Export diversification and resource-based industrialization: the case of natural gas ☆

Olivier MASSOL [a,b,*] **Albert BANAL-ESTAÑOL** [b,c]

Extended Abstract

September 14, 2011

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The present contribution aims at assessing the performances of these export diversification strategies and to provide useful guidance to the policy makers who have to design an industrial strategy for the monetization of a given resource. Accordingly, our analysis focuses on the processing industries associated with this particular resource. Our approach has its roots in Markowitz's (1952, 1959) Mean–Variance Portfolio (hereafter MVP) theory and focuses on the trade-offs between the gains derived from diversification and those resulting from specialization. On the one hand, a wisely selected export diversification may look desirable to moderate the variability of the export earnings of a commodity-dominated economy. But, on the other hand, such a policy can also have a negative and substantial impact on the perceived resource rents if it involves shifting the gas resources from export-oriented infrastructures into substantially less profitable uses. The theoretical basis of our approach stems from Brainard and Cooper (1968) who pioneered the application of MVP concepts in the field of development economics.

Paradoxically, processing costs are usually disregarded in the applied studies based on the portfolio approach (e.g. Love, 1979; Caceres, 1979; Labys and Lord, 1990; Alwang and Siegel, 1994). With few exceptions, this omission is seldom justified. Such an oversight seems reasonable in the case of export goods with comparable production costs but can hardly be advocated when processing costs differ significantly as it is likely to be the case with resource-based industries[2]. Indeed, any optimal portfolio obtained while focusing solely on export earnings could be largely suboptimal from the perspective of a governmental planner concerned by both the variability of export earnings and the expected amount of resource rents to be perceived. Interestingly, public engineering studies are generally available for resource processing technologies. These studies typically reveal some interesting features of the industries under scrutiny, such as cost information, an order of magnitude for the economies of scale that can be obtained at the plant level, the ranges of possible capacities for the processing plants... We thus detail an adapted model that conveys a richer and more realistic framework than those associated with traditional application of the MVP concepts for addressing the diversification problem faced by resource-rich countries. Indeed, this modified MVP model explicitly incorporates the observed differences in the processing costs, the possible existence of economies of scale at the plant level, and the lumpy nature of the decision to enter into a new processing industry (as the minimum capacity that can be implemented is usually strictly positive).

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Then, the proposed methodology is put at work to examine the optimal export-oriented gas-based industrialization strategies that could be implemented of the strategies conducted in a sample of nine countries (Angola, Bahrain, Brunei, Equatorial Guinea, Nigeria, Oman, Qatar, Trinidad & Tobago, and the U.A.E.). We focus on six gas-based industries that represent the main monetization options offered by natural gas: (i) the liquefaction train (a dedicated cryogenic infrastructure used to export natural gas in an LNG form); metal processing industries like (ii) aluminum smelting or (iii) iron and steel plants producing Direct Reduced Iron (DRI); petrochemical plants converting natural gas into (iv) diesel oil - with the so-called Gas-To-Liquid (GTL) techniques - or another basic non-oil petrochemical like (v) methanol; and fertilizer industries such as (vi) urea plants.

Lastly, an adapted gauging methodology is developed to assess the performance of the gas-based industrialization strategies conducted in these countries. This method takes its inspiration from the widely applied Data Envelopment Analysis (hereafter DEA) methodology (Charnes et al., 1981). Finally, the proposed framework is used to derive some policy-relevant recommendations.

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