LONG RUN RELATIONSHIP BETWEEN OIL PRICES AND AGGREGATE OIL INVESTMENT: EMPIRICAL EVIDENCE

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Overview

Using the aggregate number of oil rigs as a proxy of oil investment, I evaluate the bidirectional relationship between oil prices and oil investment in OPEC and Non-OPEC countries. We take advantage of Bayesian estimation techniques and innovation accounting (variance decomposition and impulse-response functions) to incorporate the long run dynamics of the oil market without imposing strong restrictions on its structural form.

Oil investments are deeply conditioned on oil price behavior cause it determinates the future profitability of those investments that are used in the oil production process. On the other hand, as a previous phase in oil production, oil investment conditions the future supply of the exhaustible resource, which means that aggregate oil investment (or that made by non-competitive actors) should affect oil prices using future supply as a transmition channel. Based on that, our work focuses on a multiequational approximation that allow us to study and evaluate the effects that may exist when oil prices and aggregate oil investment are treated simultaneously.

Recent literature help us in understanding this relationship. Ringlund et al. (2004), estimates the elasticity of oil rig investment demand to changes in oil prices in different countries and regions, suggesting that oil rig investment respond positively to changes in oil prices, although it varies in speed and magnitude around the region studied. Casassus et al. (2005) in replicating the behavior of future and spot oil price in a DGE environment, suggest the existence of a risk prime in oil prices that depends on the distance between the decision to invest and the actual realization of that investment.

Our empirical approximation is relevant because: (1) it incorporate's one of the basic assumptions of the aggregate oil market, which is that investment decisions have an impact on oil prices due to its influence in future oil supply and, (2) it examines a dynamic behavior rather than estimate an specific parameter, allowing us to delimit the uncertainty level surrounding its magnitude.

Methods

As exposed, there are theoretical justifications to consider aggregate oil investment as endogenous when studying oil price behavior. (Sims, 1980) proposes a non-structural approach to analyze this kind of situation in order to avoid a large number of restrictions over a specific structural approximation. This is particularly useful when it is not whether variables are exogenous, and a natural use for a vector autoregressive analysis (VAR). Additionally, as suggested by Christiano *et al.* (2006), VAR-based confidence intervals accurately reflect the actual degree of sampling uncertainty associated with impulse response functions. On the other hand, Bayesian estimation allow us not just to improve the accuracy of forecast, but to deal with the lack of long periods of data, as well as with potential non-stationary problems (Sims *et al.*, 1990).

The main difference between the Bayesian and classic estimation is the use of prior information. Prior information in BVAR synthesizes all the knowledge within the time series used in a standard presentation. Common priors include the following general statistical ideas: (1) aggregate time series usually have a near to one root on its autoregressive representation, (2) Lagged coefficient have a larger probability to be close to zero when the lagged period is longest, and (3) Own lagged terms of a particular variable tend to be more useful for forecasting proposes than other explicative variables.

We estimate the following BVAR model presented on its reduced form: $x_t = A_0 + \sum_{i=1}^{5} A_i x_{t-i} + e_t$

Where x_t is a (6x1) vector with observables variables such as: OPEC oil production, Non-OPEC oil production, oil rigs in OPEC countries, oil rig in Non-OPEC countries, OECD industrial activity index (as a proxy for world oil demand) and Brent oil price in real terms. A_0 is a constant (6x1) vector, A_i is a coefficient matrix (6x6) for lagged values of x_t , and e_t is a vector of error terms. All variables are expressed in logs.

Results

Aggregate oil investment for OPEC and Non-OPEC groups respond positively to shocks in oil price. Both reach a maximum response near to 6th to 7th quarter, however, Non-OPEC oil response at this point surpass OPEC investment by 2,5 percentage points, basically doubling it.

Oil production variables for both groups positively respond to shocks in oil investment, but again Non-OPEC behavior is higher in magnitude. On the other hand, oil production response to shocks in oil prices suggests that OPEC has a larger capacity to respond in the short term to a permanent oil price variation than Non-OPEC producers as a group. The latter, however, has a slow growing but persistent pattern, contrary to the OPEC group, which seems to react with an overshooting of oil production in the short term (first 5 quarters) to then permanently reduce its production level. This kind of response is consistent with a cartel behavior.

Oil price response to oil investment shock its lower in magnitude than the others presented, and confidence intervals suggest the noisiest behavior. Variance decomposition suggest that long term oil price its explained only by 8% to OPEC changes in oil investment and 12% in case of Non-OPEC group.

Conclusions

Our findings follow the traditional Hotteling model in sense that oil investment seems to be explained by oil prices in the long term by 47% for OPEC group and 40% for Non-OPEC group. Their response to a permanent shock in oil price are at its highest level of 2,5% and 4,9% respectively, reached out around the 6th to 7th quarter. However, contrary to common intuition, our result suggests that the oil price response to shocks in oil investment seems to be barely significant and usually transitory. This kind of response for oil price should arise in a model when a BVAR with 5 lags and 92 usable observations is run on the data from it, we do not claim about to discovered any particular robust response. This result is against any particular risk-prime on oil prices such as that suggested in Casassus et al. (2006). We suggest that this result could have two different explanations. First, as expressed in Hotelling (1931), long term determinants of an exhaustible resource price are technology and scarcity, not investment. Second, as frequently expressed by analysts, more oil investment does not necessarily imply a greater oil production. Instead, a greater secondary extraction could be taking place suggesting that new oil findings aren't in quantity and quality similar to those in the past. This mean that, on aggregate, oil investment is being directed to less productive phases of the oil fields, limiting the potential increase in supply.

The framework presented here could be extended. One possible extension could be to incorporate oil stock information, which up to day isn't available for the period studied. Additionally, a detailed research agenda about the quality of oil investment in OPEC and Non-OPEC groups is required in order to completely understand the former results.

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