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Analysis of Gas Export Trends of MENA Countries:

Case Study of Yemen

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Technology Management, Economics and Policy Program

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Abstract

The Middle East and North Africa (MENA) region plays a significant role in the global markets of natural gas. Its share of the global pipeline gas exports in 2013 was 8.8%, and its share of the LNG exports was 47% (BP, 2014). The main gas-exporting countries in the region are Algeria, Egypt, Iran, Libya, Oman, Qatar, United Arab Emirates (UAE), and Yemen. Although Yemen is the latest comer in the gas industry and marketing, Yemeni gas has earned the confidence of many countries as well as a good reputation in the global markets. Using the Logarithmic Mean Divisia Index (LMDI) method, this study analyzed the changes in the factors affecting gas export revenue and the effects of these changes on the gas export revenue of Yemen in particular and of the other MENA countries in general in 2004-2013.

Considering gas export price, market share, market structure, and total demand the factors affecting gas export revenue, the study obtained results that revealed that the main factor influencing the gas export revenue in the

case of Yemen and most of the MENA countries is the market share, while the total demand, market structure, and gas export price play key roles as assisting factors in gas export revenue driving.

Yemen ranks second (after Qatar) in the MENA region in terms of market share. The county's market share significantly increased due to the significant growth of its liquefied natural gas (LNG) industry and marketing, especially after the opening of Yemen LNG Plant towards the end of 2009.

Even though Yemen has shown a significant increase in its market share, its low gas export prices compared to those of the other MENA countries represent a major obstacle to its further gas export revenue growth. Therefore, this study recommends that the decision makers in the Republic of Yemen adopt the Qatar gas pricing policy to enhance the country's gas export revenue in the future.

Key words: MENA countries, Yemen, gas export revenue, Logarithmic Mean Divisia Index, export price factor, market share factor, market structure factor, total demand factor.

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Chapter 1. Introduction

1.1 Background

Growing population and expanding economies are main causes of increasing global energy demand. World's energy demand is expected to surge by an average of 1.3% per year (Outlook for Energy, 2008), and gas consumption is expected to account for about a quarter of global energy consumption by 2030, up about 20% from now. Today, 80% of global energy demand is provided by oil, coal and gas (fossil fuels) due to their abundance, affordability and availability (Satish Kumar, 2011). Since energy demand increasing dramatically the natural gas industry is projected to be increase to meet the growing of demand.

Global natural gas demand growth over the next two decades is expected to average 1.9% annually, this is twice that of oil. MENA will be the biggest contributor to meet this growth with an increased production of 31 (billion cubic foot per day) Bcf/d, mainly to meet its increased demand for power generation and water desalination as well as meeting the demand of its rapidly growing petrochemicals industry. It is expected that LNG will contribute an increasing share of the gas trade, and is estimated to grow at a rate of 4.3% annually, meeting 15.5% of global gas demand by 2030 (Khatib, H., 2014).

Middle East and North African (MENA) region plays an important role in the global gas market. According to BP- statistical review of world energy (2014), the proved gas reserves of MENA region increased from over 50 trillion cubic meter (TCM) in 1993 to over 88 (TCM) at the end of 2013, which represent 47.5% of the

world's total known reserves in the end of 2013. The production of natural gas of MENA region increased from over 187 billion cubic meter (BCM) in 1993 to 715 billion cubic meter (BCM) in the end of 2013. Gas exports of MENA countries reached to over 215 billion cubic meter (BCM) in 2013 and 71% of the exports have been exported in LNG form, while 29% by pipeline. One of the implications of this trend is that, overall, the MENA region will continue to play a relatively modest role in the international gas trade. Over the last decade, its share of global pipeline gas exports has not exceeded 12%, with Algeria, Egypt, Libya, Iran, and Qatar being the only exports of pipeline gas. Of the five MENA pipeline exports, only Algeria, Iran, and Libya send gas outside the region, mainly to Italy, Spain. And Turkey. However, in terms of LNG trade, MENA has played a more important role, accounting for about 44% of total shipment in 2010. This is in large part due to the recent expansion of Qatar's liquefaction capacity, which now tends at over 100 billion cubic meter per year, and the development over the last ten years of LNG production industries in Egypt, Oman, and Yemen.

