COST-BENEFIT ANALYSIS FOR PETROCHEMICAL PROJECTS: THE CASE FOR SAUDI ARABIA

[Dongmei Chen, King Abdullah Petroleum Studies and Research Center, 966112903192, dongmei.chen@kapsarc.org]
[Philipp Galkin, King Abdullah Petroleum Studies and Research Center, 966112903194, philipp.galkin@kapsarc.org]
[Colin Ward, King Abdullah Petroleum Studies and Research Center, 966112903062, colin.ward@kapsarc.org]

Overview

The key idea behind the cost-benefit analysis (CBA) is that for some projects the financial appraisal alone can fail to capture their gains (or costs) to a society at large. In such cases, supplementing financial indicators with those based on CBA aims to quantify in comparable currency units the project's impact on social welfare. Many countries, international organizations and development agencies have adopted CBA as one of requirements for project financing. However, the key objectives and relevant legal frameworks remain varied across nations (OECD 2015) and institutions (OBPR 2020, ADB 2009, EC 2014).

Major sectors, in which CBA is usually performed, include transportation, utilities, environment, waste management, energy, education, healthcare, ICT and R&D. In this study, we advocate for applicability of CBA for the investment decision process in the petrochemical industry, illustrated by a hypothetical project in Saudi Arabia.

Distorted market conditions, substantial government role in the sector and a broad range of external effects of petrochemical investment projects call for a framework which would: (1) account and quantify – where possible – such impacts and distortions; (2) provide an option to amend the financial KPI's of the project based on such calculations; (3) extend the project risk assessment framework accordingly. We propose such methodology based on the general CBA framework and practices established for other sectors and illustrate the proposed theoretical framework with a petrochemical investment project case study.

Methods

For this study, we apply the methodology based on the general CBA framework and established best practices for other sectors highlighted in EC (2014), and tailor it to the specifics of the petrochemical industry. First, we produce financial plans based on the set of cost estimates for an ethylene plant in Saudi Arabia, Malaysia, and China under the following assumptions: the plants use the same technologies and feedstocks; the plants are the same size (1.5 Mtpa); the plants were constructed at the same time (2021); the only differences are the locations and associated construction and operation costs; all the projects target Chinese market for their output.

In the second phase we apply the CBA methodology to the project located in Saudi Arabia. Proposed approach covers three major areas: adjustments to the project's proforma financial plan, accounting for the project externalities, and risk assessment. For this project, major adjustments to the financial plan include the costs of inputs – natural gas and electricity – where the government-set tariffs are substituted with the market-based estimates based on domestic shadow prices. Existing CAPEX, labour costs and general overheads are assumed to reflect the market prices.

Key externalities estimated for this project cover associated pollution and climate costs, specifically, emissions of CO2, NH4, SOx, NOx and PM10. Emission volumes are calculated based on the data from similar projects, and the associated costs are taken from EC (2014) and CE Delft (2018).

For the risk management section, we apply sensitivity analysis to identify critical variables and their potential impact on the project bottom line, followed by the qualitative risk assessment, where specific risk factors, grouped into categories, are analysed according to their effects, timing, and severity.

Results

Based on the financial planning results, Saudi Arabia would be the only profitable location for the project with stated assumptions. Since the revenue streams are assumed to be similar for all locations, its advantages are driven by cost competitiveness, the input costs in particular. Total project costs associated with natural gas in Saudi Arabia comprise only 25.1% of those in China and 36.8% in Malaysia; the electricity costs in Saudi Arabia amount to

60.3% and 69.9% respectively. Comparing remaining two options, Malaysia seems preferable than China due to cost advantage observed in all areas (natural gas costs in particular), except for transportation and tariffs.

The CBA adjustments significantly affect the outcome of a sample ethylene project based in Saudi Arabia, reducing its NPV by $7.1 billion. Pollution and climate costs amount to $5.0 billion or 9.6% of the adjusted project OPEX. Removing domestic subsidies for natural gas and electricity increases the cost of natural gas up to 51.8% of the total project OPEX, followed by electricity cost at 33.0%. The resulting outcome is still more favourable than that of the "Chinese location" financial plan, however, it would make Saudi Arabia a less attractive project location than Malaysia.

Applying CBA also helped identify additional critical risk factors. The critical variables for the sample project are ethylene price, natural gas and electricity tariffs. The latter two factors were not critical according to the pre-CBA financial plan. The impact of these factors on the project bottom line from the ± 1 % variation in these variables is estimated at 5.5%, 2.7% and 1.7% respectively.

Conclusions

The general principles of CBA are applicable to evaluation of investments beyond the "traditional" sectors and industries, especially if relevant markets are heavily regulated, and if a government acts as an investor or a major stakeholder of a project. In the environment where non-financial factors – including energy security, climate goals and protectionism – increasingly drive economic policy and investment, CBA provides a broader assessment of the project outcomes and can help align the interests of investors and policy makers.

A broader scope – characteristic of CBA – also contributes to a more comprehensive project risk assessment, which is becoming increasingly relevant given the escalating trend of macroeconomic and geopolitical shocks. CBA can help identify critical risk factors that may not be visible at the financial planning stage and quantify potential impacts.

In the case of a joint international project, the perspectives of investors on certain CBA costs and externalities may not concur. The CBA practices and outcomes can also vary significantly depending on the industry and project location. The established CBA standards for specific sectors could contribute to methodological transparency and help address potential conflicts of interests.

References

Asian Development Bank (ADB). 2009. "Cost-Benefit Analysis for Development: A Practical Guide". https://www.adb.org/sites/default/files/institutional-document/33788/files/cost-benefit-analysis-development.pdf

CE Delft. 2018. Environmental Prices Handbook 2017. Delft. May 2018. https://cedelft.eu/publications/environmental-prices-handbook-2017/

European Commission (EC). 2014. "Guide to Cost-Benefit Analysis of Investment Projects". https://op.europa.eu/en/publication-detail/-/publication/120c6fcc-3841-4596-9256-4fd709c49ae4

OECD. 2015. "Government at Glance 2015". https://doi.org/10.1787/gov_glance-2015-en

Office of Best Practice Regulation (OBPR) of the Australian Government. 2020. "Cost-Benefit Analysis". https://obpr.pmc.gov.au/sites/default/files/2021-09/cost-benefit-analysis.pdf