Modeling the Impacts of Middle East and North Africa Unrest on the Global Oil Price

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ABSTRACT

Social and political phenomena of the Middle East and North Africa (MENA), as the main oil producer region, are of the crucial importance. In this paper, we will try to give a better model of the oil markets and the factors that are important in determining the oil price. The previous models take into account the interactions of the supply and demand forces of the market to determine the oil price. However, in our model, we will consider another important factor as well, namely the Naked Fear in the oil markets, which mainly reflects the several concerns in the supply and demand parts of the oil trade. After studying the various causal loops, by means of simulating the model, we will show that the predictions for the trends of oil price made by our model, concords with the real data that have been observed. Furthermore, the model provides a way for testing some policies and solutions proposed for reducing the fluctuations of the oil markets due to the social unrests in the region, in addition to their influences on the global economy.

Index Terms— Oil Price, Middle East and North Africa Unrest, Oil Supply, Oil Demand, Naked Fear, Economic Model, OPEC Oil, Oil Crisis

1. INTRODUCTION

Most of the oil-producing countries have monarchy systems, and republicanism and democracy do not play a significant role in their governments. Due to the rapid developments in the technology of communications and information, it is reasonably expected that the collective consciousness of the region's people in social and political arena is highly increasing. As an outcome, growing rebellions and upheavals in this region in the forms of several demonstrations or even revolutions are not out of the minds of social scholars.

On the other hand, as an observation, the market of oil-products is severely affected by social conditions in the region. Thus, any case of unrest could cause remarkable fluctuations in the oil price and make the oil markets watch the vacillations of oil price [1]. Therefore, according to the effects of oil products on the global economy and welfare, there is a crucial demand for the researches about the effect of social movements and unrests on the global oil price. In this paper, after studying and modeling the mechanisms of the oil market that determines the oil prices, we would try to study the effects of unrests in the Middle East and North Africa (MENA) region on the global oil

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market using simulations to predict the oil price in several cases of the unrests that might occur in the region.

The rest of the paper is organized as follows: Section two will address the problem in more depth, and will elaborate why it is necessary to be more attentive in the MENA's unrest. Section three, will elaborate the economic model, which consists of four parts that would be explained deeply in the mentioned section. The next section, that is section four, will depict and discuss the simulation results. Section five, will propose some policies according to the model and will give an assessment and conclusion of what is discussed in the paper. Finally, section six would provide an acknowledgment.

2. PROBLEM DEFINITION

In this model, we will try to find the MENA unrests' effects on the oil market, and will address the economic aspects of the problem in more details and would not investigate the causes of the unrest itself. Rather, we will take the unrest as it has been created by some other reasons and we will survey the effects of it on the economic aspects of the oil market, and should follow the trend of its most important factor, that is, the global oil price.

Now, let us consider the importance of the problem specifically, and have a glance on the problems caused by the important phenomena occurred in the region during the recent years. As mentioned before, the dominating idea of this paper is to investigate the fluctuations of the oil price due to upheavals arising from the economic and political issues of the MENA governments, which have been suffering from social protests and changes during the recent years.

Researches already done in this area are mostly about the wars and past events, each, having long time gaps between and leaving their own effects on the oil price separately.

The oil revenues of its exporters have a direct relationship with the oil price, and increases when the prices are growing up. This makes them to produce and export more oil when the prices go up, which simultaneously decreases the prices. However, the oil resources are not forever lasting, and each barrel that is taken out of the ground leaves the oil reserves with one lost barrel. Thus, the support of the oil has some limitations due to the finite reserves, and it leads us to know that the support of the oil is not the one hand that must be taken account facing the oil problems and it has a limited power to fix the problems arisen. Thus, as a rule of thumb, the overall plan of the global marketers is to confine the production of the oil, and even reduce it gradually to leave the oil for some better consumption. In such a condition, the oil dependency in the exporting countries' economy determines the amount of oil to be exported. On the opposing side, studies in the oil producing countries show that when the oil exporting, instead of other resources such as taxes, is the most income-generating activity of government, the satiety of people in the government grows, which results in the governmental tyranny that is most observable in the oil producers [2].

Since OPEC's foundation, the oil price has faced some unexpected changes due to several phenomena. For instance, from 1972 to 1974 the price of oil increased 4 times [2]. This was mainly because of Yom Kippur war, which was started with the attacks of Egypt and Syria to Israel. These attacks were aborted and led to

Arab oils sanction by the pro-Israel governments.

From 1974 to 1978, there was a relative balance in the oil market and the price did not change significantly. However, aftermath, the war of Iran and Iraq, following Iran's revolution caused another shock during the years 1979 to 1981. To be more detailed, one year after the 1979's revolution, which led to a suspension of the Iran's oil production, Iran could raise its production to a proper amount. However, the war happening in the following year reduced the exports of Iran and Iraq to less than 1 million barrels per day totally. Thus, the global oil production were decreased by 10%, which imposed a spike in the oil price, which in turns, increased the oil price from 12 to 30 Dollars per barrel during the mentioned years [3].

