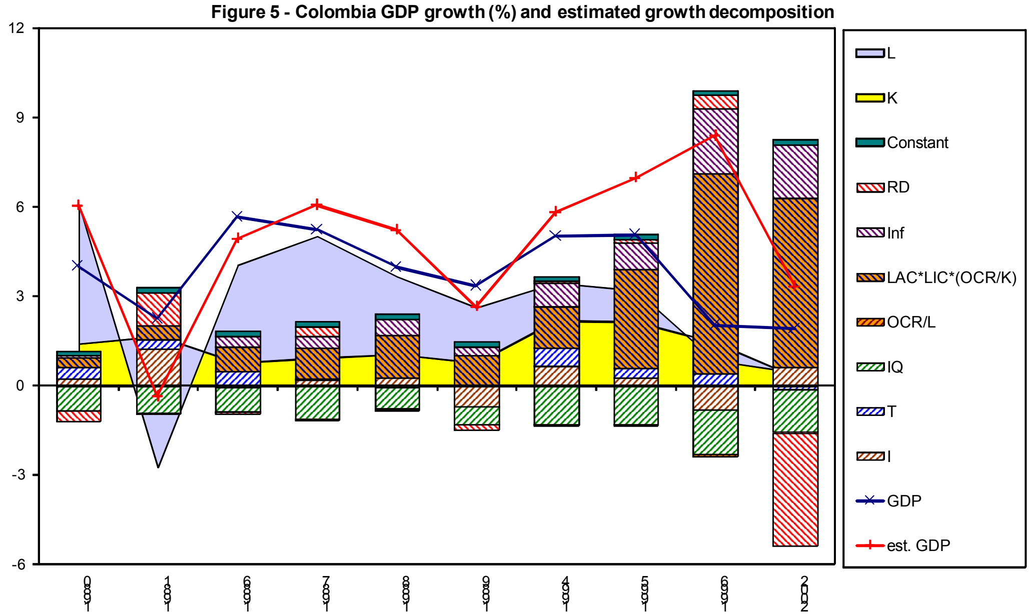
Figure 4 - Malaysia real GDP growth (%) and estimated growth decomposition



(ii) Colombia decomposition (Figure 2 from 1980 to 2002)

In this case, L and K are gradually replaced by $\frac{Oil}{K}$ as the most important growth factors. The contribution of *Inf*, by g, is also important and contrasts with the negative effect of *IQ*.

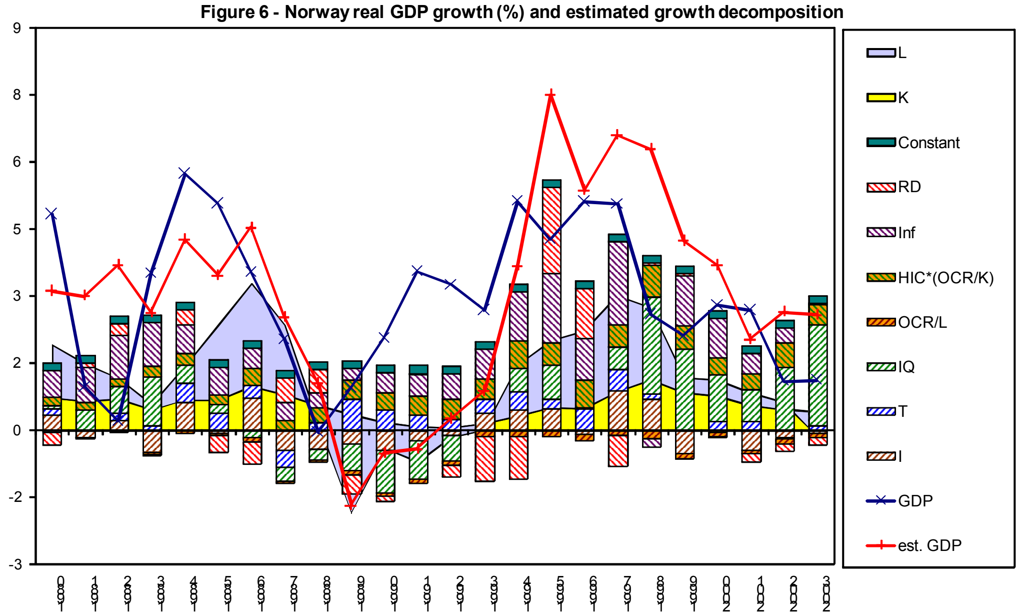
Figure 5 - Colombia GDP growth (%) and estimated growth decomposition



(iii) Norway decomposition (Figure 3 from 1980 to 2003)

In this case, we have a more balanced decomposition, with varied contributions in TFP. We stress the positive stable contributions of *Inf* and rig productivity (by g), and also the important impacts of *IQ*, *T* and *RD*, despite negative values in some years.

