

## A GLOBAL MARKET OIL STOCKPILING MODEL

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**Abstract.** A global market oil stockpiling model is developed in this paper. It is formulated as a many persons' game problem with Markovian jumps. Variational inequality approach is employed to obtain the existence and uniqueness of the Nash equilibrium. Algorithms using network structure and parallel processing methods are proposed and developed.

**Keywords.** oil stockpiling, global market, Nash equilibrium, variational inequality.

**AMS (MOS) subject classification:** 90A15, 90D15, 90D40.

### 1 Introduction

Lately, a series of troubling events has made the energy prices volatile than they have ever been for years. Oil prices hit a 10-year high and as a result, natural-gas prices are also soaring. This forces us to take more serious consideration in energy policy making to prepare for disruption in unstable world oil market. In recent years, the research of oil strategic stockpiling has received much attention; see [1–3] and the references therein. Using an import insecurity loss function, the optimal SPR (strategic petroleum reserve) policy was calculated by solving a finite horizon dynamic programming problem in [1]. This result was extended to allow multiple possible disruption severities and joint stockpiling policies in [2]. In [3], a dynamic Nash equilibrium problem was introduced, in which both public and private sectors, using the game theory terminology, termed as *players*, are included. The model was described by one public player and one (aggregate) private player (aggregation of all individual private players). By means of the dynamic programming approach, the Nash equilibrium was characterized by a system of equations and the solution was found via Gauss-Seidel relaxation procedures. In [4], we studied strategic planning of oil stockpiling via variational inequality approach. Sufficient conditions for existence and uniqueness of the Nash equilibrium were derived, and efficient algorithms were suggested.

In spite of the interesting and important discoveries in the aforementioned papers, the models studied are essentially 'local,' in that the problems being considered are stockpiling in one nation only. There has yet been a global oil market model in this respect to the best of our knowledge. Nevertheless,