In 1990, the fear of Iraq's attack to Kuwait caused another oil shock, which was followed by the war itself in 1991 named as the Gulf war. During the following years, the oil prices did not face rapid changes and the overall prices were relatively unchanged, until the 11 September 2001, on which the terrorists' attacks on the world trade centers imposed some worries on the oil productions. In 2002, Venezuelan oil companies' strikes decreased the production of oil in that country, that was another global worry on the productions. Even though the status of Venezuela began to improve, the NATO's attacks to Iraq again, disturbed the oil markets and the market faced another shock in the oil prices [3].

Iran, Libya, Bahrain, Yemen, Syria and Egypt own 10% of the whole world oil productions, meanwhile these countries are in the neighboring of the main oil producers such as Saudi Arabia, Iraq and Kuwait, which serve some of the regional bases of the US army. Since 2010, the first groups' countries have experienced remarkable social movements and political changes, which have influenced their economic circumstances and their oil industries as a significant participant of their economy. The influences on the oil markets far distances from these countries' own economies. There are many factors, which affect the oil price including uncertainty in changing the oil transmission paths that as an example making the transition via Red sea instead of Suez Canal in the area of Egypt can be mentioned [4]. Furthermore, these social events draw up an uncertain and risky future.

Beyond the demand and supply relations of the oil markets, which form the main mechanisms in determining the oil price, there, are some external effects on the oil prices, which give a better understanding of the changes made in the prices. One of the most important is the naked fear [4] on the oil supply that exists as an inevitable factor that reinforces the ordinary mechanisms of the oil markets. In the conditions in which the oil markets face some shocks due to the reduction of production in the countries facing the social crisis and repression, the oil prices may not precisely reflect the reduction in the oil supply, as it magnifies the conditions due to the worries in the markets for the future conditions. Thus, we have to discuss how the oil market replies to the production's suspension or changes for supply by better modeling of the causal loops and investigating the supporting factors of the oil markets. We have to note that, because of the amounts of production, these concerns in the Middle East are much bolder than the North Africa. For instance, in the Saudi

Arabia, in any case of social disturbance that might lead to the reduction in the production, this problem could be much more serious. However, it is worth noting that the mentioned country plays another significant role in the oil market as it contains a supporting role in the case of suspension in the other MENA countries productions by producing more oil and exporting from its spare reserves. Thus, it can partially control the shocks in the cases of spikes in the prices due to the reductions in the production.

In the following section, we will introduce the model we have given for the parts of the oil markets that determines the oil prices, and will elaborate how the different factors interact with each other in the oil market.

3. THE ECONOMIC MODEL

As mentioned before, oil price in the global market is not merely affected by the amount of supply and demand in the market. Yet, unlike many other goods, it is also affected by international naked fear in the supply and demand of the oil barrels. In our model, the Naked Fear is a variable that reflects the several worries on the oil markets. In the supply section, it may reflect the worries due to the reduction in the oil production that might happen in the oil producing countries facing the upheavals. In addition, these worries also reflect the worries on production caused by any other case of unrest like a strike in the producing industries, as well as reductions caused by the terrorists' attacks in the region [5]. Some other worries, that are of less importance in this case, consist of worries in the oil reserves, worries on the potential uprisings in the other producing countries, worries on the strength and ability of the governing states in controlling the hostile events that occur in their region including national and international conflicts. Finally, the variable also reflects the worries on the security of strategic checkpoints that are in the transition ways of the oil products to the international markets, such as Suez Canal, Horn of Africa and Hormuz Strait. These checkpoints face several issues regarding their security, such as the control of the governors of them on the checkpoints and confronting the piracy and terrorism in such regions which impose a potential risk in the supply of the exported oil.

In the demand section of the market, the Naked Fear might reflect the worries that might emerge due to the increasing demand of the importers. It also provides the way of modeling the worries in the growing oil dependency of the emerging markets including the Russia, India, Brazil and China (RIBC) [6].

The Naked fear is an important part of the model. An example is what happened in the Libyan case in 2011, where at first, the amounts of oil supply and oil demand remained constant, at least in a short period of time, but the global fears due to the unrests made significant fluctuations in the price [4].

In the following parts of the section, we will explain the several parts of the built model.

A. THE CORE MODEL

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Now, we can introduce the core of the model, which consists of the three main variables including the total global oil demand, total global oil supply and the naked fear that contribute in determining the global oil price.

The oil price like any other good has a direct relationship with the demand as well as an inverse relationship with the supply [7]. However, as shown in the Fig. 1, the Naked Fear has the impact of amplifying the Supply-Demand Ratio, which in turns determines the oil price. To be more detailed, the Naked Fear is considered to act as a cofactor that may reduce the oil supply. However, during the upheavals in the oil producers, the global demand for the oil production might face a slow increase due to the worries on the shortage. Thus, the Naked Fear has an increasing act as cofactor in the demand part of the market. Another relation is the backward effect of the supply on the Naked Fear that cases a reduction in that, whenever the reduction in oil supply is compensated through any other way, including the spare supply of the OPEC and non-OPEC or even the Strategic Petroleum Reserves of the US as a potential spare supply.