Figure 6 - Norway real GDP growth (%) and estimated growth decomposition



(iv) New Zealand decomposition (Figure 4 from 1987 to 2003)

We also find varied contributions in this case, but the effect of $\frac{Oil}{K}$ is much more predominant than in (iii), explaining most of the estimated growth, especially before 1993, when *L*, *K* and *IQ* showed negative contributions.[33] We also observe a steady positive impact of *T*, and in some years, good contributions from *RD* and *Inf*.

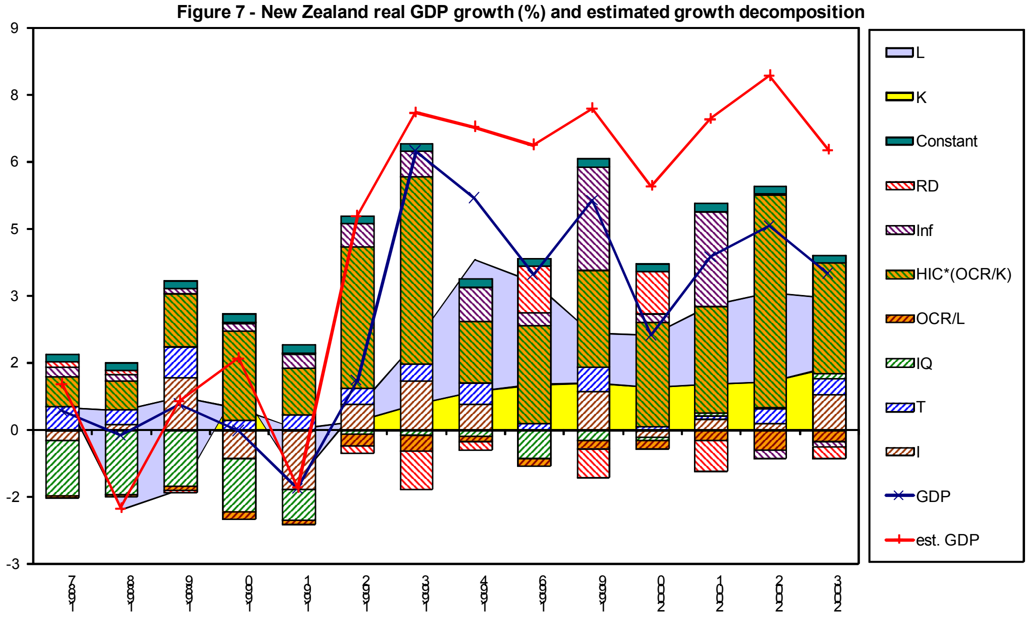


Figure 7 - New Zealand real GDP growth (%) and estimated growth decomposition

4. Concluding remarks

In this study, we estimate the impact of several oil abundance indicators (fuel export dependence, crude proven reserves, production and rig productivity) on economic growth, considering the conflicting findings of existing empirical studies, and dismiss the oil cross-section curse result in a panel estimation based on a growth-accounting factor efficiency framework. This result is robust to the exclusion of institutional quality, which is hindered by oil and ores in several resource curse cross-section studies, explaining the curse.

We measure the oil contributions to labour and capital efficiency (interpreted as oil windfalls in the assessment of the resource curse), along with other growth factors (namely,

---

[33] Norway and New Zealand belong to the advanced technological-knowledge club, which is reflected in *RD* contribution. The *RD* effect is less visible in the case of Malaysia and Colombia, both follower countries.

investment, trade, institutional quality, infrastructures and R&D), and also estimate the effect as a productive factor. To estimate the unobserved efficiency levels, we use the labour profit maximization condition in a flexible log growth version, which allows the estimation of all growth contributions in a wage equation and justifies the human-capital exclusion.

Our results show that the oil effect as a productive factor is insignificant for all abundance indicators, the same going on with the effects on factor efficiency, with the exception of rig productivity, which shows a positive effect on capital efficiency. This effect may reflect capital and technological intensity owing to the exploitation of those resources, and economies of scale, as spatial concentration of oil allows the dilution of high fixed costs.

We decompose the significant effect of rig productivity with dummy variables separating countries according to income, technological-knowledge clubs, geographical areas, and wage inequality. Results show that the positive effect is confined to countries with low and middle incomes (from East Asia & the Pacific and Latin America & the Caribbean, all followers in terms of technological-knowledge convergence), and showing high-income inequality. This may occur because only in developing countries can the oil sector induce a productivity advantage over the rest of the economy, driving growth and inducing wage inequality (*e.g.*, Sachs and Warner [51]). Distinct oil exploration conditions may explain why only two of our area groups for low and middle-income countries show significant effects of oil concentration by capital efficiency. In our view, the overall results reflect the broader scope for factor-efficiency and technological improvements in less-developed countries arising from the oil industry, which is defined by a highly globalised know-how.

