Monetizing oil imports impacts to incorporate them in a CBA

A qualitative study for the Netherlands

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Abstract

In many European countries social cost-benefit analysis is used to examine and evaluate government projects. One potential benefit is that a country becomes less dependent on oil imports: this can be considered a societal benefit. However, in standard Cost-Benefit Analysis (CBA) this benefit never appears. This paper aims to gain understanding of the importance of incorporating the costs and benefits which accrue from an augmentation or a reduction in oil imports in a CBA within the transportation sector in the Netherlands. The article uses a method that was applied in the United States and modifies it to apply it in Dutch CBA.

Keywords - Oil imports, Energy security, Oil dependence, Social benefits, Transportation sector, Cost benefit analysis

Contents

1. Introduction

This document proposes a method in which the changed impacts of oil imports due to policies can be included in Cost Benefit Analysis (CBA). Most countries have something in common: they are unable to meet their energy needs with their own resources. The vast majority of the world's 197 countries depend on a dwindling group of exporting countries, producing a mismatch between supply and demand. On fossil fuels this unequal distribution is more significant in the case of oil industry, which is almost wholly globalized. This paper focus on oil imports, which represent a problem for these countries when a huge percentage of their local oil consumption is based on imports. When policies increase or decrease oil imports, this can be considered a welfare loss or gain, respectively. The article has a societal contribution because there is a lot of literature regarding to the oil field but there is a gap regarding to how to take into account these changed oil imports impacts in CBA.

Countries can be divided between oil demanders and oil suppliers. On the demand side are North America, Asia-Pacific, and Europe, with only 10% of the world's reserves but accounting about 78.6% of the demand; while on the supply side are Middle East, former Soviet Union (FSU), and Africa, which hold 81.3% of world's reserves but account for 15.5% of the world's oil demand in 2005 (Gupta, 2008).

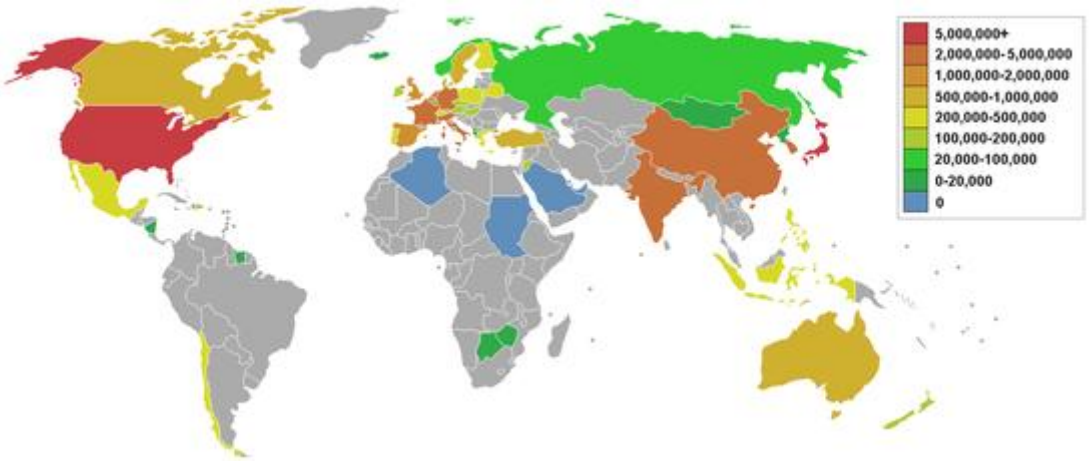

Figure 1. Oil importing countries in the world in 2006 (Wikipedia)

World oil consumption was about 86 million barrels per day (MBPD) in 2012, and this is projected to increase to 112 MBPD in 2035 (Litman, 2013). By 2020, it is known that half of the oil production will come from countries which are currently considered as high risk areas because of their political instability. Many of these risk areas are situated in countries that are member of The Organization of Petroleum Exporting Countries (OPEC) – Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela- and which currently hold 75.2% of world's oil reserves and control about 41.7% of oil production. Therefore, it is highly important that tensions, crises and international conflicts do not impair the flow of resources and investments.

As it can be seen, declining oil imports is becoming more and more important in European countries like the Netherlands. According to Frankel and Menzies (2013) the biggest part of these imports come from the increasing use of vehicles which turns into an increasing fuel demand and this is the reason why this paper is focused mainly on projects related with the transportation field. Research has shown that policies in the transportation sector have a direct impact on oil imports but these impacts are not considered in CBA. Including these impacts in CBA would make the result more accurate and as it will be explained in more detail in Section 3, this paper tries to fill de gap that actual CBA have. Thus, the aim is to find if it is reasonable to include these impacts in further CBA. For example, a project that advocates public transport which reduces oil imports may have a higher CBA score if oil imports impacts are included.

First, the research problem will be discussed to show the gap in the literature. Furthermore, a literature review will be done in order to show the state-of-the-art of the field and to introduce some crucial concepts such as oil vulnerability or oil scarcity. After that, the current situation of the Netherlands will be studied. Next, a method will be studied to try to find the way of incorporating oil imports impacts in Dutch CBA. Finally, the conclusions of the research will be shown and ideas for further investigations will be explained.

2. Research method

The literature used in this article is found by doing a systematic literature review. Different research articles were gathered by using the online search databases of Scopus and Google Scholar. Search terms that were used were based on subject orientated search parameters relating to the combination of the following keywords: Oil imports, Energy security, Oil dependence, Social benefits, Transportation sector, Cost benefit analysis. This search resulted in several useful articles for the literature review of the subject.

Articles that have been mainly used and which the author recommends to read in order to gain more knowledge on the topic are listed below:

Table 1. Recommended papers

Paper	Topic
Oil vulnerability index of oil-importing countries (E. Gupta)	Oil vulnerability
Oil Imports: An assessment of benefits and costs (P. Leiby, D. Jones, T. Curlee, R. Lee)	Oil Import Premium
Estimating the Energy Security benefits of reduced U.S. oil imports (P. Leiby)	Oil Import Premium
The Oil Security Problem (H. Huntington)	Oil Security Premium
Reassessing the Oil Security Premium (S. Brown, H. Huntington)	Oil Security Premium

After the literature review, the concept of Oil Import Premium appeared and it was fully studied. As it has only been used in the United States, this paper makes an analytical study of the way of incorporating it in Dutch CBA by comparing the impacts that may differ between both countries due to their differences in terms of culture, economy and politics.