In the next part of this section, we will elaborate the oil supply causal loops more precisely.

B. THE SUPPLY PART OF THE MODEL

In our model, we suppose that the oil supply in the global market is formed in two ways, the regular supply and the spare supply. The regular supply is the amount of oil supply, which is the part that all of oil producers support it in the ordinary conditions and makes the main part of the oil supply. Regular oil supply can be decreased due to the continuing oil extractions of the reserves in the far long-term horizon, and might increase due to the new reserves found by the excavations made as regular developmental programs of the oil producing countries, as well. Critical conditions in the oil producing countries might lead to oil shocks followed by decreasing in their regular oil supply. However, the spare oil supply is the part of the oil production, which some producing countries such as Saudi Arabia and Algeria could produce according to their own declaration [8]. This consists of the OPEC and non-OPEC spare oil reserves as well as the Strategic Petroleum Reserves of the United States, which can be supported in the abnormal conditions to adjust the oil markets fluctuations as a potential controlling factor [9].

The overall amount of the spare supply is limited and it is possible just up to a certain fraction of the oil reserves. Thus,
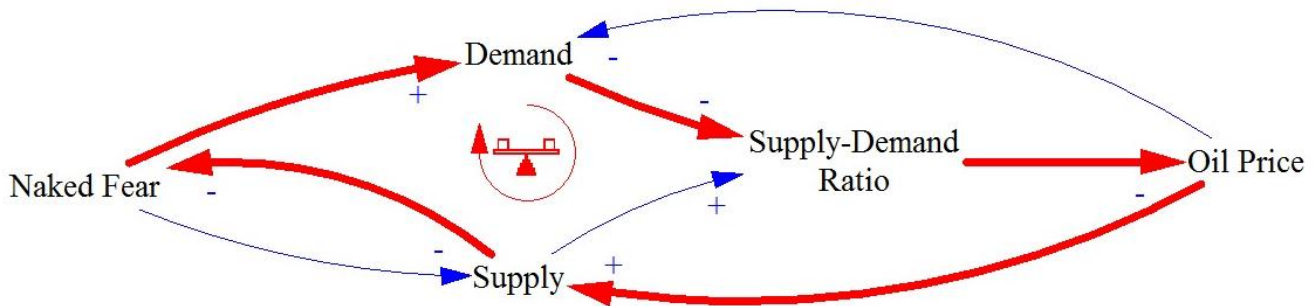

Fig. 1. The Core Model

an increase for spare supply is only possible when a critical social condition happens in a country that does not have spare oil reserves. That is, if a country such as the Saudi Arabia faces an upheaval resulting in the reduction of oil production, it would more drastic for the oil prices, as it would be much difficult for the global oil producers to compensate for the reduction, since, one of the main producers of both regular and spare supply have faced troubles. In the case of Libyan revolution, which led to a reduction of Libyan oil exports in a time interval, the regular oil supply was reduced suddenly, leading to a spike in the oil price [9]. Afterwards, the Saudi Arabia announced that it would compensate for the lost barrels of the Libyan oil that prevented the overall oil supply reduction. However, the prices remained high with a slight decrease [10]. This was mainly because of the naked fear mentioned before, that is, because of the several worries in the future of the oil supply in the region. The other reason was the difference in the oil grades of the two countries, that is, the Libya's oil is known as light grade and the Saudi Arabia's is known as heavy oil. The problem was that the Libyan oil, that is, the light oil is exported to the European

importers with old refineries that cannot refine the most of the heavy grades [4]. Thus, a limitation in oil market's adjustment shows itself consequently, and causes the prices to face some movements. Thus, in short run, the old European refineries should provide their required oil from the spare reserves of a country like Algeria that has an oil grade of the most similar to the Libyan. However, these are some hypothesis and all with their own limitations and costs that all lead to oil price of higher level. In addition, the heavy oil grades of the spare supply might find their ways to the newly built Asian refineries that can refine heavy grades better than the old Europeans can. These limitations, all impose new costs on the oil trades, including costs of the new contracts and new shipping ways with their own risks [11].

Moreover, the oil price also affects the amount of oil supply in a direct way; however, it would not make sudden effects on the oil production. Instead, it might change the supply in much smoother way in a much slower trend to compensate for the prices. The other factor, which affects the oil price, is the oil sanctions on the producing countries, which may occur in the upheavals case due to the undemocratic behavior of the
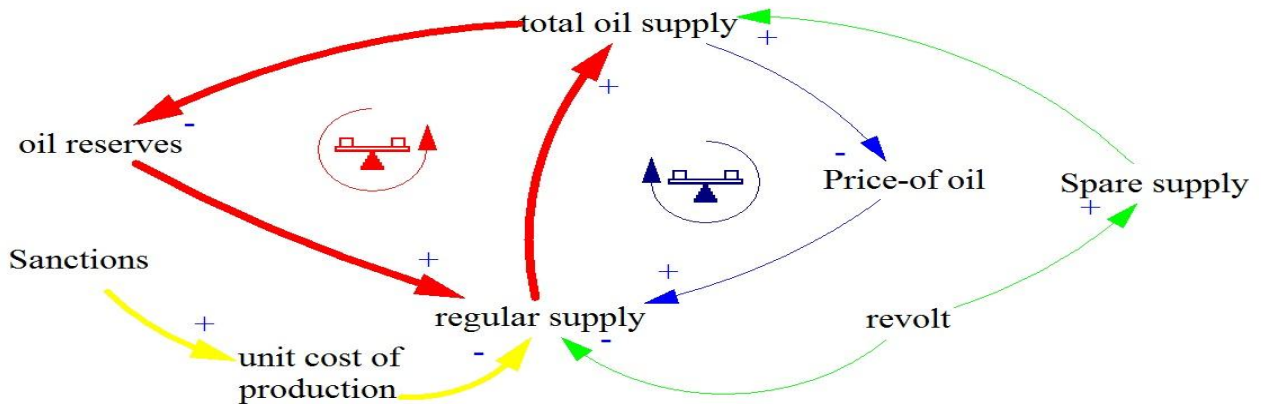