We also present the estimated growth decompositions for countries with the highest rig productivity contributions in our income/area categories. We stress the high importance of the oil impact in Malaysia (the country with the highest contribution despite the low levels of rig productivity) and Colombia decompositions, in contrast to the balanced growth contributions of Norway, where we also find effects from essential growth factors such as trade, R&D and institutional quality, as expected in a high-income and technologically advanced country. New Zealand is also an advanced country and shows high oil contributions, followed by trade and, in some years, R&D and Infrastructures, stressing the diversity among oil producers.

Future research should attempt to overcome data constraints and also include data regarding natural gas and more countries. Despite data constraints, we believe they are not crucial enough to alter the major conclusions of this study. A similar study could be conducted on ores, as abundance indicators also show conflicting results in empirical studies.

Appendix 1

Table A1 – Data treatment and sources

Variable	Name	Measure	Source	Comments
Y	Output	GDP at constant prices	U.Nations (National Accounts Database)	
L	Labor	Employment	ILO, OECD, World Bank (World Development Indicators 2007, WDI 07), IMF (IFS), UN (UNECE and Common Database)	Compatible data was used to extend the series.
K	Capital Stock		Authors own calculations with *I* and *Y*	Permanent Inventory method[34]
I	Investment	Gross capital formation (constant prices)	U.Nations (National Accounts Database, NAD)	
T	Trade	Exports + Imports	U.Nations (NAD)	
IQ	Institutional Quality	Budget balance in percentage of GDP	U.Nations (NAD), OECD (Statistics Database), WDI 07, IMF (IFS)	Compatible data was used to extend the series
		Polity, Polity$_{-1}$, Polity (1979)	Polity IV Project, 2007	
		Freedom, Freedom $_{-1}$, Freedom (1979)	The Freedom House	
Oil	Oil abundance indicators	Weight of fuels in merchandise exports, and also net of the weight in imports (adjusted measure)	WDI 07	
		Crude proven reserves (million barrels), and production (thousand barrels/day); rigs and wells	OPEC Annual Statistical Bulletin, 2007	
RD	R&D	patent applications to national patent offices[35]	WIPO	
Inf	Infra-structures	number of telephone lines and subscriptions for mobile telephone services	UN (Common Database), WDI 07	Data is compatible between sources.
GNIpc79	Initial Income	GNI *per capita* in 1979 US dollars	UN (ATLAS method)	
Dummies	country dummies	Income, geog., tech.clubs, inequality groups	WDI 07, except tech.clubs (Castelacci, 2008)	

---

[34] Initial capital was calculated $K_{1970} = \frac{I_{1970}}{r+d}$, following Harberger [31], being I_{1970} the first available value for I, r the average GDP growth in 1970-80 and d is the depreciation rate (6%, as in Hall and Jones [30]). For the following years: $K(t) = [1-d]K(t-1) + I(t)$, following the capital dynamics of the Solow-Swan Model.

[35] Chosen due to data availability for a high number of countries and years. It includes international applications under Patent Cooperation Treaties and excludes those to regional offices, which concede protection in the area. Since the proxy includes patent applications from both residents and non-residents, it measures the effect of applied domestic and foreign R&D on internal capital efficiency, thus multiple counting is not a problem. The WIPO alerts that not all inventions are patented, patent application and inventive activity may not coincide in time and space;, and the number of patent applications may vary across countries due to differences in patent systems.

