

THE OIL-GROWTH NEXUS IN OIL PRODUCERS: MACRO PANEL EVIDENCE

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Overview: The literature on the energy consumption-economic growth nexus, namely the one that focuses on oil production, oil consumption, energy consumption and economic growth, has not been consensual as far as its findings. In particular, it does not offer full understanding of how the energy-growth nexus is affected when countries have these energy resources, namely hydrocarbons. Actually, it fails, to our knowledge, to capture the interaction effects between energy production and energy consumption. In other words, one expects that the nature of the nexus could be not unchanging to the fact of a country being, or not, oil producer, even if the oil production level is far from enough for export. As consequence, a workable and theoretical consistent approach is the use of the concept of self-sufficiency. Roughly understood, the concept establishes a relationship between energy production and energy consumption. In the case of oil producing countries, the forces that shape the degree of self-sufficiency are multidimensional and work differently among them. For example, the priority given to maximization of energy-self-sufficiency and the conditions to achieve it tend to be associated both to the level of the oil country endowment, and to the relationship between its oil sector fully capacity and oil domestic demand. In turn, the self-sufficient analysis embraces the role of supply and demand mechanisms and their interactions. From the supply point of view, its movements express the presence of supply shocks, its propagation, and the technological and energy mix changes. From the demand point of view, the concept captures changes in energy prices stimulated by external or domestic demand, sectoral structural changes, as well as changes in energy intensity. Accordingly, the use of a measure that integrates oil production and energy consumption to examine the causality hypotheses between energy and economic growth could shed some light on idiosyncrasies of oil producing countries. The purpose of this empirical research is to examine the contributing of the ratio of oil production to primary energy consumption (SE) to the energy-growth nexus.

Methods: The nexus is assessed by the control of the ratio of oil production to primary energy consumption. Annual data for the period 1965-2012 is used. The oil producing countries focused in this study include the countries that meet the following criteria: (i) are oil producers during the period under analysis; and (ii) have data for the entire period, simultaneously on primary energy consumption, oil consumption, oil production, and exports of goods and services. Therefore, our analysis focuses upon a balanced panel of fifteen countries, specifically: Australia, Algeria, Brazil, Canada, Colombia, Ecuador, Egypt, India, Indonesia, Italy, Mexico, Peru, United Kingdom, United States, and Venezuela. The sources of raw annual data are from the World Bank Data, and BP Statistical Review of World Energy.

The expected presence of dynamic effects strongly supports that the analysis will be conducted by econometric techniques that analyse both short- and long-run adjustments. To permit the breakdown of the total effect of dynamic interactions into short- and long-run components, the equivalent conditional unrestricted error correction model (UECM) form of an autoregressive distributed lag (ARDL) model is used. When working with macro panels, the possibility of the panel being heterogeneous must be assessed. Indeed, the option for a panel approach or for techniques that allow diversity to be accommodated is conditional upon the units' degree of heterogeneity. If parameter slope heterogeneity is found, then Mean Group (MG) or Pooled Mean Group (PMG) estimators should be applied. MG is the most flexible model. It estimates the regressions for each individual, and then calculates an average coefficient for all crosses. Its estimates of the long run average coefficients are consistent, but inefficient when there is a slope of homogeneity (Pesaran et al., 1999). The former estimators (MG and PMG) were tested against panel fixed effects (FE). For that, a Hausman's test was used and it clearly supports the FE as the appropriate estimator. Given that heteroskedasticity, contemporaneous correlation, first order autocorrelation, cross

section dependence (CSD) and a large time span are present, the Driscoll and Kraay (1998) FE estimator was used.

Results: The results reveal a strong internal consistency and the use of the ratio of oil production to primary energy consumption proves to be appropriate. The set of countries under analysis is a mixture of OPEC and non-OPEC, and developing and developed countries, but the diversity is not enough to be econometrically handled as heterogeneous. Indeed, the presence of parameter slope heterogeneity in the panel of countries was not confirmed. The control for the presence of heteroskedasticity, contemporaneous correlation, first order autocorrelation, and CSD was pursued and compared with benchmark ones and no changes, with statistical significance, were observed on the parameters of the model.

The results reveal that the elasticity of oil consumption on growth is positive, although humble in magnitude, especially in the short-run. The relative oil resource abundance, captured by the variable *SE*, reveals to be a driver of economic growth for this set of countries. On which the magnitudes of elasticities to growth respect, both in the short- and in the long-run, oil consumption is the main driving force, followed by the ratio of oil production to primary energy consumption. The option for the use of dynamic panel techniques reveals be adequate as the phenomena under analysis is both a short- and long-run one. The speed of adjustment is very low, under 3%, as shown by the error correction term (ECM), revealing that the adjustment to shocks requires a longer time span to come back to the equilibrium.

Conclusions: The oil-growth nexus in oil producing countries was analyzed within a framework where the oil consumption, the ratio oil production to primary energy consumption, and the structural shift of the second oil shock were controlled for. To bring trustworthiness to the use of recent panel data estimators that are sensitive to time asymptotic properties, a long period is used. Albeit they were worked upon macro panels, no cross heterogeneity of parameters was found. The CD-tests indicate the presence of CSD. The decision to decompose the total effects into their short- and long-run components proved to be wise. Bring together diverse panel data estimators constitutes a proper contribution to the literature of oil-growth nexus on oil producing countries.

Evidence was found supporting the traditional *growth hypothesis* of the energy-growth nexus, for the set of countries analyzed, both in the short- and in the long-run. Furthermore, the panel dynamic specification detects cointegration/long memory, as the ECM term is negative and statistically highly significant. Indeed, the speed of adjustment to the long-run equilibrium is fundamental for the understanding of the oil-growth nexus. The structural break in elasticity of oil consumption to growth proved to be positive, but of low magnitude. The *SE* and the oil consumption were confirmed as drivers of economic growth.

References

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