3. A gap in CBA

Cost-benefit Analysis (CBA) is a systematic approach which is used to estimate the strengths (benefits) and weaknesses (costs) of alternatives that satisfy an activity in a business. CBA helps to predict if the benefits of a policy outweigh its costs, and by how much relative to other alternatives (Cellini & Kee, 2010).

Many governments use CBA for transportation policies to decide whether they should invest in a new technology or not[1]. For example, to show the advantages and disadvantages of the electric vehicle compared to the conventional (fueled) vehicle, a CBA may be carried out. A standard CBA would weigh costs of the project such as investment or maintenance, against societal benefits such as travel time gains, environmental influence or safety.

A knowledge gap can be found because one potential benefit is that a country becomes less dependent on oil imports but CBA hardly ever include this benefit. If, for example, a government is studying the incorporation of a new subsidy for electric vehicles, the result might be different if the reduction of oil dependence is taken into consideration or not.

Taking oil reduction into account in CBA's might increase chances of *green* projects, which is something good for society. As oil dependency reductions have not been taken into account in previous CBA's, this approach could prove scientifically whether it is necessary and meaningful to introduce it or not.

The main issue is to find the way to measure oil dependence in order to fit it in a CBA. The term of oil dependence regards the inability of a country of controlling the price at which it can buy oil. This is risky not only when prices raise and oil is very expensive but also because oil prices are very volatile and it is very difficult to predict them.

Oil dependence may be considered to be an energy security. Energy security is a broad concept with different definitions which principal requirement is to balance supply and demand (Allen, 2012). Cost-Benefit Analysis tries to compare the benefits of reducing disruption risks with the costs of security investments. The problem for policymakers is that the benefits of energy security are not easy to quantify and that sometimes the benefits that are quantified economically may not be exactly the same as the ones perceived by society.

Many studies demonstrate that a high dependence on imports is an indicator of a low energy security (see Section 4). Consequently, a country which is dependent on oil imports will be exposed to higher risks due to the fact that it cannot control oil disruptions. Depending on the degree that a country depends on oil imports it will be more or less vulnerable. Next chapter discusses the concepts of oil vulnerability and oil scarcity.

[1] http://bca.transportationeconomics.org/

4. The big issues for oil importers: oil scarcity and oil vulnerability

Oil prices have been very volatile during last decades with a general growing tendency (*Figure 2*). This fact clearly shows that oil is becoming a scarce resource due to the increasing demand in emerging economies such as China, which has increased its consumption until being the second largest oil consumer in the world – only behind the United States – and the largest energy consumer. Furthermore, China has changed from being a net oil exporter country until 1990 to become the world's largest net oil importer since 2013 (EIA, 2014).

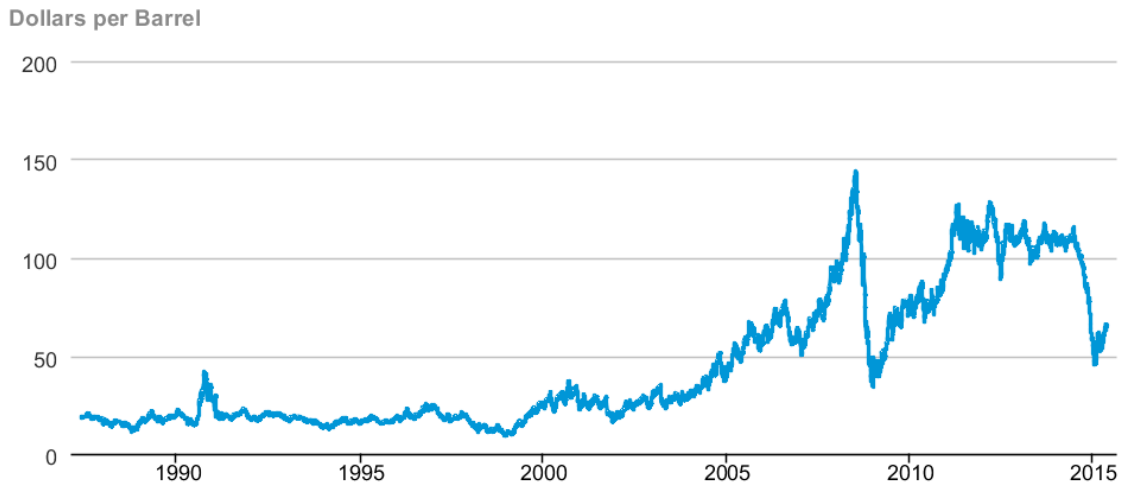

Figure 2. Europe Brent Price (Energy Information Administration, 2014)

This change in oil demand is transforming the oil market that, according to the International Monetary Fund (IMF) (2011), is presenting a period of increased scarcity. Oil scarcity is a term used by the IMF and other experts to explain the moments that oil demand is higher than oil supply at a specific price. Oil scarcity is making that many countries are becoming oil vulnerable because of its big dependence plus its little control of oil demand and oil prices which are established in a global market.

There is a lot of oil literature that determines that oil is a key issue for society: it represents the 33% of the total primary energy consumed (IMF, 2011) and this percentage has been increasing during recent times. The emergence of renewable resources is being quite fast but it is very difficult to substitute oil in all the industries where it is used due to its special properties.

The industry where oil accounts for a higher importance is the transport industry and, more specifically, the automobile one. Akbari and Nurul Habib (2014) studied the relationship between oil vulnerability and automobile dependence by realizing that oil has a negative social and economic impact on society, not only in rural areas where households tend to be more dependent on the car, but also in urban areas where alternative transportations are not efficient enough. This study concludes that one of the main principal solutions to reduce oil dependence in a specific country is by reducing car dependence. The problem is that for reducing car dependence it is required that new transportation policies are implemented in

order to promote public transit and active transportation, that is to say, walking or cycling. Factors that contribute to car dependence are, among others, that low urban densities together with a dispersion of employment and service facilities do not help to promote other viable transportation options such as public transport or walking.