Appendix 2

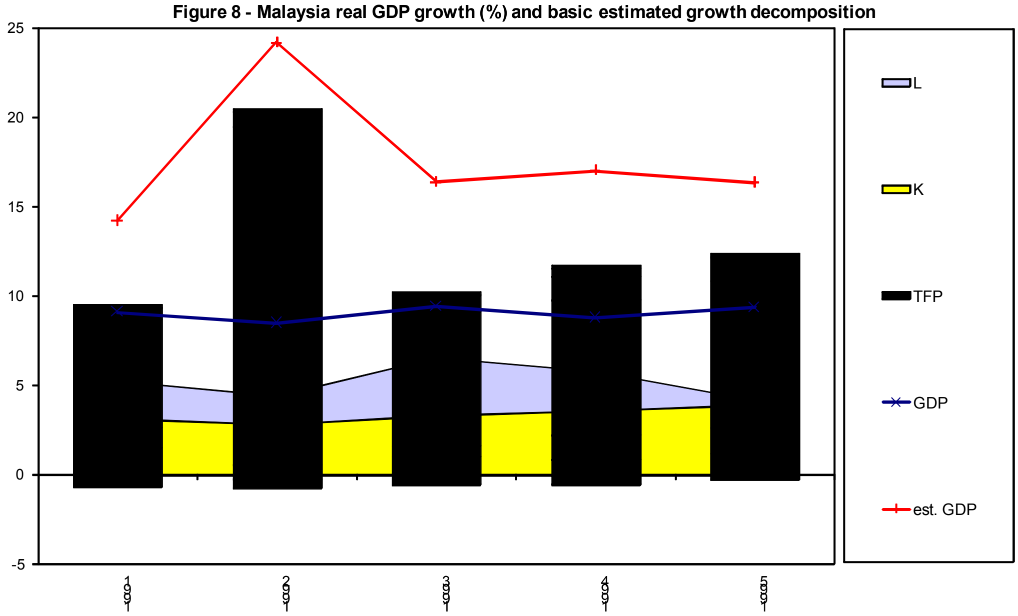
Table A2: Estimation panel

	Oil producer	t=t0	t=T	N	Dummies			
					Geog.(for LIC; FM)	Income	Tech.Clubs	Inequality
1	Algeria	1994	2000	7	MNA	LIC	FM	GL40
2	Albania			0	ECA	LIC	FM	GL40
3	Angola			0	MNA	LIC	FM	GH40
4	Argentina			0	LAC	LIC	FM	GH40
5	Australia	1980	2003	24		HIC	A	GL40
6	Bahrain			0	MNA	HIC	FM	n/a
7	Brazil			0	LAC	LIC	FM	GH40
8	Brunei			0		HIC	n/a	n/a
9	Cameroon			0	SSA	LIC	FM	GH40
10	Canada	1980	2003	24		HIC	A	GL40
11	Chile	1980	2003	21	LAC	LIC	FM	GH40
12	China			0	EAP	LIC	FM	GH40
13	Colombia	1980	2002	10	LAC	LIC	FM	GH40
14	Congo, Dem. Rep.			0	SSA	LIC	FM	n/a
15	Denmark			0		HIC	A	GL40
16	Ecuador	1989	1994	2	LAC	LIC	FM	GH40
17	Egypt, Arab Rep.	1991	2001	5	MNA	LIC	FM	GL40
18	France	1980	2003	21		HIC	A	GL40
19	Gabon			0	SSA	LIC	FM	n/a
20	Germany	1980	2003	24		HIC	A	GL40
21	Hungary			0	ECA	LIC	FM	GL40
22	India	1995	1998	4	SAS	LIC	FM	GL40
23	Indonesia			0	EAP	LIC	FM	GL40
24	Iran, Islamic Rep.	2001	2001	1	MNA	LIC	FM	GH40
25	Iraq			0	MNA	LIC	n/a	n/a
26	Italy	1980	1985	6		HIC	FM	GL40
27	Kuwait			0	MNA	HIC	FM	n/a
28	Libya			0	MNA	LIC	n/a	n/a
29	Malaysia	1991	1995	5	EAP	LIC	FM	GH40
30	Mexico	1992	2003	12	LAC	LIC	FM	GH40
31	Netherlands	1980	2003	22		HIC	A	GL40
32	New Zealand	1987	2003	14		HIC	A	GL40
33	Nigeria			0	SSA	LIC	FM	GH40
34	Norway	1980	2003	24		HIC	A	GL40
35	Oman			0	MNA	LIC	FM	n/a
36	Peru			0	LAC	LIC	FM	GH40
37	Qatar			0		HIC	n/a	n/a
38	Romania			0	ECA	LIC	FM	GL40
39	Saudi Arabia			0	MNA	HIC	FM	n/a
40	Syrian Arab Republic			0	MNA	LIC	FM	n/a
41	Trinidad and Tobago	1980	2002	3	LAC	HIC	FM	GL40
42	Tunisia			0	MNA	LIC	FM	GL40
43	Turkey			0	ECA	LIC	FM	GH40
44	United Arab Emirates			0	MNA	HIC	FM	n/a
45	United Kingdom	1980	2003	24		HIC	A	GL40
46	United States	1980	2003	20		HIC	A	GH40
47	Venezuela, RB	1980	1994	11	LAC	LIC	FM	GH40
48	Yemen, Rep.			0	MNA	LIC	FM	GL40
# =21	Estimation Panel	1980	2003	284		N=284	N=284	N=284

Authors' own estimations; the former USSR and Yugoslavia are excluded due to lack of data; $t = t_0$ and $t = T$ indicate the initial and final years with information for all variables, respectively; N = number of observations with data for all variables.