Fig. 2. The Supply Mail Causal Loops

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states with the demonstrations. This might increase the costs of production, for instance, sanctions may prevent the trade of drilling tools and in the worst case, global market may sanction the producing country from its oil exports. Thus, the oil prices might face some movements in such a case due to the changes for the supplied oil.

Now let us investigate the causal loops of this part of the model as shown in Fig. 2.

The Red loop in Fig. 2: Total supply of oil is the sum of regular supply and spare supply. Thus, the more regular supply will make the more total. On the other hand, as a long-term and much less important factor in our model, the increase in total supply makes the oil reserves decrease, reducing the regular supply again in the far-time horizon.

The Blue loop in Fig. 2: Increasing regular supply increases total oil supply, and according to the supply law increasing total supply decreases the global oil price smoothly during a time interval. On the other hand, reduction of oil price decreases the regular oil supply in a long-term horizon.

The green lines show the effects of the revolt (that is the upheavals and unrests) on the supply of the oil in the producers. In our model, we suppose that the revolt will act as an impulse that leaves its effects on the different parts of the model including the supply part; these effects will be explained more deeply in the simulation section of the paper. For now, we mention that after the effects of the revolt impulse, the regular supply of the oil will decrease and the spare supply will increase. However, the amounts of these increasing and decreasing can be manipulated and would be adjusted into the model according to the data that are provided in the real world, changing the amount of the mentioned impulses.

C. THE DEMAND PART OF THE MODEL

We have divided global oil demand part of the model into two separate parts according to their different economic structures. In the first part, there are western countries named as West oil demand, and in the second, there are the Emerging markets including Russia, India, Brazil and China (RIBC), which have rapid economic growth [5].

Two important factors, which affect the amount of oil demand, are oil price and oil dependency of importing countries economy. The oil dependency of an economy is the part that the oil barrels play in that economy's output products, that is, the value added by oil in that country's Gross Domestic Product (GDP). Thus, the more the oil dependency is, the more the oil demand of that country would be. In addition, the oil dependency of a country's economy has relations with its economic growth. For western countries accretion of the economic growth, reduces their oil dependency; however, in the RIBC countries, because of their economy's structure, addendum in the economic growth, increases their oil dependency [5]. As an extreme, if the unrests in the MENA cause the oil prices jump in a way that leads to an oil shock followed by an economic crisis, the economic growth rate of the oil importer countries would reduce. On the other hand, growing oil dependency increases the global economy's vulnerability on oil prices, that is, there would be higher risks of oil crisis whenever there are sudden shocks of oil prices. To elaborate, when oil's share in manufacturing the final goods is high, that

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is, the oil has a high added value, in the case of oil price fluctuations, global economy would be more vulnerable, and this vulnerability increases the economic crisis probability that can be highly amplified in the case of upheavals in the producing countries.

One of the factors that affect the amount of oil dependency is the ability of substitution of oil with other energy resources in the oil importing countries. A high ability of substituting the oil intensively decreases their oil dependency, and can be seen as a remedy for the oil crisis prevention and would be referred in the policy section much deeper [9].

