

## **Shale boom in Argentina: impact of the development of unconventional gas and oil using multi-regional CGE and Input-Output Models**

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### **Overview:**

According to the US Energy Information Agency, Argentina has the second shale gas reserves and the fourth shale oil reserves in the world. Also, Argentina is now one of only four countries (along with the US, Canada and China) to produce commercial volumes of crude oil from tight formations. The reservoirs are concentrated principally in the Vaca Muerta field (“Dead Cow”) in the province of Neuquén. The government has encouraged investments to develop a large-scale production. The required amount of investment until 2030 is estimated between 35 and 50 billion of Dollars.

While stressing the importance of the sale oil and gas (O&G) discoveries, there is a lack of studies evaluating its impact on the economy. The objective of the paper is to assess the effect of the exploitation of Vaca Muerta on the region and the whole country.

### **Methodology:**

The tool developed for the estimation of economic impact is a bi-regional Social Accounting Matrix (RSAM) of Neuquén and the Rest of Argentina. It contains input-output from sectorial transactions, household, government and rest of the world information. For the construction of the RSAM, we use a national SAM using: i) an existing input-output matrix for Neuquén, ii) state data from production and exports, iii) specific information about O&G production, iv) non-survey estimations of IRIO with additional information which was included to improve the precision of the models.

The RSAM is used with different models. Two groups of models were applied: input-output multipliers (Leontief) and a Computable General Equilibrium model (CGE). In these models, we simulate different shocks of the aggregate growth of conventional and unconventional hydrocarbons in line with MINEM’s forecasts in “Energy Scenarios 2030”<sup>5</sup>. Results show potential changes in GDP at a national and regional level, as well as employment and other sectorial impacts.

Two hydrocarbon scenarios from the forecasts of MINEM were used for Leontief and CGE’s simulations<sup>6, 7</sup>:

- EFIC + INV - “Efficient + Investment”: 750 kbd of oil production (399 kbd unconventional oil), 174 mcmd of gas production (109 mcmd unconventional gas).
- TREND + INV - “Trend + Investment”: 750 kbd of oil production (399 kbd unconventional oil), 200 mcmd of gas production (109 mcmd unconventional gas).

Simulations on the Leontief model were made as demand shocks while the ones on CGE were made as productivity shocks. In both cases, the simulation was made to represent the cumulative growth of conventional and unconventional hydrocarbon production in MINEM’s forecasts.

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Author(s) are responsible for the arguments, ideas and/or opinions expressed and they do not symbolize the official opinion of the National Direction of Scenarios and Project Assessment (SSEyEP-MINEM) or any office under the Secretariat of Government of Energy from Argentine Republic.

<sup>5</sup> Ministry of Energy and Mining, March 2018.

<sup>6</sup> The simulations were made considering the two different hydrocarbon scenarios (oil and natural gas). The comparative static simulated in the models do not consider direct changes on fuels demands, electric matrix diversification between other analysis considered on “Energy Scenarios 2030” from MINEM.

<sup>7</sup> Difference in gas production is driven by efficiency measures. Both scenarios assume regional gas exports of 25 mcmd in summer, implying 18.5 mcmd annual exports.

It is important to consider that Leontief models assume unlimited production capacity and fixed prices. Leontief closed and open models were used for simulations. The closed model only considers indirect effects from activity sectors while the open model incorporates as endogenous household's consumption and income. The CGE models assume behavioral functions for each economic agent and both prices and quantities are endogenous. Total capital was fixed; however, a capital increase in hydrocarbon sectors was modeled as an investment return made in this sector.

#### **Expected Results:**

The results allow observing the effect on the different activities (in and out of the region). This study will help to identify potential bottlenecks that it should be removed to reach the production goals. Our results indicate that there is not a large difference between the two scenarios EFIC+INV y TREND+INV.

GDP annual growth ranges between 0.3% y 0.4% for Argentina. The GDP of Neuquén ranges from an annual growth rate of 4.6%/4.8% in EFIC+INV and 4.9%/5.1% in TREND+INV. The effect is smaller in the CGE model (2.6%/2.7%) as a consequence that it allows capital substitution between regions.

In terms of sectoral effects, metal sectors are the ones with higher growth as they offer services for well drilling and fracking. Other sectors also experience considerable growth because the energy and metal sectors have forward and backward linkages with the rest of the economic sectors.

Employment effect is measured by the employment multipliers in Leontief's models and increase approximately 25% Neuquén's employment and 2% Argentina's total employment.

#### **Conclusions:**

The joint study is the first attempt to estimate the potential impact of the development of Vaca Muerta in the economies of Argentina and Neuquén, considering the effects on productive sectors, household welfare and macroeconomic variables.

Results show that the development of Vaca Muerta's resources has a significant impact on regional economy (measure only in Neuquén province in this opportunity) and relevant growth for the rest of the country.

This study also could help to identify potential bottlenecks in different intermediate requirements that it should be removed to reach the production goals.

#### **References:**

- Capobianco, S., G. Michelena, L. Mastronardi y J. P. Vila Martínez, 2017. "Matriz de contabilidad social para Argentina: Estimación con desagregación exhaustiva de los sectores energéticos", Documento de trabajo conjunto elaborado por Ministerios de Energía y Minería y Producción, disponible en: <http://scripts.minem.gob.ar/octopus/archivos.php?file=7619>
- Chisari, O., C. Romero (con la colaboración de INECO-UADE), 2009. *Un modelo de equilibrio general computable para la Argentina*, PNUD, Buenos Aires.
- Chisari, O., L. Mastronardi y C. Romero, 2014. "Interregional fiscal spillovers: A CGE study for Buenos Aires City and the Rest of Argentina". Anales 47º JIFP
- EIA, 2016. "Trends in U.S. Oil and Natural Gas Upstream Costs".
- Gomes y Brandt, 2016, "Unconventional Gas in Argentina: Will it become a Game Changer?". Oxford Institute for Energy Studies.
- Ministerio de Energía y Minería, 2017, "Escenarios Energéticos 2030". Disponible en: <http://scripts.minem.gob.ar/octopus/archivos.php?file=7755>