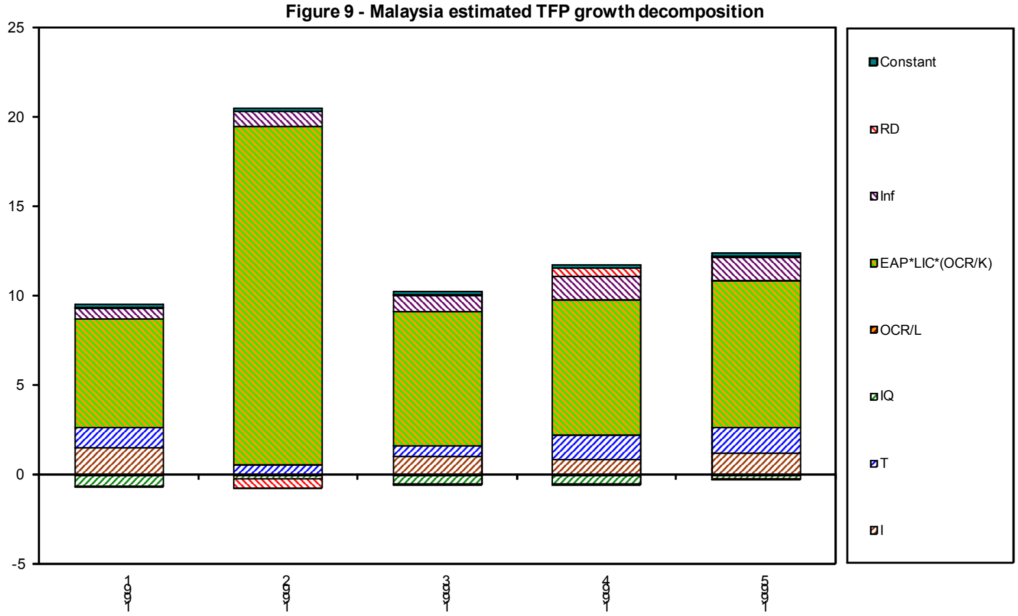
Appendix 3 – Malaysia growth decomposition explained in detail

Figure 8 - Malaysia real GDP growth (%) and basic estimated growth decomposition



In Figure 5, the blue line represents actual real GDP growth and the red line shows estimated growth, which results from the sum of the other components in the graphic. The blue and yellow areas represent the physical contributions of labour and capital stocks to estimated GDP growth in each year, respectively, while the columns' net value constitute the TFP impact.

Figure 9 - Malaysia estimated TFP growth decomposition



In Figure 6, we show in detail the estimated TFP growth decomposition: the rectangles in green, the constant term of the wage equation, constitute the share of GDP growth not accountable by the explanatory variables; the rectangles associated with labour efficiency are illustrated with ascending lines, while the ones related to capital efficiency have descending lines; the impacts of oil concentration ratio through labour and capital efficiency are highlighted by an orange background.

References

[1] Acemoglu, D., Johnson, S., Robinson, D., 2005. Institutions as the fundamental cause of long-run growth, in: Aghion, P. and Durlauf, S. (Eds), *Handbook of Economic Growth*, vol. 1, 385-472.

[2] Acemoglu, D., Johnson, S., Robinson, J., Thaicharoen, Y., 2003. Institutional causes, macroeconomic symptoms: volatility, crises and growth. *Journal of Monetary Economics* 50(1), 49-123.

[3] Aghion, P., Howitt, P., 1992. A Model of Growth through Creative Destruction. *Econometrica* 60(2), 323-351.

[4] Alexeev, M., Conrad, R., 2009. The elusive curse of oil. *Review of Economics and Statistics* 91(3), 586-98.

[5] Auty, R.M., 2001a. *Resource Abundance and Economic Development*. Oxford University Press, Oxford.

[6] Auty, R.M., 2001b. The Political Economy of Resource-driven Growth. *European Economic Review* 45(4), 839-846.

[7] Barro, R. J., 1991. Economic growth in a cross-section of countries. *Quarterly Journal of Economics* 106(2), 407-443.

[8] Barro, R. J., Sala-i-Martin, X., 2004. *Economic Growth*. McGrawHill.

[9] Bertrand, M. and S. Mullainathan, 2005. Profitable investments or dissipated cash? Evidence on the investment-cash flow relationship from oil and gas lease bidding. *NBER Working Paper* 11126.

[10] Bleaney, M., Nishiyama, A., 2002. Explaining growth: a contest between models. *Journal of Economic Growth* 7(1), 43-56.

[11] Bleaney, M., Halland, H., 2009. The resource curse and fiscal policy volatility. *CREDIT Research Paper 9*.

[12] Bulte, E., Damania, R., Deacon, T., 2005. Resource Intensity, Institutions, and Development. *World Development* 33(7), 1029-44.

[13] Burnside, C.; Dollar, D., 2000. Aid, policies, and growth. *American Economic Review* 90(4), 847-68.

[14] Brunnschweiler, C., 2008. Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth. *World Development* 36(3), 399-419.

[15] Brunnschweiler, C., Bulte, E., 2008. The resource curse revisited and revised: a tale of paradoxes and red herrings. *Journal of Environmental Economics and Management* 55(3), 248-264.

[16] Castelacci, F., 2008. Technology clubs, technology gaps and growth trajectories. *Structural Change and Economic Dynamics* 19(4), 301-314.

[17] Coe, D.T., Helpman, E., 1995. International R&D spillovers. *European Economic Review* 39(5), 859-897.

[18] Dasgupta, P., Heal, G.M., 1980. *Economic Theory and Exhaustible Resources*. Cambridge University Press.

[19] Davis, G., 1995. Learning to love the Dutch disease: evidence from the mineral economies. *World Development* 23(10), 1765-79.

[20] Davis, J., 2001. *Stabilization and savings funds for non-renewable resources: experience and fiscal policy implications*. International Monetary Fund, Washington DC.