It can be said that oil scarcity is a global problem while oil vulnerability is a local problem. On the one hand oil scarcity appeared because oil is a finite resource and because of the increased global demand which turned on to an increase on the oil price. On the other hand, oil vulnerability is a concept that affects each country differently. There are several aspects that affect the oil vulnerability of a specific country.

Oil vulnerability is a broad concept which includes three main risks: market risk, supply risk and environmental risk (Gupta, 2008). Market risk – also known as economical risk – is reflected on the volatility of oil prices, which make very difficult to predict their fluctuations. Supply risk is affected by the probabilities of a physical disruption in oil supply in a certain place. Finally, environmental risk is affected by the quantity of oil used by a country that produces environmental damages such as pollution, global warming or influence on climate change.

In the study carried out by Gupta (2008), the goal was to find an index to measure oil vulnerability in oil-importing countries. In order to quantify the oil vulnerability index (OVI), the factors which most influenced oil vulnerability in a country were listed individually and calculated for each of the 26 oil-importing countries that took part on the study.

Market risk is influenced by the quantity of oil imports and oil consumption in a country. Logically, market risk is not only influenced by the absolute value of oil consumption or imports but also, and more important, for its relationship with GDP. In some countries oil consumption represents a huge part of GDP what contributes to higher oil vulnerability in these countries. India, The Philippines or China are examples of countries where oil consumption is around the 20% of GDP of the country whereas in Japan or Switzerland represents only a 5%. Another indicator that is closely related to the one which has been just explained is the percentage of GDP that is represented by oil imports. In this case, The Philippines accounts for the highest percentage with more than 5% while Austria's oil imports only represents a 0.44% of its GDP (Gupta, 2008).

There are two other factors that influence the market risk of a country. First, GDP per capita, which is negatively related to oil vulnerability because countries with higher GDP per capita tend to have less dependency on oil. According to Gupta (2008), GDP per capita is highly correlated with oil intensity (relation between oil consumption and GDP of a country), which is logical due to the fact that if a country has a higher GDP per capita, households will be able to consume more quantities of oil. Last but not least, oil share has also an impact on the market risk that a country owns. Oil share is the percentage that oil consumption represents in the total primary energy consumption of a country, what means that a higher percentage of this factor will imply that the country is not investing enough in using other primary resources. Portugal, Greece and Ireland use oil as a primary energy resource in more than 55% of the cases, so this is one of the factors which most affect oil vulnerability in these countries. On the other hand, China or Slovak Republic need less than 20% of oil usage to meet their energy demand.

After investigating the key factors that influence market risk in a country, it is time to have a look to the indicators that are useful to evaluate the supply risks that countries take when they are too dependent on oil-importing countries.

A country which is very dependent on oil imports will be assuming higher supply risks: the more oil a country needs to import, the more risk the country is taking during the transportation of that oil in terms of oil disruptions due to, for example, accidents or political conflicts.

One of the factors which help to predict the level of supply risk in a country is the quantity of domestic oil reserves that the country possesses in comparison with its oil consumption. Countries such as Korea, Belgium or Finland – among others – do not have any oil reserve (Gupta, 2008), what implies that they are fully dependent on oil-importing countries. On the opposite side, Australia, China or India not only would be able to meet their energy requirements only with their oil reserves, but also they have enough reserves to export a huge part of their oil.

When thinking on oil supply risk it is common to focus on the geopolitical risk that the importing country assumes when depending on other political unstable countries. Most of the exporting countries are grouped in OPEC, the Organization of Petroleum Exporting Countries, what makes it one of the biggest stakeholders in the oil industry. OPEC acts as an international cartel and is used by its members to control prices and prevent the entrance of other competitors; thus, their policy decisions always have an important impact for the importing countries what means that having a fluent and positive political relationship is mandatory in order to reduce risks. Apart from the importance of the political relations, there are also some decisions that countries may take in order to prevent oil disruptions. For example, being excessively dependent on one single country is very dangerous because of the vulnerability that the importer may have if there is any disruption. For that reason it is crucial to diversify the exporters in order to diversify risks and, thus, being less vulnerable.

The last indicator that Gupta (2008) found that has a direct influence on supply risk is market liquidity, which is calculated by dividing the quantity of world oil imports by the net imports of a specific country. Therefore, countries with low levels of oil imports or with huge domestic reserves will have higher market liquidity while countries such as the United States, which imported the 21% of total oil imports in the world in 2010 (Chen, 2013), will have a lower market liquidity that will make that this country tend to be more oil vulnerable.

According to most of the literature (Litman, 2013; Leiby, 2007; Gupta, 2008), environmental risks may not be directly related to oil imports because they are a consequence of oil production and consumption. The environmental damages that occur during oil transportation (for example, oil spills and accidents) are included in supply risks. Therefore, water pollution, land contamination, greenhouse gas emissions are consequences of oil drilling and will not be considered in oil import external costs.

5. Situation in the Netherlands

After having a general overview of the actual situation in the oil-importing sector, it is time to focus on the Netherlands, which is the reason for this study. In order to know the state-of-the-art of the oil industry in the Netherlands, publications by the *International Energy Agency* (IEA), the *U.S. Energy Information Administration* (EIA) or the Dutch government itself have been consulted.

The Netherlands has an important role in the oil supply infrastructure in Europe being the biggest oil refining centre in the continent. There are five refineries around the country: four in the area of Rotterdam and another one in Vlissingen (IEA, 2014). According to the EIA (2015), these refineries have a total crude oil refining capacity of 1200 kb/d. Furthermore, the Netherlands represents the largest hub for oil distribution in Europe with two main pipelines: one which has a capacity of 600 kb/d and transports oil to the region of Antwerp in Belgium and another one with a capacity of 400 kb/d for the area of Ruhr in Germany (IEA, 2014).

Not only in oil distribution does the Netherlands play a key role in Europe but also in oil storage with a capacity of almost 210 mb, most of it located in the Rotterdam area (EIA, 2015). Playing such an important role makes the Netherlands owning a huge responsibility for European oil security. In order to reduce oil vulnerability which would affect the rest of the continent, the Netherlands always holds more oil than what is required by the European Union and IEA agreements (IEA, 2014).

