

## Fossil fuel price shocks and CO<sub>2</sub> emissions: the case of Spain

*Jorge Blazquez*<sup>1</sup>, *Jose Maria Martin-Moreno*<sup>2</sup>, *Rafaela Perez*<sup>3</sup> and *Jesus Ruiz*<sup>4</sup>

### Executive summary

Since the 70s, abrupt shifts in oil prices and their impact on economic activity are at the core of economic analysis. Oil shocks, positive and negative ones, can have a significant effect on business cycles and this is why they are matter of concern for policymakers. However, oil currently represents around 1/3 of the fossil fuel energy mix at a global level. Natural gas and coal are as relevant as oil from an energy perspective. Nevertheless, the potential macroeconomic impacts of coal and natural gas price shocks have not been explored. In addition, fossil fuel prices are strongly correlated and tend to move in parallel, suggesting that hydrocarbon prices respond to the same perturbations or shocks and affect economic activity simultaneously. Usually a sharp shift in oil prices is accompanied by a sharp shift in natural gas and coal prices. This is an extra reason for paying attention to the three fossil fuels at the same time.

The objective of this paper is to understand the impact of oil, natural gas and coal price shocks on the business cycle and on CO<sub>2</sub> emissions of a small open economy like Spain. This study shows that oil prices, but also natural gas and coal prices, have an impact on economic activity, on the consumption of these commodities, on energy productivity and on carbon emissions, making easier or more difficult to achieve environmental targets.

Although the share of oil in the Spanish fossil fuel mix is larger than the one at a global level, we consider Spain to conduct this study because the country has negligible production of indigenous fossil fuels and its economy is 'sufficiently small' to assume that any change in this demand has not relevant impact in the international prices. These reasons back our decision to consider the international price of fossil fuels independent from Spanish economic fluctuations. Additionally, the evolution of fossil fuel energy productivity is an intriguing characteristic of the Spanish economy. A systematic increase in fossil fuel energy productivity is a common characteristic of many economies, but this productivity has stagnated in Spain over the last 40 years. Fossil fuel productivity is not improving, making the economy less resilient to energy shocks. Given this unusual fact of the

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<sup>1</sup> Research Fellow. KAPSARC. King Abdullah Petroleum Studies and Research Center. Riyadh 11672, Saudi Arabia. e-mail: [jorge.blazquez@kapsarc.org](mailto:jorge.blazquez@kapsarc.org)

<sup>2</sup> Corresponding author: José María Martín-Moreno. Dpto. Fundamentos del Análisis Económico. Facultad de CC.EE.EE. Universidad de Vigo. Campus Lagoas-Marcosende s/n. Phone: +34 986812531. Fax: +34 986812401. e-mail: [jmartin@uvigo.es](mailto:jmartin@uvigo.es)

<sup>3</sup> Departamento de Fundamentos del Análisis Económico I and ICAE. Universidad Complutense de Madrid. e-mail: [rmperezs@ccee.ucm.es](mailto:rmperezs@ccee.ucm.es)

<sup>4</sup> Departamento de Fundamentos del Análisis Económico II and ICAE. Universidad Complutense de Madrid. e-mail: [jruizand@ccee.ucm.es](mailto:jruizand@ccee.ucm.es)

Spanish economy, this paper also addresses the cyclical properties of energy productivity.

In order to analyze the role of the three fossil fuel price shocks on aggregate fluctuations, we use Bayesian procedures to estimate a Dynamic Stochastic General Equilibrium (DSGE) model. This paper finds that natural gas and coal price shocks have a significant impact on Spanish aggregate fluctuations, but the price of oil seems to be most relevant cause of these fluctuations. As it is standard in this methodological approach, productivity shocks and, to a lesser extent, oil price shocks mainly explain the volatility of output, while the contribution of natural gas and coal price shocks are marginal. We could state that the oil price is still the ‘king’ of energy prices. Paradoxically, productivity shocks have a negligible impact on fossil fuel energy productivity which is explained by price shocks. The reason is that technological shocks stimulate the demand of energy, offsetting potential energy productivity gains. Finally, this study shows that the three fossil fuel prices are relevant to understand the evolution of fossil fuel consumption and the energy mix.

An interesting result of the estimation of the model is that oil, natural gas and coal are complementary inputs, meaning that fossil fuels tend to move in parallel when there is a change in prices. In other words, the economy demands simultaneously more (or less) oil, natural gas and coal. An increase in oil prices not only decreases the demand for oil, but the demand for gas and coal as well. To the best of our knowledge, this is the first time that these parameters have been estimated at a macroeconomic level.

Policymakers tend to define carbon emission targets independently from the macroeconomic environment. For example, the European framework on climate and energy 2030 sets a 40 percent reduction in greenhouse emissions below the 1990 level as a binding target. This reduction is independent from the cyclical situation of the economy and from the level of fossil fuel prices. Our study shows that the volatility of carbon emissions and, then, the level of carbon emissions in a particular year is influenced by fossil fuels prices. A sharp increase in fossil fuels prices favor a significant decrease in carbon emissions. Thus, the success of the European climate and energy agenda will depend on the policy implemented, but also it will depend on the level of fossil fuel prices in 2030.

**Keywords:** energy prices, fossil fuels, DSGE models, Bayesian estimation, small open economy, CO2 emissions