[21] Dawe, D., 1996. A new look at the growth in developing countries. *World Development* 24(12), 1905-1914.

[22] Dobbs, R., Manson, N., Nyquist, S., 2005. Capital Discipline for Big Oil. *McKinsey Quarterly* 18, 6-11.

[23] Dodrik, D., Subramanian, F., Trebbi, F., 2004. Institutions rule : the primacy of institutions over geography and integration in economic development. *Journal of Economic Growth* 9(2), 131-65.

[24] Englander, A., Gurney, A., 1994. La productivité dans la zone de L'OCDE: les déterminants a moyen terme. *Revue économique de l'OCDE* 22**,** 53-119.

[25] Fatás, A., Mihov, I., 2003. The case for restricting fiscal policy discretion. *Quarterly Journal of Economics* 118, 1419-47.

[26] Fatás, A., Mihov, I., 2005. Policy volatility, institutions and economic growth. *CEPR Discussion Paper 5388*.

[27] Frankel, J.A., Romer, D., 1999. Does trade cause growth? *American Economic Review* 89(3), 379-399.

[28] Grace, J.D., 2005. *Russian Oil Supply: Performance and Prospects*. Oxford University Press.

[29] Greenspan, A., 2005. Remarks before the Economic Club of New York. New York, May 20.

[30] Hall, R., Jones, C., 1999. Why do Some Countries Produce so Much More Output per Worker Than Others? *Quarterly Journal of Economics* 114(1), 83-116.

[31] Harberger, A., 1978. Perspectives on capital and technology in less developed countries. In: Artis, M.J., Nobay, R.A. (Eds.), *Contemporary economic analysis*. Croom Helm, London.

[32] Hartford, T., Klein, M., 2005. Aid and the resource Curse. The world Bank Group, private Sector Development Presidency, Note #291. Washington, DC.

[33] Herb, M. (2005). No Representation without Taxation? Rents, Development and Democracy. *Comparative Politics* 37(3), 297-317.

[34] Isham, J., Woodcock, M., Pritchett, L., Busby, G., 2005. The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth. *World Bank Economic Review* 19(2), 141-74.

[35] Law, J., 1957. Reasons for Persian Gulf oil abundance. *AAPG Bulletin* 41(1), 51-69.

[36] Lederman, D., Maloney, W., 2008. In Search of the Missing Resource Curse. *World Bank Policy Research paper 4766*. World Bank, Washington DC.

[37] Leite, C., Weidmann, J., 2002. Does mother nature corrupt? Natural resources, corruption and economic growth. In: Abed, G., Gupta S. (Eds.), *Governance, corruption, and economic performance*. International Monetary Fund, Washington DC, pp. 156–169.

[38] Lucas, R.E., 1988. On the mechanics of economic development. *Journal of Monetary Economics* 22(1), 3-42.

[39] Manzano, O., Rigobon, R., 2006. Resource curse or debt overhang? In: Lederman, D., Maloney, W. (Eds.), *Resources, Neither Curse nor Destiny*. Stanford University Press, Washington, DC, Chapter 4, 71-99.

[40] Martin, P., Rogers, C., 2000. Long-term growth and short-term economic instability. *European Economic Review* 44, 359-81.

[41] Matsuyama, K., 1992. Agricultural Productivity, Comparative Advantage and Economic Growth. *Journal of Economic Theory* 58(2), 317-34.

[42] Mauro, P., 1995. Corruption and Growth. *Quarterly Journal of Economics* 90, 681-712.

[43] Mehlum, H., Moene, K., Torvik, R., 2006. Institutions and the resource curse. *Economic Journal* 116(508), 1-20.

[44] Mincer, J., 1993. *Studies in human capital: collected essays of Jacob Mincer*. Edward Elgar, Cambridge.

[45] Nunn, N., 2008. The long-run effects of Africa's Slave Trades. *Quarterly Journal of Economics* 123(1), 139-76.

[46] Osmundsen, P., F. Asche, B. Misund, K. Mohn, 2006. Valuation of International Oil Companies. *Energy Journal* 27(3), 49-64.

[47] Roller, L.W., Waverman, L., 2001. Telecommunications Infrastructure and Economic Development: A Simultaneous Approach. *American Economic Review* 91(4), 909-923.

[48] Romer, P., 1987. Growth Based on Increasing Returns Due to Specialization. *American Economic Review* 77(2), 56-62.

[49] Romer, P.M., 1990. Endogenous technological change. *Journal of Political Economy* 98(5), S71-S102.

[50] Sachs, J.D, Warner, A.M., 1995. Natural Resource Abundance and Economic Growth. *NBER Working Paper Series 5398*, Cambridge.

[51] Sachs, J.D, Warner, A.M., 2001. The Curse of Natural Resources. *European Economic Review* 45(4), 827-838.