In the demand part of the model, the main variable is the aggregate demand of oil,
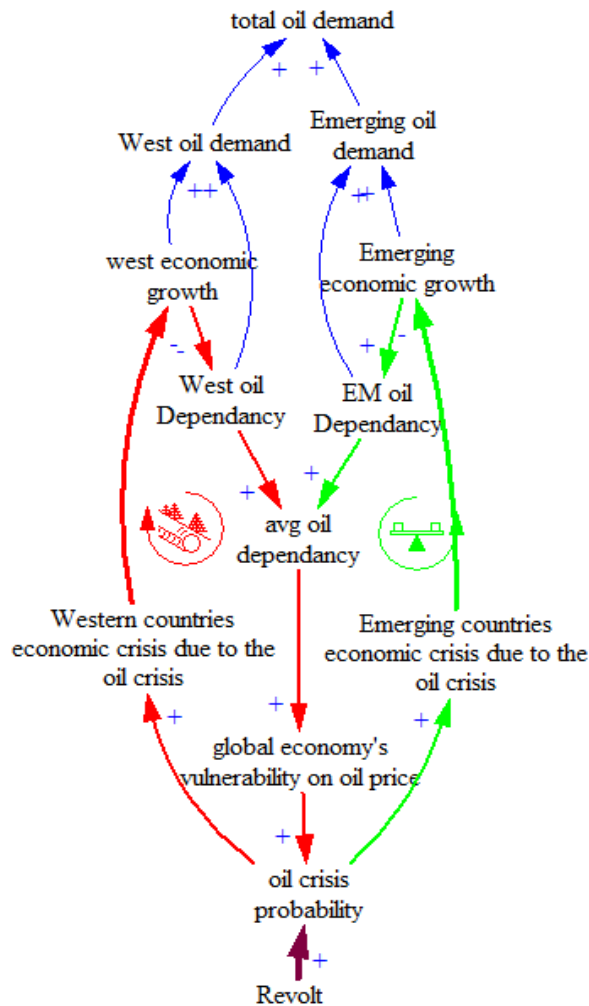
which is the sum of western countries demand and RIBC's demand. Aggregate demand affects the price of oil due to the law of demand.

Now let us inspect the loops that we have used in this part of our model. Fig. 3 depicts this part.

The Red loop in Fig. 3: when oil crisis probability increases, it is more probable that the western economies face an economic crisis. Thus, in the case of an oil shock, which leads to an economic crisis (the extreme case that has happened several times in past), the western countries economic growth will decrease. Then next causal line, introduces the relationship of the western economic growth and their oil dependency that is a negative relation. Now, the average oil dependency of the western countries and the emerging ones constitutes according to the weighted sum of the mentioned economies with their parts in the global overall GDP as the cofactors. As mentioned before, accretion of the oil dependency would increase the global economy's vulnerability on oil price, and this accretion will make the occurring of an oil crisis more probable.

The Green loop in Fig. 3: this loop is mainly similar to the red loop with one slight difference, that is the sign of causal relation between the economic growth of the emerging countries and their oil dependency, which is positive as discussed before. That is, the addendum of their economic growth increases their oil dependency unlike western countries. It is worth noting that reduction of oil dependency in western countries, decreases risks of global economy due to oil dependency via decreasing average dependency of oil.

To be more specific, let us discuss a long-term effect of these loops. Growing of the

Fig. 3. The Demand Main Causal Loops

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oil price due to the unrests, would decrease the RIBC countries' oil demand. Thus, because of the fundamental role of oil in their economy, their production would decrease as well, and it would cause reduction in their revenues. This would successively lesson their imports that are mainly from the western economies. The reduction in imports of RIBC countries would decrease western countries revenues in addition to their economic growths, successively.
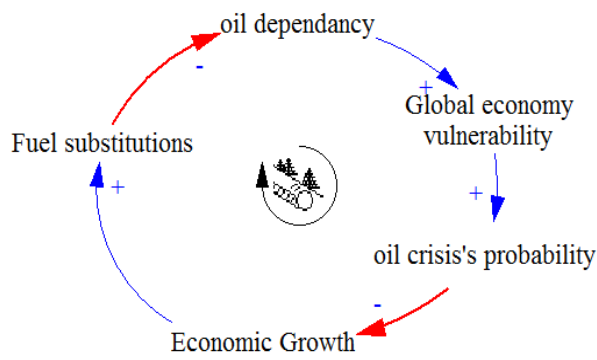

Fig. 4. The Supporting Loops of Demand Part

The next loop in the demand part is depicted in the Fig. 4. It shows that, when global oil dependency increases, global economy's vulnerability increases too. This increases the oil crisis's probability, consequently, which in turns, decreases the economic growths. As a result, the countries' research budgets to find other substitution fuel resources would decrease, which make them more dependent to the oil products. This loop acts as long-term intensifier of the previous loop, and makes the crisis mechanisms working more intense in the nowadays economy. However, in another viewpoint, the mentioned mechanism can be treated as a remedy that could alleviate the crisis mechanisms for the future's economy.

D. THE NAKED FEAR PART OF THE MODEL

As we discussed previously, the global oil market is affected by a third important factor in addition to oil supply and oil demand, which is named as Naked Fear in our model. The Naked fear affects the price through making changes in the ratio of supply and demand, by amplifying it through changing amounts.

In our model, three main factors affect the naked fear due to the unrests. The first factor is the domino effect [11] of these unrests and the spreading manner of the upheavals to the other countries in the region. The second factor is the security of checkpoints previously mentioned including the Strait of Hormuz, the Horn of Africa and the Suez Canal. Finally, the

Fig. 5. The Main Causal Loops of Naked Fear

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third factor is the worries about reduction of oil production because of unrests.

Security of strategic checkpoints is dependent on the strength of their ruling governments which itself increases as their oil revenues goes up. This is mainly because; their overall budgets and successively the budget allocated to military sector increases, in such a situation.