Oil demand in the Netherlands has been increasing at a similar rhythm as the global oil demand. As it can be seen in Table 2, during the 90s it grew a 16% in ten years and this percentage increased to a 20% between 2000 and 2005. Since 2005 Dutch oil demand has been almost constant with values around 1020 kb/d (IEA, 2014). On average, since 2000 Dutch oil demand has been increasing at a rate of 1.5% and predictions determine that it will keep increasing at a rate of almost 1% until 2020.

Table 2. Oil data in the Netherlands (International Energy Agency, 2014)

	1990	**2000**	**2005**	**2010**	**2011**	**2012**
Production (kb/d)	78,7	48,5	46,8	36,0	37,9	51,7
Demand (kb/d)	734,5	854,5	1021,4	1019,8	1016,4	1020,8
Net imports (kb/d)	655,8	806,0	974,6	983,8	978,5	969,1
Import dependency (kb/d)	89,3	94,3	95,4	96,5	96,3	94,9
Δ in demand (%)		16,3	20			

Although this high demand, oil is not the main primary energy in the Netherlands: gas has a 42% of the total primary energy supply while oil represents a 39% (IEA, 2014). However, gas production is higher than gas demand so the country is a net gas exporter and it is predicted than in 2018 more than 50% of gas produced can be exported. For that reason, despite being the major primary energy source, gas does not represent a dependency problem like oil does. Oil domestic production was around 66,000 bbl/d in 2014 (EIA, 2015), a low value compared

to the increasing demand that turned into an oil import dependency that has been increasing since 1990, when the Netherlands imported a 90% of the local demand. Since the beginning of the 21st century the oil imported by the Netherlands has been around 95% which is a clear indicator of the high dependency on foreign countries. To make matters worse, predictions show that the Netherlands will be completely dependent on oil imports in a near future. In Gupta's study (2008) it is shown that this increasing dependency on oil imports is the factor that most influence the Dutch oil vulnerability.

When comparing oil dependence in the different sectors it can be seen that transformation (for example, from crude oil to petroleum products) and industry are the ones that show a higher growth. However, transport sector still represented more than 40% of oil demand in 2011 (IEA, 2014) and for that reason, the government is looking forward to improve energy efficiency in that sector investing in new primary energies such as biofuels or new technologies such as the electric vehicle (Energy Report 2011).

As the Dutch government informed in its *Energy Report* (Ministry of Economic Affairs, Agriculture and Innovation, 2011), the problem for most of the European countries that need to reach their increasing oil demand is that they are becoming more dependent on a reduced group of oil-producing countries. In the case of the Netherlands, the origin of oil imports can be divided in three main groups: firstly, Russia provide one third of the total crude oil; secondly, OPEC with countries like Nigeria (12%) or Saudi Arabia (12%) also contribute with one third of Dutch oil imports; and thirdly, imports from the North Sea, which account for one quarter of these imports coming principally from the United Kingdom (14%) and Norway (11%) (IEA, 2014). Consequently, it can be said that the Netherlands is dependent on some political unstable countries: first, a dependence of a 33% on OPEC countries can be really risky because, as it was explained before, they act as a cartel and have high influence on global oil price. Second, Russia is becoming an unstable supplier in recent times due to its political conflicts that are raising tensions with the European Union, so having a 33% of oil imports coming from that country does not seem the best idea.

In general, the Netherlands is not extremely vulnerable to oil dependence but it should improve some factors in order to decrease its vulnerability and trying to have a lower oil vulnerability index like, for example, Sweden (Gupta, 2008). Although being a country without oil reserves, Sweden has a lower oil dependency due to their capacity of using other primary energies rather than oil. In the Netherlands, reducing oil consumption would turn into a decrease on oil share by using different types of primary energies. Also, oil imports would decrease immediately, turning into a lower oil imports to GDP ratio, which is one of the indicators that also influence the oil vulnerability index according to Gupta (2008).

6. Oil import premium

The analysis of the concept of oil vulnerability and the study of the actual situation in the Netherlands allows focusing now on the methodology to monetize the impacts that policies in the field of oil may produce to oil imports. Research was done and the concept of oil import premium was found and deeply studied. It is a concept that has only been used in USA so it must be modified to be able to use it in Dutch CBA.

Since the first study of the external costs and benefits of oil imports done by (Leiby, Jones, Curlee & Lee, 1997), many other authors have contributed to give their own scientific opinion by study the best way of calculating the impacts of oil imports. Leiby (2007) update the first assessment and others like Huntington (2008) or Brown and Huntington (2010) also contributed to study this scientific gap.

The term of oil import premium is largely used in energy security literature but, before concentrating on it, it is very important to emphasize that this study is focused on oil imports, which is only a portion of the whole oil sector. This is remarkable due to the fact that the aim of this paper is not monetizing all the benefits and costs of oil production or oil consumption, but only look at the oil imports part.

The last report of the International Energy Agency (IEA, 2014) showed that since 1990 the Netherlands has imported oil following the next equation:

$$\text{Oil imports} = \text{Oil consumption} - \text{Oil production}$$

This equation shows that all the oil which is produced in the Netherlands is consumed by Dutch people and they do not export oil to other countries. Besides, it can be seen that oil imports, oil consumption and production are interdependent so a change in one of them must affect the others.

This report is not going to study any specific policy in order to keep the focus on the effect of changing the level of imports in the Netherlands, because the impacts of oil production and consumption are already taken into account in CBA whereas oil imports impacts are very difficult to quantify. Social benefits and costs of oil imports are going to be reviewed in order to know the real impact of oil imports for further policy decisions.

Net benefits of oil imports can be described by the following equation:

$$\text{Net benefits of oil imports} = \text{Social benefits} - \text{Social costs} =$$
$$(\text{Private benefits} + \text{External benefits}) - (\text{Private costs} + \text{External costs})$$

On the one hand, the private cost of oil imports is the money that is spent by the country for purchasing oil so this is calculated by multiplying the market price of oil by the quantity of oil imported. Therefore, private benefits are the ones that the country gains directly by importing oil. Both, private benefits and costs are not going to be studied in this paper because they are

already included in CBA because it is only necessary to know the market price and the direct (private) benefits to calculate them.