[52] Sala-i-Martin, X., 2000. The Classical Approach to Convergence Analysis. In: Dixon, H.D. (Ed.), *Controversies in Macroeconomics: Growth, Trade and Policy*. Blackwell, Oxford.

[53] Sala-i-Martin, X., Doppelhofer, G., Miller, R, 2004. Determinants of long-term growth: a Bayesian averaging of classical estimates (BACE) approach. *American Economic Review* 94(4), 813-35.

[54] Sala-i-Martin, X., Subramanian, A., 2003. Addressing the Natural Resource Curse: An Illustration from Nigeria. *NBER Working Paper Series* 9804, Cambridge.

[55] Stein, J., 2003. Agency, Information, and Corporate Investment, in: Constantinides, G., Harris, M. and Stultz, R. (Eds.), *Handbook of the Economics of Finance*. North-Holland, Amsterdam.

[56] Stein, E., Tommasi, M., Echebarría, K, Lora, E, Payne, M., 2005. *The Politics of Policies: Economic and Social Progress in Latin America*. IDB, Washington DC.

[57] Torvik, R., 2002. Natural Resources Rent Seeking and Welfare. *Journal of Development Economics* 67(2), 455-70.

[58] Tsui, K., 2007. More Oil, Less Democracy: Evidence from Worldwide Crude Oil Discoveries. *Economic Journal*, forthcoming.

[59] Wood, A., Owens, T. 1997. Export-oriented industrialization through primary processing? *World Development* 25(9), 1453-70.

[60] Wooldridge, J. M., 2002. *Econometric Analysis of Cross Section and Panel Data*. MIT Press, Cambridge, MA.

Recent FEP Working Papers

Nº 376	Ricardo Correia and Carlos Brito, “*O Marketing e o Desenvolvimento Turístico: O Caso de Montalegre”*, May 2010
Nº 375	Maria D.M. Oliveira and Aurora A.C. Teixeira, “*The determinants of technology transfer efficiency and the role of innovation policies: a survey”*, May 2010
Nº 374	João Correia-da-Silva and Carlos Hervés-Beloso, “*Two-period economies with private state verification”*, May 2010
Nº 373	Armando Silva, Óscar Afonso and Ana Paula Africano, “*Do Portuguese manufacturing firms learn by exporting?”*, April 2010
Nº 372	Ana Maria Bandeira and Óscar Afonso, “*Value of intangibles arising from R&D activities”*, April 2010
Nº 371	Armando Silva, Óscar Afonso and Ana Paula Africano, “*Do Portuguese manufacturing firms self select to exports?”*, April 2010
Nº 370	Óscar Afonso, Sara Monteiro and Maria Thompson, “*A Growth Model for the Quadruple Helix Innovation Theory”*, April 2010
Nº 369	Armando Silva, Óscar Afonso and Ana Paula Africano, “*Economic performance and international trade engagement: the case of Portuguese manufacturing firms”*, April 2010
Nº 368	Andrés Carvajal and João Correia-da-Silva, “*Agreeing to Disagree with Multiple Priors”*, April 2010
Nº 367	Pedro Gonzaga, “*Simulador de Mercados de Oligopólio”*, March 2010
Nº 366	Aurora A.C. Teixeira and Luís Pinheiro, “*The process of emergency, evolution, and sustainability of University-Firm relations in a context of open innovation ”*, March 2010
Nº 365	Miguel Fonseca, António Mendonça and José Passos, “*Home Country Trade Effects of Outward FDI: an analysis of the Portuguese case, 1996-2007”*, March 2010
Nº 364	Armando Silva, Ana Paula Africano and Óscar Afonso, “*Learning-by-exporting: what we know and what we would like to know”*, March 2010
Nº 363	Pedro Cosme da Costa Vieira, “*O problema do crescente endividamento de Portugal à luz da New Macroeconomics”*, February 2010
Nº 362	Argentino Pessoa, “*Reviewing PPP Performance in Developing Economies”*, February 2010
Nº 361	Ana Paula Africano, Aurora A.C. Teixeira and André Caiado, “*The usefulness of State trade missions for the internationalization of firms: an econometric analysis”*, February 2010
Nº 360	Beatriz Casais and João F. Proença, “*Inhibitions and implications associated with celebrity participation in social marketing programs focusing on HIV prevention: an exploratory research”*, February 2010
Nº 359	Ana Maria Bandeira, “*Valorização de activos intangíveis resultantes de actividades de I&D”*, February 2010
Nº 358	Maria Antónia Rodrigues and João F. Proença, “*SST and the Consumer Behaviour in Portuguese Financial Services”*, January 2010
Nº 357	Carlos Brito and Ricardo Correia, “*Regions as Networks: Towards a Conceptual Framework of Territorial Dynamics”*, January 2010
Nº 356	Pedro Rui Mazeda Gil, Paulo Brito and Óscar Afonso, “*Growth and Firm Dynamics with Horizontal and Vertical R&D”*, January 2010
Nº 355	Aurora A.C. Teixeira and José Miguel Silva, “*Emergent and declining themes in the Economics and Management of Innovation scientific area over the past three decades”*, January 2010
Nº 354	José Miguel Silva and Aurora A.C. Teixeira, “*Identifying the intellectual scientific basis of the Economics and Management of Innovation Management area”*, January 2010
Nº 353	Paulo Guimarães, Octávio Figueiredo and Douglas Woodward, “*Accounting for Neighboring Effects in Measures of Spatial Concentration”*, December 2009
Nº 352	Vasco Leite, Sofia B.S.D. Castro and João Correia-da-Silva, “*A third sector in the core-periphery model: non-tradable goods”*, December 2009
Nº 351	João Correia-da-Silva and Joana Pinho, “*Costly horizontal differentiation”*, December