The Fig. 5 shows the Naked Fear's main loop. Social unrests decrease government's strength. Successively the security of checkpoints would decrease that serves as a resource of a global naked fear. An example is the Libyan revolution, which has attenuated its governments' control on the neighboring Mediterranean regions that has become a source of worries for the oil tankers passing from there, against the piracy and terrorism. As we discussed, global naked fear increases oil price via changing the amount of oil supply and oil demand (red and green loops), as if acts it to reduce the ratio of supply to demand.

Fig. 6 mainly discusses about the effects of the domino effect and other influencing factors in the naked fear. As already discussed, unrests affect the global naked fear via three factors including working of the Domino-effect of the social objections, loss of oil barrels due to revolts, that is, the reduction of the regular oil supply in the revolting countries, and finally, the hardship of finding substitute energy resources. As mentioned before, in the red loop of the Fig. 6, increasing of the oil supply would decrease the amount of naked fear due to the reduction of worries on the oil support.
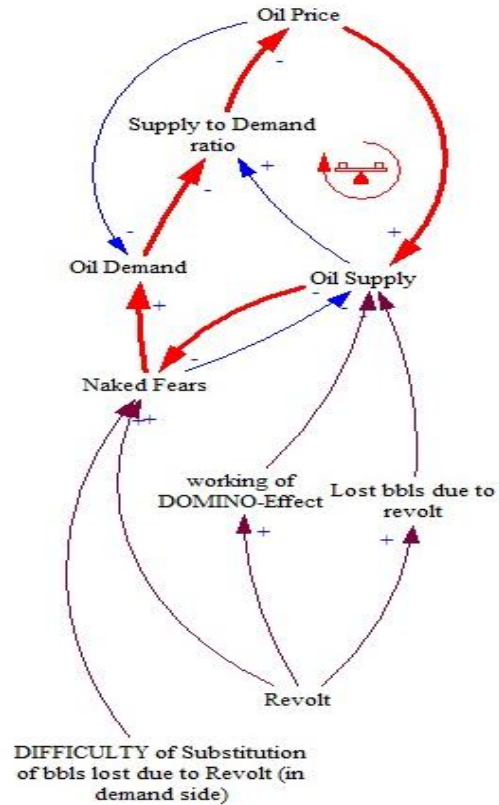

Fig. 6. The Factors that affect Naked Fear

4. THE SIMULATION RESULTS

In this section, we try to simulate the model for 30 days in Vensim software.

The simulation results are shown in the following figures:

- Fig. 7 shows the price trend.
- Fig. 8 shows the total oil demand's trend.
- Fig. 9 shows the total oil supply's trend.
- Fig. 10 shows the total oil demands trend as well as its components.
- Fig. 11 shows the total oil supply's trend, as well as its components.

First, in run 1, we tested the model by taking a simulation in which the revolts are not taken into the account. As expected, the results show that the oil price, the total oil supply, and the total oil demand follows a natural trend.

Second, in run2, we tested the model by taking into account the happening of the revolt in one of the oil producing countries. The revolt variable in our model is a sudden impulse that is imposed on the supply part, in addition to the Naked Fear part of the model. The height of the impulse is proportional to the intensity of the social event that has occurred in the mentioned country. Moreover, we have taken into account the amount of the oil barrels reduced in the production of that country, further to the amount that can be compensated for by increasing the support of the spare oil supply. Furthermore, in this simulation, we have supposed that the amount of lost barrels does not exceed from the amount that could be compensated through increasing the spare supply of oil. The simulation predicts that the oil price in such a case may face a sudden peak followed by smooth reduction. This is mainly because the spare oil compensation occurs usually with some delay.

Third, in run 3, we made another simulation in which the amount of oil barrels lost is more than that can be compensated. This situation can be an extreme part of the situation. For instance if there are large scale uprisings in a large producer like the Saudi Arabia, and the amount of lost oil is remarkable, this simulation can predict what might happen for the oil price in such a situation. The results are of the expectations. They predict that this case can be a much worse case than the former one for the global economy, as it imposes the oil markets to see the oil prices of nearly twice what is normal for the oil prices in a normal condition.

In the following simulations, we have shown the effects of proposed policies:

Forth, in run 4, we have increased the amount of substitute resources to test the policies that can be made. This policy would be discussed more deeply in the following section. The results confirm that by substituting the oil products by other

resources, the oil dependency of the western countries decreases by reduction of their oil demand, and consequently their economy's vulnerability on the oil prices will reduce, even though the prices still remain high.