On the other hand, the difficult part of calculating the impacts of oil imports is to quantify the value of external benefits and external costs. Leiby et al. (1997) realized that the social benefits associated to oil imports were the same than the private benefits, that is to say, oil imports do not have other benefits *per se* than the benefits which are already represented in the oil market price. For that reason and following recent studies, this paper is going to be focus only on the external costs that arise from oil imports.

The Oil Import Premium is the difference between private net benefits and social net benefits but as the social benefits are the same than private benefits, then the Oil Import Premium can be defined as the difference between social costs and private costs (Leiby, 2007). The term of Oil Import Premium is largely used in the energy security literature and represents *the difference between the true incremental cost of oil imports and the market price of oil* (Leiby et al., 1997).

As Huntington (2008) explained in *The Oil Security Problem,* when the oil price is negotiated in the private market, there are some oil security costs that are not incorporated which are associated with increased oil imports. These external costs are considered as *hidden costs* by many policymakers and are the ones that will be analyzed in this study. The Oil Import Premium is a measure of the quantifiable economic costs per barrel that a country – in this case, the Netherlands – would avoid by a reduction in oil imports (Leiby, 2007).

Then, the initial equation which looked at the Net benefits of Oil Imports must be replaced – eliminating the external benefits – and will become the following:

Net benefits of oil imports = Private benefits – (Private costs + External costs)

$$N\ (q_{iu}) = B_i\ (q_{iu}) - P_w\ q_{iu} - C_f\ (q_{iu})$$

Being q_{iu} the level of oil imports in a country, P_w the current oil price and C_f the external costs which are only dependent on oil imports and which will be studied in the following sections.

There is also a lot of literature regarding the concept of Oil Security Premium, which has the goal of *quantifying the externality portions of the economic losses which are associated with the potential disruptions in world oil supply that result from the increased consumption of either domestic or imported oil* (Brown and Huntington, 2010). As it can be seen, there is a noticeable difference between both concepts because Oil Import Premium only looks at the oil imported while Oil Security Premium looks at both the imported oil and the domestic oil.

For the consumers in general, it is impossible to know whether they are consuming domestic or imported oil because the price is determined in a global market, so both, the domestic and imported oil, are influenced by the same global oil price shocks (Brown and Huntington, 2010). Oil consumers will only assimilate the private cost of oil and they will pass over the external

costs of oil even if these costs influence other consumers: when a consumer (a country) buys an extra barrel of oil, the decrease in energy security not only influences this consumer but also the other consumers which are participants in the oil market.

6.1 Marginal approach

The main issue when monetizing the impacts of oil imports through the Oil Import Premium is to find a reference point in order to quantify the external costs that these imports may have. One option is to set up a hypothetical ideal competitive market, where supply and demand would not be affected by price shocks produced by supply disruptions or market failures. This hypothesis would help to have a general view of the external costs of oil imports but it would only partially show the effects that oil imports can produce to society (Leiby, 2007). Another alternative studied by Leiby et al. (1997) was to calculate an efficient level of imports given market failures. The drawback with this idea is that this optimal level of imports is dependent on many of the factors which were listed in Section 4, for example, the relationship between oil imports and consumption or the vulnerability of world oil markets to disruptions. As these factors are different in every country, this methodology is also rejected in the Oil Import Premium literature (Leiby et. al, 1997) (Leiby, 2007) (Huntington, 2008) (Brown and Huntington, 2010).

The third reference point that is analyzed in most of the literature and which is finally the one which is chosen is to make a study of oil imports using a marginal partial approach. Marginal means that it is focused on small incremental changes in oil imports and partial means that it only looks at oil imports without considering oil consumption or production costs, as was explained in previous sections. Thus, the marginal costs of oil imports does not require to know the total costs of oil imports: the goal is to study the incremental costs which are associated with a unit change in oil imports, that is to say, how total costs change with the level of oil imports (Leiby et. al, 1997).

Mathematically, the marginal is expressed as the derivative respect the import level (q_{iu}) so the previous equation for calculating the net benefits of oil imports would be the following for calculating the marginal economic net benefit of oil imports:

$$N'_{social}\,(q_{iu}) = B_i'\,(q_{iu}) - (P_w + q_{iu}\,P'_w) - \partial C_f\,(q_{iu}) / \partial q_{iu}$$

Consequently, the Oil Import Premium (π) is defined as the difference between the marginal social costs and the marginal private costs (Leiby, 2007) and can be expressed with the following equation:

$$\pi = N'_{private} - N'_{social} = (B'_{private} - C'_{private}) - (B'_{social} - C'_{social}) =$$

$$= C'_{social} - C'_{private} = C'_{social} - P_w\,,$$

being P_w the current price of oil in the world market.

In order to clarify the concept of Oil Import Premium calculation, the following graph may be useful. It can be seen all the concepts which have already been explained and the importance of calculating the Oil Import Premium so that the external (social) costs of oil imports are taken into account when making CBA for making proper policy decisions in the Dutch oil import sector.

