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A statistical approach for a fuel subsidy mechanism

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ABSTRACT

This paper presents an economic policy as well as statistical procedure for optimizing fuel subsidy regimes to effectively manage pump prices. The procedure is applied to the Indonesia fuel subsidy policy as a case study. The application concentrates on the historical time period from 2011 to 2015 and attempts to retroactively forecast the evolution of prices and demand for fuel oil, and consequently the robustness of the presented fuel subsidy mechanism. The results of the quantitative analysis suggest that it is possible to construct an oil price stabilization fund that is able to minimize pump price volatility, while at the same time maintaining healthy economic as well as financial conditions. In view of the fact that the fuel subsidy mechanism presented in this paper works by replacing actual market prices with reference prices, it has a modular property, and the technical as well as the practical implementation would work equally well in a subsidy or non-subsidy environment. Hence, it is possible to extend the same approach to other countries and economies as well as to other commodities.

1. Introduction

The impact of oil price volatility on fuel pump prices generally depends on the cost structure of fuel pump prices. Fluctuations in pump prices have major impacts on spending behaviors when oil-related costs take up a high proportion of overall fuel pump prices. The consequences of such volatilities are worse on fuel producers and providers; with very little subsidy, any adverse price movement will translate directly into critical financial and operational performances. Moreover, decisions to revise and adjust pump prices are never free from political entanglement as governmental involvement would not always set decisions that would appropriately consider the prevailing economic conditions (Yépez-García and Dana, 2012). Hence, in the medium- to long- run, such price uncertainties would deter future investments in this sector. Investment is needed to rejuvenate and build new infrastructures, hence facilitating continuous growth in fuel oil supply and promoting increasing demand.

Several governments have employed different economic-policy measures to dampen the impact of oil price volatility on their domestic pump prices (Kojima, 2013a, 2013b). For example, countries such as Saudi Arabia and Venezuela were able to decouple their pump prices from the market by applying fixed lower prices than prevailing market prices. India imposed excise duties to reduce the proportion of fuel price components to the overall pump price, while Ghana not only imposed additional levies but also introduced subsidies for various products. Chile implemented the “Fondo de Estabilización de Precios del Petróleo (FEPP)”, an oil stabilization fund that works by absorbing excess revenues from fuel oil when market prices were actually lower than previously set pump prices, which in turn is used later on when prices reverse (that is market prices are higher than pump prices), hence reducing the overall volatility. However, the FEPP went bust in 2003 due to the sharp increase in oil prices in the late 1990s that nearly depleted the fund. One of the major drawback of this fund was its failure to properly incorporate volatility into the equation (IEA, 2009; GSI, 2012; IMF, 2013; OECD, 2013).

In November 2014, the government of Indonesia increased pump prices of gasoline and diesel to about Rp 2000/liter (Beaton et al., 2015). Abiding by the general global trend, already observed by Davis (2016), Coady et al. (2015), the IEA (2015) and OPEC (2016) this hike in prices reflected the government's desire to gradually phase out fuel subsidies in Indonesia. Following this price hike, a new pump price system was introduced that aimed at subsidizing diesel only. The corresponding amount of subsidy was set at a fixed amount of Rp1000/liter (Jakarta Post, 2015). Although gasoline was no longer directly subsidized, the government still considered it as an obligation to protect its people's purchasing power by setting on a quarterly basis the pump prices for regular gasoline and regular diesel products throughout the country.[1] The following oil supply shock, which led to the significant

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[1] Malaysia used a similar approach as Indonesia by setting its pump prices periodically.

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decline of prices helped to cushion the impact of earlier price increases. This allowed the government to cancel parts of the hike while maintaining minimum overall subsidy amounts (GSI, 2015). In Indonesia the oil related costs take up about 80–90% of overall fuel pump prices, hence rendering customers in Indonesia to higher exposure from oil price volatility (Tappata, 2009). The average Indonesian citizen spends about 10% of its disposable income on fuel products.

The main objective of this study is to statistically model an oil fund mechanism that is observable, controllable and most importantly financially sustainable to carry out its mission to dampen the oil price volatility impact on pump prices.

Various statistical methods ranging from linear regressions, stochastic approaches and probability functions to time-series analysis and techniques relating to fuzzy logic, decision tree and optimization functions, will be employed to develop a dynamic oil fund that exhibits a modular property that is able to work well in different pricing environments (i.e. with subsidy, without subsidy, and fixed subsidy), while guaranteeing acceptable domestic retail prices with lower price volatility as well as guaranteeing sustainable financial conditions for the oil fund. A success criterion for the fund mechanism will be its ability to sustain operations under several different scenarios of government's initial paid-in capitals and pump price variance targets. The effectiveness of the fund mechanism will be back-tested, by means of a retroactive forecast, using Indonesia's actual market data from 2011 to 2015 which incorporates periods of both stable and fluctuating oil prices.

