



Proposing a decision-making process for the development of sustainable oil and gas resources using the petroleum fund: A case study of the East Natuna gas field



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ABSTRACT

The East Natuna gas field in Indonesia is planned to be developed to meet the increasing natural gas demand of Indonesia. This research investigates the sustainable development of the field using a multi-criteria decision analysis method (MCDA), namely the preference ranking organisation method for enrichment of evaluations (PROMETHEE). For this purpose a PROMETHEE model is employed to compare and appraise four alternative of petroleum funds against technical, economic, environmental and socio-political criteria. Those alternatives are determined by allocating 0%, 10%, 15% and 25% of the government's share of the gas field exploitation as petroleum funds. The results show that the adoption of a petroleum fund for the sustainable field development is both relevant and feasible. The bigger the petroleum fund, the better the merits. Employing 25% of the government's revenue towards this fund is found to be the most preferable choice, since it benefited from technology, environment and social aspects. However, the downside of this alternative lies in the economic aspects, such as the reduction of government revenues and potential increase in government debt as well as government resistance. As this study demonstrates, PROMETHEE can provide a relevant tool to assist decision makers to formulate policies aiming at a sustainable petroleum resources development.

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1. Introduction

The success of Indonesia's economic development depends on its ability to provide a sufficient and sustainable energy supply to its people. Thus, fulfilling the demand growth and ensuring the economic and environmental sustainability of energy supplies constitute the key subjects of Indonesia's economic policies. When pursuing its sustainable development, one of the main factors a country must consider is the energy supply, as it is tied to the country's institutions, policies, regulations, in-depth planning, investments in energy infrastructure, and consistency in planning and implementation.

In addition, the use of fossil energies should address the needs of future generations by taking into account the criticality of the non-renewable resources, use of technologies to minimise depletion, and availability of energy alternatives to substitute fossil energies (Schilling and Chiang, 2011). The rate of depletion and economy of use should be carefully determined to ensure that the

resource does not run out before acceptable substitutes are available. Moreover, development policies should pay attention to changes in the access to resources and in the distribution of costs and benefits. For this reason, sustainable development in the energy sector, such as the exploitation of oil and gas, has been widely implemented through natural resource management (NRM). NRM is concerned with the management of natural resources to ensure environmental, social, and economic sustainability for both present and future generations, in accordance with the principles of sustainable development (Barma et al., 2012). There are various ways to ensure sustainable NRM, one of which is through natural-resource or petroleum funds (PFs) that are recognised as sovereign wealth funds. PFs were established to manage fiscal challenges, achieve intergenerational equity, and transform resource wealth into more productive assets (Aslanli, 2015). Intergenerational equity focuses on the benefit of non-renewable resources to both the current and future generations, as equally as possible. Further, it is aimed at ensuring that the productive capacity enclosed in the current resources is shared across generations, in the form of resources deposits, capital assets, or technological knowledge. The fiscal sustainability challenge should be met by targeting a fiscal

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policy that preserves government wealth. This preservation of wealth would require that consumption in each period be limited to permanent income or implicit returns on government wealth (Barnett and Ossowski, 2002).

Most petroleum-producing countries have established petroleum stabilisation and/or savings funds, attributed as sovereign wealth funds that manage a portion of their oil and gas revenues for various purposes (Bacon and Tordo, 2006; Sturm et al., 2009). The stabilisation function of PFs deals with the short-term challenges of fiscal policy, while the savings function deals with the long-term challenges of intergenerational equity and fiscal sustainability that occur along with non-renewable resources. Almost all petroleum-producing countries have established petroleum stabilisation and/or savings funds. These countries include Kuwait (since 1953), UAE (1976), Oman (1980), Brunei (1983), Saudi Arabia (n/a), Norway (1990), Venezuela (1998), Azerbaijan (1999), Kazakhstan (2000), Algeria (2000), Qatar (2005), Timor Leste (2005), Libya (2006), Russia (2008), Ghana (2011), Iran (2011), and Nigeria (2012) (SWFI, 2015).

Theoretically, the optimal management of natural resources funds refers to Hotelling's Rule, which states that, under certain conditions, the price charged for exhaustible resources must grow at a rate equal to that of interest (Hotelling, 1931). Moreover, the rule contains a reminder that the consumption of a resource unit today has an opportunity cost equal to the present value of the marginal profit from selling the resources in the future. This principle provides assurance that an optimal extraction policy maximises inter-temporal benefits. In this instance, a decision-maker will always face the choice between the increasing value of the resources, if left unexploited, and their current value, if extracted and sold. Further, this inter-temporal trade-off is addressed by developing the permanent income hypothesis (PIH), which is evolved from Hotelling's Rule (Venables, 2010). The PIH states that countries base their consumption and savings decisions not on their current income, but on the total expected stream for future incomes from employments, investments, inheritances, etc. In addition, PIH can be considered an inter-temporal rule that ensures current generation shares in the proceeds of the natural-resource endowment, such that it preserves the endowment for the next generation. Those savings should be held abroad and managed by a sovereign wealth fund, so that PIH can provide an important benchmark in intergenerational transfer.