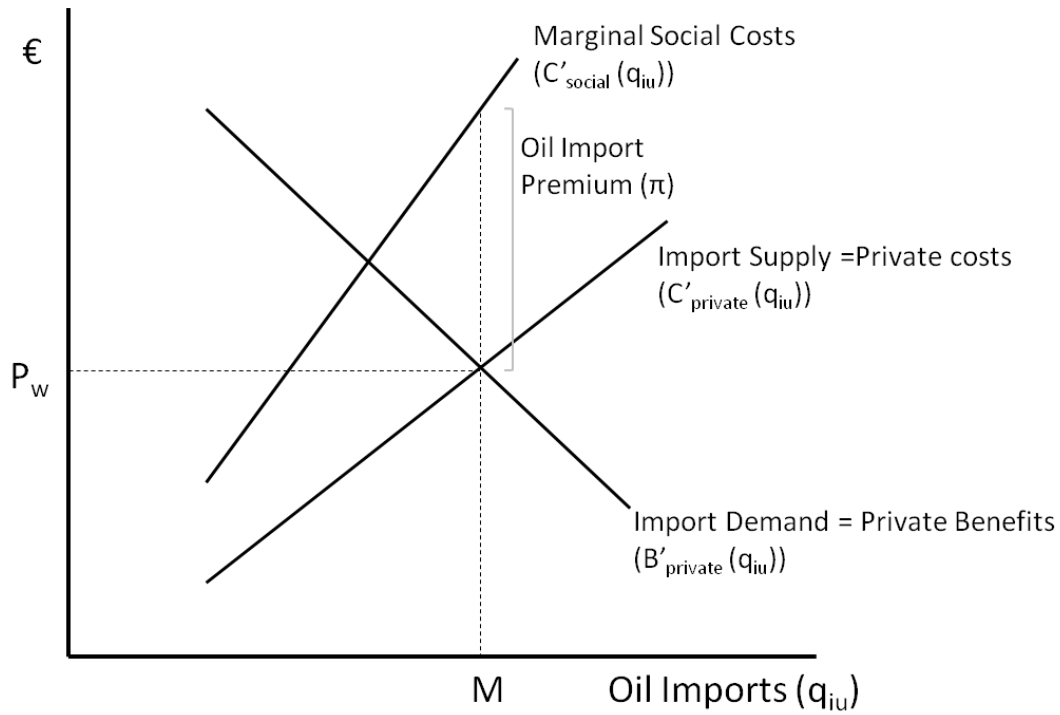

Figure 3. Difference between marginal social costs and marginal private cost

6.2 External costs

"The Oil Import Premium reported include only those external costs which arise from changing oil imports. They exclude costs which arise from changes in consumption or production, or which do not vary with the level of imports." (Leiby et. al, 1997)

The external costs that the Oil Import Premium takes into account are considered, by many authors, as hidden security costs produced by market failures (Huntington, 2008). These hidden costs are difficult to monetize and there is few literature showing which costs may be included in the Oil Import Premium depending on each country. First of all, these costs will be explained and then they will be studied in order to show which ones apply for the Netherlands and which ones do not. As the Oil Import Premium uses a marginal approach, the external costs that are considered must only be affected by a change in the quantity of oil imports in the studied country, that means that if there are costs which are fixed without depending on the level of oil imports it makes no sense to include those in the Oil Import Premium.

6.2.1 Monopsony power

When a country has a high dependence on oil imports it has been demonstrated that it is more vulnerable for many reasons. Huntington (2008) argues that the Organization of Petroleum Exporting Countries (OPEC) acts as a clumsy cartel and exercises a power to increase oil prices. This price power is demonstrated, for example, by the fact that even if oil production cost is below the current market price of oil, exporter countries will not produce more oil in order to avoid a decrease in the market price. This excessive power is considered a market failure due to the fact that it is one of the reasons that makes that the global oil market has no perfect competition. In order to reduce this vulnerability, the Oil Import Premium includes the capacity of importing countries of organizing themselves as a group for reducing the monopoly that OPEC and other powerful oil exporters exercise (Leiby et. al, 1997).

The monopoly that OPEC and oil-exporting countries have in the oil market is played in the supply side and the counterpart in the demand side is called monopsony power. Monopsony power is the capacity that certain countries have to reduce the monopoly of the demand-side of the oil market to reduce their influence in the market price.

Big countries that import high quantities of oil are said to have monopsony power: for example, the United States has a big share of the global oil imports which gives it power to influence the global oil price. If the United States increases its oil import demand, the market price will increase whereas if they decrease their demand, the price will also decrease (Leiby, 2007). Several studies debate the real impact of monopsony power and in which way this power may be used. If countries with monopsony power abuse, this can turn into a reaction in OPEC countries that can increase the oil price.

Monopsony power is calculated in the Oil Import Premium through the monopsony premium ($\pi_{monopsony}$), which is *the marginal reduction in excess wealth transfer resulting from imports reduction* (Leiby et al., 1997). The monopsony premium depends on the supply elasticity (η_{is}), the oil market price and the level of oil imports:

$$\pi_{\text{monopsony}}\ (q_{iu}) = \frac{P_W\ (q_{iu})}{\eta_{is}}$$

This equation shows that the relationship between the money spent by a country in oil imports and the supply elasticity of oil imports is the same than the difference between social and private costs in terms of monopsony power. The more elastic is the oil import supply, the smaller will be the monopsony premium, according to this equation (Leiby et al., 1997).

If the global oil demand increased, the price would also increase and this would not only affect the oil import price but also all the imports of a country (Leiby et al., 1997). This can be expressed in the monopsony premium like the incremental change in world oil price caused by the import reduction times the level of imports in a certain country:

$$\pi_{\text{monopsony}}\ (q_{iu}) = P'_w\ \ q_{iu}$$

Apart from big countries such as the United States which can use their monopsony power, it is very difficult for most of the countries to have such an influence in the global oil market. In order to have this power it would be necessary to make agreements between oil-importing countries to enhance their position in the market.

Although the Netherlands has been having a growing oil demand during last decades, it has a very low share of the total world oil imports which not enables the country to have monopsony power. As the goal of this paper is to look at the impacts which are directly related with oil imports it can be declared that the Netherlands has such a smaller monopsony power that it can be neglected so it should not be included in the calculation of the Dutch Oil Import Premium.

The following graph shows the inexistence of monopsony power in the Netherlands due to the fact that attending at its small share of the world oil imports they do not influence the global oil price (Leiby et al., 1997):

6.2.2 Disruption costs

The most clear example of costs which are not taken into consideration when establishing the market price of oil are the costs which arise from disruptions which are the result – most of the times – of political instability that affect supply countries and, consequently, oil-importing countries. Disruption costs are widely studied in oil literature by Litman (2013), Leiby (1997 and 2007), Huntington (2008) or Brown and Huntington (2010) because they are almost totally accepted in the oil industry and included in the premium. However, different approaches to calculate them are studied.

As the Oil Import Premium uses a marginal approach, this section will look at the marginal disruption costs so it is not necessary to know the total costs which arise from supply disruptions but only the costs which vary with the level of oil imports. The quantity of oil imported by the Netherlands clearly affects the probability of a disruption.