	2009
Nº 350	João Correia-da-Silva and Joana Resende, "*Free daily newspapers: too many incentives to print?*", December 2009
Nº 349	Ricardo Correia and Carlos Brito, "*Análise Conjunta da Dinâmica Territorial e Industrial: O Caso da IKEA – Swedwood*", December 2009
Nº 348	Gonçalo Faria, João Correia-da-Silva and Cláudia Ribeiro, "*Dynamic Consumption and Portfolio Choice with Ambiguity about Stochastic Volatility*", December 2009
Nº 347	André Caiado, Ana Paula Africano and Aurora A.C. Teixeira, "*Firms' perceptions on the usefulness of State trade missions: an exploratory micro level empirical analysis*", December 2009
Nº 346	Luís Pinheiro and Aurora A.C. Teixeira, "*Bridging University-Firm relationships and Open Innovation literature: a critical synthesis*", November 2009
Nº 345	Cláudia Carvalho, Carlos Brito and José Sarsfield Cabral, "*Assessing the Quality of Public Services: A Conceptual Model*", November 2009
Nº 344	Margarida Catarino and Aurora A.C. Teixeira, "*International R&D cooperation: the perceptions of SMEs and Intermediaries*", November 2009
Nº 343	Nuno Torres, Óscar Afonso and Isabel Soares, "*Geographic oil concentration and economic growth – a panel data analysis*", November 2009
Nº 342	Catarina Roseira and Carlos Brito, "*Value Co-Creation with Suppliers*", November 2009
Nº 341	José Fernando Gonçalves and Paulo S. A. Sousa, "*A Genetic Algorithm for Lot Size and Scheduling under Capacity Constraints and Allowing Backorders*", November 2009
Nº 340	Nuno Gonçalves and Ana Paula Africano, "*The Immigration and Trade Link in the European Union Integration Process*", November 2009
Nº 339	Filomena Garcia and Joana Resende, "*Conformity based behavior and the dynamics of price competition: a new rational for fashion shifts*", October 2009
Nº 338	Nuno Torres, Óscar Afonso and Isabel Soares, "*Natural resources, economic growth and institutions – a panel approach*", October 2009
Nº 337	Ana Pinto Borges, João Correia-da-Silva and Didier Laussel, "*Regulating a monopolist with unknown bureaucratic tendencies*", October 2009
Nº 336	Pedro Rui Mazeda Gil, "*Animal Spirits and the Composition of Innovation in a Lab-Equipment R&D Model*", September 2009
Nº 335	Cristina Santos and Aurora A.C. Teixeira, "*The evolution of the literature on entrepreneurship. Uncovering some under researched themes*", September 2009
Nº 334	Maria das Dores B. Moura Oliveira and Aurora A.C. Teixeira, "*Policy approaches regarding technology transfer: Portugal and Switzerland compared*", September 2009
Nº 333	Ana Sofia Ferreira, Leonídio Fonseca and Lilian Santos, "*Serão os 'estudantes empreendedores' os empreendedores do futuro? O contributo das empresas juniores para o empreendedorismo*", August 2009
Nº 332	Raquel Almeida, Marina Silva and Tiago Soares, "*Coesão Territorial - As relações de fronteira entre Portugal e Espanha*", August 2009
Nº 331	Custódia Bastos, Suzi Ladeira and Sofia Silva, "*Empreendedorismo nas Artes ou Artes do Empreendedorismo? Um estudo empírico do 'Cluster' da Rua Miguel Bombarda*", August 2009
Nº 330	Filipe A. Ribeiro, Ana N. Veloso and Artur V. Vieira, "*Empreendedorismo Social: Uma análise via associativismo juvenil*", August 2009
Nº 329	Argentino Pessoa, "*Outsourcing And Public Sector Efficiency: How Effective Is Outsourcing In Dealing With Impure Public Goods?*", July 2009

Editor: Sandra Silva (*sandras@fep.up.pt*)

www.fep.up.pt

Faculdade de Economia da Universidade do Porto
Rua Dr. Roberto Frias, 4200-464 Porto | Tel. 225 571 100
Tel. 225571100 | www.fep.up.pt