Even though PIH has several conceptual advantages, its use might not be appropriate for developing countries, since they lack capital, infrastructures, human resources, public funds, etc. (Venables, 2010). For these countries, the value to the society of consumption in the very near future, in favour of domestic investments, should be higher than that in the far future, when the economy has developed. Moreover, their level of savings is lower than that mentioned in the PIH. Therefore, this shows that the rule on the consumption-saving trade-off over the proceeds from natural resources depends on a wide range of circumstances and preferences. Thus, there is no a specific consumption-saving approach that would be applicable to all countries.

In fact, most savings or natural-resource funds have deposit rules that are sometimes governed by fiscal rules, while others are not. Since the design of fiscal rules depends on the context, there is no single rule suitable for every country (Bauer, 2014). Sometimes, the funds receive a constant share of petroleum revenues to save for future generations (Davis et al., 2001). In order to be effective, the savings amount should be high and budget expenditure should be limited. In the case that the expenditure is not reduced, then the savings-fund assets are only offset by government debt. As examples, the state of Alaska in the US adopted a constitutional obligation that at least 25% of its oil revenues be placed into its savings fund, Kuwait assigned 10% of its oil and non-oil revenue to

be reserved (Fasano, 2000), and Ghana allocated 9% of its petroleum revenue to a heritage fund for future generations (Bauer, 2014).

Despite the fact that Indonesia has a long history in the oil and gas industry, which was created in 1885 when oil was discovered in North Sumatera, it never endorses any laws or regulations regarding PFs or the sound implementation of NRM to fulfil the needs of sustainable development. Rather, all oil and gas revenue is considered state revenue. In fact, in the 1980s, oil and gas revenue made up about 60 to 70% of all state revenue, but that number has dropped to less than 20% in the last five years (SKK Migas, 2014). This policy has caused the nation's petroleum reserves to decrease significantly, since there is no specific fund assigned to conduct exploration activities in the pursuit of additional proven reserves, or in developing renewable energy sources. Between 2007 and 2013, oil production declined by 14%; moreover, the average reserve replacement ratio (RRR), which measures the amount of proven reserves added to the country's reserve base during the year, relative to the amount of oil and gas produced, was less than 0.6 (DEN, 2014; EIA, 2015).

Due to the depletion of non-renewable resources and their volatile prices, many countries have established PFs in order to transform these resources into sustainable and more stable future income, and to distribute the wealth across generations (Clark et al., 2013). Considering these arrangements, governments seek to smooth out consumption in order to manage future price shocks, as well as to utilise it for current and future generations in a fair way. This will prevent countries from making similar mistakes as those made when there were oil price shocks in the 1970s, in which the assets associated with the commodity boom were, for the most part, unwisely spent. To some extent, Indonesia has not learned from those mistakes. By not implementing a PF, the economy of the country is vulnerable to the increased volume of oil imports, due to depleted reserves and fluctuating prices. In fact, in the last five years, Indonesia's imported oil has increased from US\$ 8.65 billion (2010) to US\$ 17.53 billion (2011), US\$ 20.44 billion (2012), US\$ 22.48 billion (2013), and US\$ 23.91 billion (2014). This increasing in imported oil has become the major reason for Indonesia's current account deficit (CAD) and increase in the state's debt (Bank of Indonesia, 2015). Due to the rising CAD, in the last five years, the state's debt has increased from US\$ 4.65 billion (2010) to US\$ 6.45 billion (2011), US\$ 11.84 billion (2012), US\$ 15.80 billion (2013), and US\$ 19.24 billion (2014) (MFRI, 2015, 2016). The absence of PFs and budget deficit policy has caused future generations to inherit debt instead of accumulated assets, while the exchange rates, fiscal sustainability, and country's economy is vulnerable to the volatility of commodity prices.

The implementation of PFs needs support and commitment from the government, as well as from the parliament, since it will affect the annual budget income and fiscal arrangements. So far, the government's fiscal policies have been oriented more on the financial and economic aspects of the resources, and determined based on the traditional decision-support tools used in economics, such as cost-benefit analysis. In light of the growing concerns regarding the development of sustainable non-renewable resources, which also requires a comprehensive consideration of the social, technological, and environmental aspects that could not be monetized, it is more appropriate to adopt multi-criteria analysis as the decision-support tool. Because of the multi-dimensionality of the sustainability goals and complexity of the socio-economic and environmental systems, multi-criteria decision analysis (MCDA) methods have become increasingly popular in the decision-making process for sustainable energy (Pohekar and Ramachandran, 2004).

In fact, to adopt the PF scheme in Indonesia, the decision-makers are forced to deal with complex decision processes, in the face

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