The fact that supply disruptions occur suddenly and cannot be predicted make them an important factor for the external costs of oil imports because they have a direct impact on oil price. The social costs that disruptions can cause to the economy of any country include not only the direct costs that affect to consumers during the disruption, but also the macroeconomic adjustment losses that affect the domestic economy while adjusting it to the new conditions of the market (Leiby et al., 1997).

In the *Assessment of Oil Market Disruption Risks* written by Beccue and Huntington (2005), they provide the readers a very useful approach for evaluating the real disruption risks that importing countries may take. The authors define a disruption as a *sudden shortfall in oil production from a world supplier that results in at least 2 MMBD (Million Barrel per day) unavailable within 1 month of the beginning of the disruption. After the period, world production recovers to the same level prior to the shortfall.*

Disruption can be produced by many different factors but most of them are related with the political instability of exporting regions. Beccue and Huntington (2005) differentiate between small, medium and large disruptions in order to clarify that the effects of a spillover from a producer or an internal affair – for example, between OPEC countries – are not the same and do not have the same probabilities to occur than a terrorist attack or a civil war in the supply country. Furthermore, the largest the share of the total market of a supplier is, the largest the impact in the global oil market will be if there is a disruption in this exporting country.

The Netherlands has a high storage capacity which enables the country to adjust better in case of supply disruptions. This market mechanism, though, would only be useful to reduce the first impact after the disruption but it would not prevent the oil price growth. Consequently, the Dutch oil market would experience three direct disruption costs: first, the domestic oil production would increase its costs; second, imported oil would also experience a growth on its price and, thirdly, a consumer surplus loss due to the reduction in the GDP per capita (Leiby et al., 1997).

There are different points of view which explained the methodology for calculating the disruption component of the Oil Import Premium. The most recent one is the paper published by Leiby (2007) where he updated his previous study dated on 1997. There, the disruption component of the import premium is defined as *the marginal change in expected disruption losses*:

$$\pi_{\text{disruption}}\,(q_{iu}) = \frac{\partial E[C_{disr}\ \ q_{iu}\ ]}{\partial q_{iu}}$$

The Oil Import Premium disruption component calculation is divided in two parts: first, the Import Cost component includes the added costs that arise during disruptions and second, the marginal change in expected GDP losses during disruptions. Consequently, the expected total disruption costs are the sum of the probabilities of both components:

$$E_{\{\Delta Q\}}[c_{disr}] = \quad {}_j\, \varphi_j[C_{Idisr}(\Delta P(\Delta Q_j)) + C_{GNPdisr}(\Delta P(\Delta Q_j))]$$

being ΔQ_j the possible supply losses, φ_j the disruption annual probability and ($\Delta P(\Delta Q_j)$ the associated increase in imported oil price.

The marginal change in the disruption import cost is given by the change in price times the level of imports:

$$C_{Idisr}(\Delta P(\Delta Q_j)) = q_{iu} \cdot \Delta P(\Delta Q_j)$$

Taking the derivative, the import cost component of the oil import premium can be calculated with the following equation:

$$\pi_{\text{Idisruption}}(q_{iu}) = \frac{\partial E_{\{\Delta Q\}}[C_{Idisr}\ \ q_{iu}]}{\partial q_{iu}} = \frac{\partial}{\partial q_{iu}} \quad {}_j\,\varphi_j[q_{iu} \cdot \Delta P(\Delta Q_j)] =$$

$$= \quad {}_j\frac{\partial \varphi_j}{\partial q_{iu}}[q_{iu} \cdot \Delta P(\Delta Q_j)] + \quad {}_j\,\varphi_j\,[\Delta P(\Delta Q_j)] + q_{iu} \quad {}_j\,\varphi_j\,\frac{\partial}{\partial q_{iu}}[\Delta P(\Delta Q_j)]$$

As it can be seen, there are three terms in the derivative of the product of φ_j, q_{iu} and ΔP and each of them represents different factors that influence the changing import levels during a disruption. The first term is the effect of pre-disruption import levels on the probability of disruption, what means that it is possible that reducing oil imports, the risk of disruptions – and the magnitude – will be reduced. The second term in the import-cost component of the disruption premium shows the direct effects of reducing pre-disruption import levels on the number of imports barrels which are subject to the price increase ΔP during disruptions, that is to say, that if a country reduces its oil imports before a disruption, this reduction would also apply for the level of oil imports during a disruption (Leiby, 2007). The third term represents the expected change in import costs due to the impact of pre-disruption import levels q_{iu} on the magnitude of the price increase during each possible disruption (Leiby, 2007).

The second component of the disruption premium is the GDP dislocation cost component which is the marginal change in expected GDP losses during disruptions (Leiby, 2007).

$$\pi_{\text{GDPdisruption}}(q_{iu}) = \frac{\partial E_{\{\Delta Q\}}[C_{GDPdisr}\ \ q_{iu}]}{\partial q_{iu}} = \frac{\partial}{\partial q_{iu}} \quad {}_j\,\varphi_j \cdot \Delta GDP(\Delta P_j, q_{du}(q_{iu}))$$

being $\Delta P_j = \Delta P(\Delta Q_j, q_{iu})$

This equation shows not only the relationship between GDP losses and the change in the oil price ΔP_j due to a disruption but also the possibility that the magnitude of GDP loss for any given price change could also depend directly on the level of oil demand q_{du} (Leiby, 2007). As this paper is only studying the marginal effects on societal costs without taking into account the level of oil demand in the country, q_{du} must be dropped from the equation. Thus, for calculating the GDP dislocation cost component the following formula is used:

$$\pi_{\text{GDPdisruption}}(q_{iu}) = \quad {}_j\frac{\partial \varphi_j}{\partial q_{iu}} \cdot \Delta GDP\ (\Delta P(\Delta Q_j, q_{iu})) + \quad {}_j\,\varphi_j\,\frac{\partial}{\partial q_{iu}} \cdot \Delta GDP\ (\Delta P(\Delta Q_j, q_{iu}))$$

Nowadays, as it has been explained in Section 5, the Netherlands imports oil from a broad range of countries, what helps to make the country less vulnerable than what it was in the early 1970s, when they imported almost all of the oil needed from Saudi Arabia. The broader distribution of imported oil plus the strong trade relations between the Dutch government and exporting countries makes that, at the moment, oil disruptions do not represent a real threat for the Netherlands[2]. However, it is interesting to know how to calculate the oil disruption premium because in the future these excellent relations between countries can disappear.