Fifth, in run 5, we have increased amount of spare oil supply that can be supported in the critical conditions, and we conclude that this policy is a very effective one, as it compensates the reduction of the oil supply in any condition and prevents the oil shocks. However, as it would be discussed later, this policy is an example of short-run one to confront the sudden and rapid shocks of oil prices, and other policies proposed in the following section would be more effective in the long-run horizon.
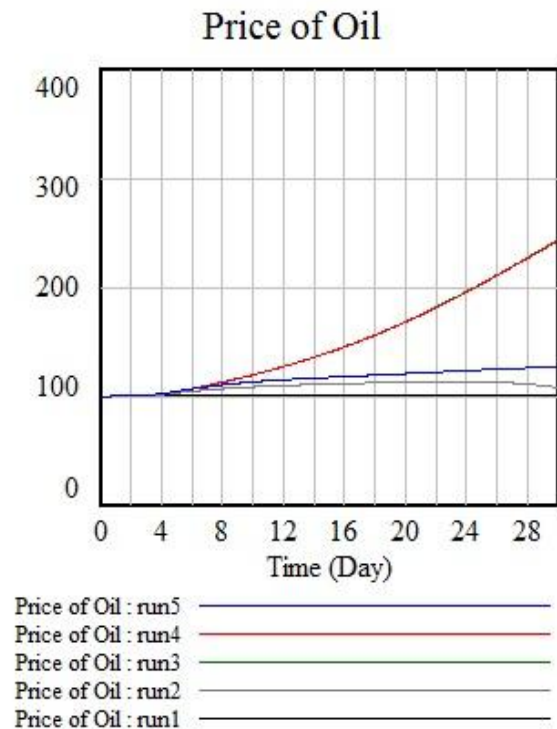

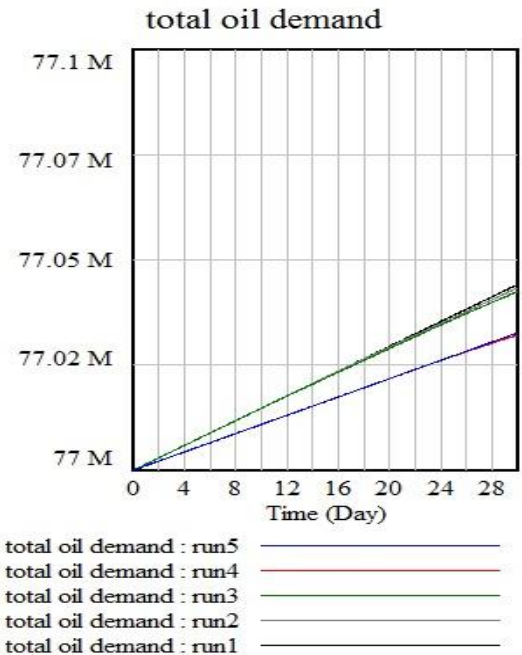Fig. 7. The simulation results for the oil price

total oil demand

Fig. 8. The simulation results for the total oil demand
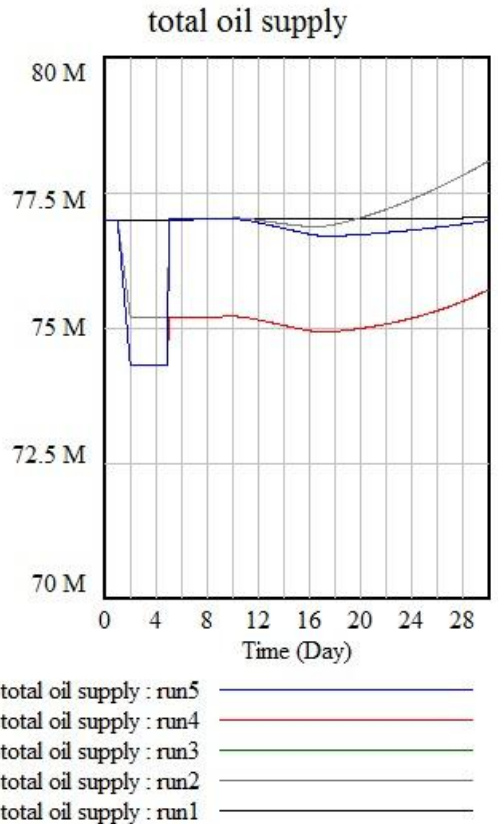
total oil supply

Fig. 9. The simulation results for the total oil supply
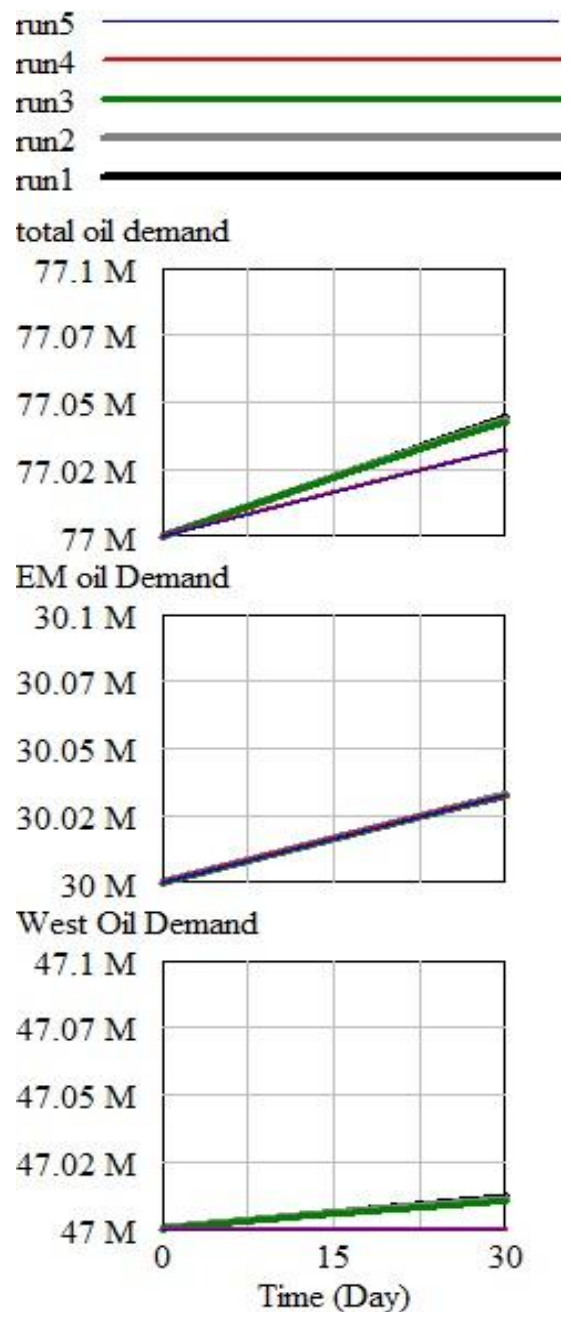