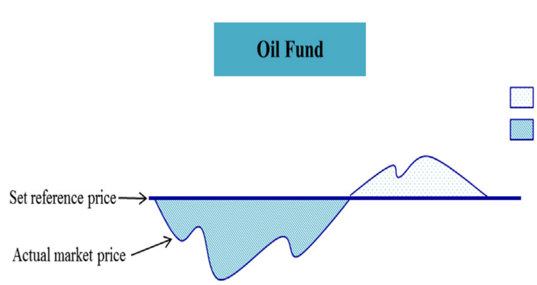
Bearing in mind the overall objective of the underling study, the remainder of this paper is organized as follows. Section 2 presents the proposed Indonesian oil fund and its general features. The subsequent Section 3 introduces the methodology and statistical application employed to examine the underlying effectiveness of the proposed oil fund. Section 4 presents the results and the last Section 5 concludes.

2. Proposed oil fund mechanism

The suggested fund mechanism will use the same basic principles as the FEPP in Chile that absorbs excess revenues from fuel during periods of market prices lower than previously set pump prices, which may later be used as means of "subsidies" when prices reverse. To properly incorporate the impact of volatility, the balance of the fund and the trigger for pump price adjustments will be determined using option-like formulas. The fund will also be managed to mimic a defined benefit pension plan model, which should allow the government to intervene through the injection of additional paid-in capitals.

The following graph illustrates the concept of an oil fund which works fundamentally very similar to an ordinary saving system (Graph 1).

The oil fund mechanism works by setting a reference price (REFPrice) for fuel products. Whenever the actual market price (MKTPrice) is below the reference price, then fuel producers/providers earn excess revenues because their sales are based on a higher reference price while their costs are based on lower actual market prices. These excess revenues are then deposited to the implemented oil fund to be



Graph 1. Concept of the oil fund.

used later on when prices reverse. Like any other savings, the implemented oil fund faces two main challenges:

1. Volatility: The amount of savings which deemed to be sufficient at the beginning may end up to be inadequate due to higher than expected future needs; Hence volatility needs to be properly taken into account when estimating the appropriate oil fund's balance.
2. Inflation: Inflation erodes the value of saving. Thus, the oil fund needs to be supervised by an experienced asset manager, whose primary responsibility is to make adequate investment with the disposable income of the fund, hence assuring that the dynamics of monetary appreciation or depreciation may not adversely impact the nominal value of the fund.

The oil fund will set a new REFPrice to replace the market based MKTPrice reference price for domestic fuel product transactions. The REFPrice will be evaluated and issued on a quarterly basis and remain fixed throughout the respective quarter. Financial effects arising from the difference between the set REFPrice and the prevailing MKTPrice prices will be settled on a monthly basis through a monthly settlement process.[2]

When the set REFPrice is higher than the prevailing MKTPrice price, fuel producers/providers will collect excess revenues which need to be deposited to the oil fund during the monthly settlement process. On the contrary, when the REFPrice is lower than MKTPrice, the oil fund needs to make up for the shortfall of the revenues at the expense of the fuel producers/providers. This is also graphically illustrated in Graph 2 by the two-way arrow between oil fund and fuel producers/providers. In case of subsidy, the monthly settlement will be arranged between the oil fund and the government, as the government is exposed to the fluctuating oil prices. This is shown by the dotted two-way arrow between the oil fund and the government.

The fund threshold (shown by the dotted lines) reflects the ideal amount of balance to be maintained. This threshold is a function of the current price level, volatility, and expected fuel consumption volumes. Thus, the difference between the fund threshold and the current balance (shown by the blue shaded area) reflects the expected gap that the oil fund should be aiming to cover in order to maintain its financial sustainability. This gap will trigger the REFPrice adjustment signal. In case of a negative gap, this signal will ask the fuel producers/providers to adjust the REFPrice upward by certain amount, which will enable the oil fund to accumulate deposited revenues from the producers/providers to cover for the negative gap and vice versa. Throughout the process, the government has always the possibility to intervene in the process by injecting funds to the oil fund to alter the amount of necessary REFPrice adjustment[3]

The fund threshold reflects the ideal amount of the balance that the oil fund should maintain. To ascertain its financial sustainability, the oil fund should optimally maintain a positive fund balance at all times. Thus, the threshold is able to cover the next three monthly settlements.

$$TH_q \geq \sum\nolimits_{m=0}^{2} (\text{REFPrice}_q - \overline{MKTPrice}_{q,m}) x Vol_{q,m} x Fx_{q,m} \quad (1)$$

where, THq: Threshold amount in quarter q
REFPriceq: Set REFPrice for quarter q
MKTPriceq,m: Average actual MKTPrice in month m
Volq,m: Actual fuel consumption in month m
Fxq,m: Local currency/USD exchange rate in month m

[2] Kojima (2016) reported that in Indonesia, the actual market prices are based on a reference price for domestic fuel product related transactions, which is the average of a set of Singapore-based oil product MKTPrice assessments published by Platts, also known as Mean of Platts Singapore (MOPS) prices. The oil fund would then issue a REFPrice for domestic fuel product related transactions, Indonesian Domestic Oil Product Reference Price (INDOPrice).

[3] As already mentioned, to overcome the problem associated with inflation erosion, the oil fund needs to be supervised additionally by a professional asset manager.