6.2.3 Other costs

There are other costs which are studied in literature in order to know whether they should be included in the Oil Import Premium calculation. The two which are the most discussed are environmental costs and military security costs.

Environmental costs and health costs are considered to be an external cost related to oil production and consumption rather than oil imports (Leiby, 2007) (Brown and Huntington, 2010). The reason is that there is no possibility to differentiate the environmental damage caused by domestic oil with the one produced by imported oil. Furthermore, environmental costs which arise from the transportation of imported oil appear to be almost fully internalized by current laws and regulations for both domestic and imported oil (Leiby et al., 1997).

Military costs and oil security are highly related but it is a problem to quantify the incremental effects from changing oil imports. There is relative agreement to affirm that military costs must not be included in the Oil Import Premium also because of the difficulties of determining if these costs vary depending on the level of oil imports (Leiby, 2007).

The big storage capacity of the Netherlands turns into a high cost of maintenance the oil reserves. These costs must not be included in the Oil Import Premium for the same reason as military costs: they are not a damage caused by the increased dependence on oil imports *per se,* but arise from the increasing oil consumption in the country (Huntington, 2008).

[2] http://www.dnb.nl/en/news/news-and-archive/dnbulletin-2011/dnb251839.jsp

6.3 Oil Import Premium Calculation

After looking at all the costs related with oil imports, it is possible to define the Oil Import Premium for the Netherlands:

$$\pi_{\text{total}}\ (q_{iu}) = \pi_{\text{disruption}}\ (q_{iu}) = \pi_{\text{Idisr}}\ (q_{iu}) + \pi_{\text{GDPdisr}}\ (q_{iu})$$

It can be said that the only real factor that affects the social (external) costs of the oil imports in the Netherlands is the cost caused by disruptions. Numerically, the Oil Import Premium is the difference between the marginal cost of oil imports and the world oil price:

$$\pi_{\text{total}}\ (q_{iu}) = C'_{\text{social}}\ (q_{iu}) - P_{\text{w}}\ (q_{iu})$$

The optimal Oil Import Premium $\pi_{\text{total}}\ (q^*_{iu})$ is the value that equalizes the marginal social costs and marginal private benefits (Leiby, 2007):

$$B'_{\text{private}}\ (q^*_{iu}) = P_{\text{w}}\ \ q^*_{iu}\ \ + \pi_{\text{total}}\ (q^*_{iu})$$

It is not the goal of this paper to calculate the exact value of the Oil Import Premium in the Netherlands. In order to calculate this value in further studies it would be necessary to follow the *Assessment of Oil Market Disruption Risks* (Beccue and Huntington, 2005) which was carried out for the U.S. Department of Energy and where they calculate the real probabilities that their country would be affected by oil disruptions and of which magnitude these disruptions might be. It would be necessary to make a parallel study of the risks that the Netherlands may have of being affected by an oil disruption.

However, using the studies that have been carried out by Leiby (1997 and 2007), it is possible to estimate a possible value of the Oil Import Premium for the Netherlands. It is important to highlight that the following values are calculated by doing rough assumptions and they should only be used to have a reference of possible values that may result when doing the proper study.

The Oil Import Premium for the United States was 13.58$ (2004$/BBL) (Leiby, 2007) and the price of the barrel of oil at that time (year 2004) was approximately of 40$/BBL. Consequently, the real cost of purchasing a barrel of oil in 2004 in USA would have changed from 40$/BBL to 53.58$/BBL, which means an increment of a 34%. As it has been explained, the Oil Import Premium for the Netherlands may only take into account the disruption cost component, which may decrease the influence of the Oil Import Premium in Dutch CBA: for instance, in the study developed by Leiby (2007), the oil disruption cost of the Oil Import Premium represents 4.68$/BBL (2004$/BBL) of the total 13.58$ (2004$/BBL). Furthermore, the disruption component added to the cost of a barrel of oil in 2004 would result to be approximately of 44.68$/BBL (2004$/BBL) which means that the disruption component represented an increase of an 11.7%. To sum up, it can be said that the Oil Import Premium has enough importance from a quantitative point of view to make more calculations of the real value for the Dutch Oil Import Premium because it really seems that it would have a relevant importance in CBA.

7. Conclusions

The aim of this paper was to understand the current situation of oil imports in the Netherlands in order to find a method to calculate the social costs that oil imports impose to the country and then be able to quantify them in a CBA.

Oil dependence has been growing during last decades and has turned into an oil vulnerability that is affecting most of the countries in Europe. This fact implies that new oil policies are going to be implemented in the near future so it is very important to include the real value of oil imports in CBA to develop these policies properly.

Oil Import Premium can be used in Dutch CBA to study specific policies which modify oil imports in the Netherlands. By using it, the result will be more accurate than it would be now because external costs that are not included in the market price will be considered. After the study of the Oil Import Premium, it was shown that disruption costs are the only ones that must be taken into account for the Oil Import Premium calculation in the Netherlands. By adding the Oil Import Premium to the marginal private costs of oil imports, the marginal social costs are obtained. Thus, the marginal private benefits are equal to the marginal private costs that are the same than the price that the country is paying for obtaining imported oil so it can be seen that the Oil Import Premium is needed to realize that the real cost of oil imports is higher than the price which is being paid for it.

This paper does not look at which policies would be the most efficient for reducing oil dependence in the Netherlands. It does not argue whether an oil tax or an import tariff equivalent to the Oil Import Premium is the solution to reduce oil imports. It only wants to demonstrate the real necessity of incorporating the Oil Import Premium in future CBA.

Further studies should seek the way to calculate the real probabilities that there exist that oil disruptions may affect to the Netherlands and by how much they would affect both the added costs during disruptions and its GDP. Rough calculations have demonstrated that the Oil Import Premium may increase the social cost of oil imports around a 10%. Once the Oil Import Premium is properly calculated, CBA which affect oil imports will be more precise because they will include the real impacts (costs) of oil imports.

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