Fig. 10. The simulation results for the oil demand's components

5. CONCLUSION AND PROPOSED POLICIES

According to the mechanism proposed in the model and the way the social unrests in the MENA influences the oil markets, some of the policies that can be proposed are as follows:
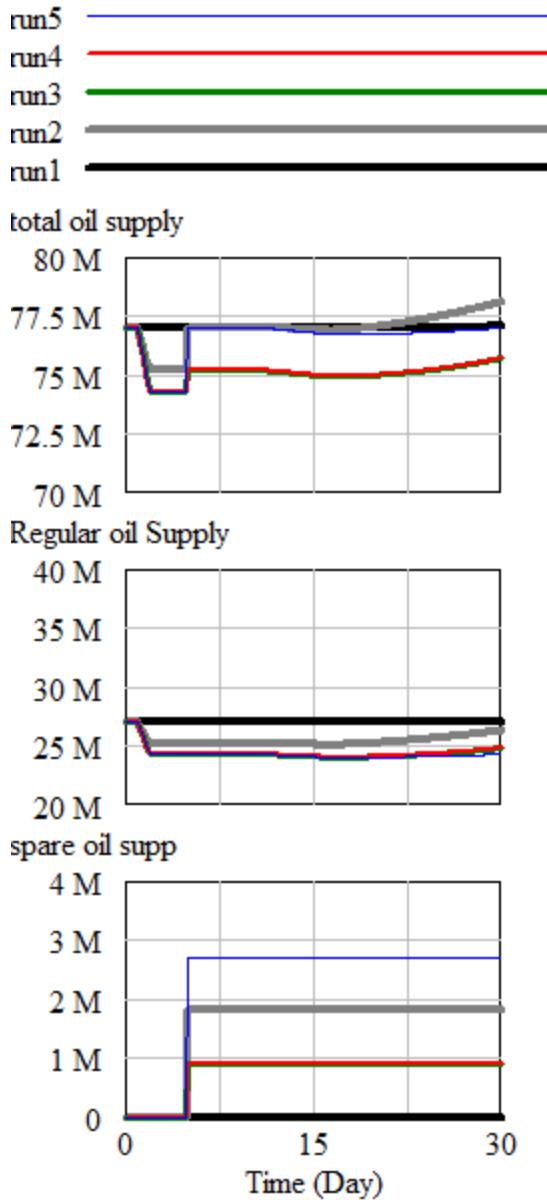
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Fig. 11. The simulation results for the oil supply's components

- reducing oil dependency of the oil importing countries;
- reducing global economy's dependence on the oil exports from the MENA countries;
- creating some mechanisms that can isolate the oil markets from the social events of the oil producing countries;

- increasing the capacity of supporting the spare supply of oil in critical conditions;
- finding substitute energy resources and investing in these fields to make them much affordable.

The oil market is a global one. Thus, the policies that can be proposed may not become effective unless there is a worldwide determination to execute them; however, some large economies can be more effective in these issues such as the US, the EU, and China [12].

The policies mentioned above, can be divided into two main categories; short-run and long-run. As a short-run solution, the importing countries may establish some strategic oil reserves as what exists in the US. This makes them, become stronger in the situations where a rapid transient oil shock may occur. As a long-run solution, the substitution process can be utilized in the transportation system, that is, some gas products such as Natural Gas fuels could substitute the oil products that are used as fuels. The main part of the Natural Gas consumption of the US is from its own productions accompanied by the imports from Canada [9]. These countries do are not capable of rough social situations in comparison to what is happening in the MENA. Therefore, if they utilize these policies, they may make important remedies for their oil dependency and the outcomes of it such as the influences from the oil shocks.

The other solution that is utilized more recently is the Lithium batteries that are used as another substitution. However, Lithium is another mineral substance that its resources have the same problem of the oil resources; that is, being focused on some small parts of the world [5]. Thus, if such places face the unrests similar to

what is happening in the MENA, the consuming countries will face the similar issues.

6. ACKNOWLEDGEMENTS

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