Among the region's gas exporters, only Qatar and Yemen saw relatively important increases in gas production, driven by the ramp up of their LNG sales through the newly-built liquefaction capacity. The rest of the growth was concentrated in associated-gas producers Saudi Arabia and to a lesser extent Kuwait which, as well as having increased their oil production to compensate for supply outages in other parts of the system (Libya, Sudan, Syrian and Yemen), began to see the results of the recent shift in their upstream gas strategies towards the development of non-associated reserves materialize. Algeria and Egypt, the region's

second and third largest gas exporters respectively, saw their production stagnate at best, with as a result a continued decline in exports.

The issue of domestic gas prices, which are kept at artificially-low levels by MENA governments, is a striking feature of regional gas markets. Not only is it one of the main drivers of gas demand growth, but it has also been an obstacle to the development of the region's abundant non-associated gas resources, both conventional and unconventional.

1.2 Overview of Middle East and North Africa

The oil and gas resources of the Middle East and North Africa (MENA) will be critical to meeting the world's growing appetite for energy. A large share of the world's remaining reserves lie in that region. They are relatively under-exploited and so there is considerable potential for increasing production. But there is considerable uncertainty about the pace at which investment in the region's upstream industry will actually occur, how quickly production capacity will expand and, given rising domestic energy needs, how much of the expected increase in supply will be available for export. The implications for both MENA producers and consuming countries are profound. MENA production of natural gas is projected to grow even more rapidly than that of oil, trebling over the projection period to 1210 billion cubic meters in 2030. The biggest volume increases in the region occur in Qatar, Iran, Algeria and Saudi Arabia. The bulk of the increase in MENA output will be exported, mostly as liquefied natural gas. Demand for the region's gas will be

driven by strong global demand and dwindling output in many other gas-producing regions.

Net gas exports from MENA countries to other regions are projected to more than quadruple to 440 billion cubic meter in 2030, with a marked shift in sales to Europe and the United States. Europe will remain the primary destination for North African gas exports. Major oil and gas importers, including most OECD countries and South Asia, will become ever more dependent on imports from MENA countries.

MENA oil- and gas-export revenues, which have surged in the last few years, will remain high. Aggregate MENA oil and gas revenues are projected to rise from about $310 billion in 2004 to $320 billion in 2010 and $635 billion in 2030. Natural gas will make a growing contribution. Cumulative revenues will far exceed the investment needed to make them possible. Total oil and gas investment is projected to amount to about $1 trillion over the period 2004-2030 (in year-2004 dollars), or $39 billion per year (Birol F. 2006).

1.2.1 Economic growth

The real struggle for change in the Arab world will only begin when the dust from its youth revolutions has finally settled down. After emergency laws are lifted, constitutions are drafted and elections are held, policymakers in the Middle East will be faced with a tough practical challenge: how to create economic opportunities for its teeming millions? This challenge will remain unmet without a strong private sector. A singular failure of the Arab world is that it has been unsuccessful in developing a vibrant private sector that survives without state crutches, is connected

with global markets, and generates productive employment for its young. The region suffers from a dangerous dearth of manufacturing, best manifested in just one statistic: in 2003 the combined manufactured exports of the entire Middle East were less than those from just one South-East Asian nation, the Philippines. With few exceptions, the private sector is generally weak and dependent on state patronage; success in it is determined more by patronage than entrepreneurship. With the public sector as the main avenue for job creation, the region suffers from a precarious employment strategy that leaves it unprepared to deal with demographic pressures. The unfolding crisis in the Middle East is thus not just about the Arab state-its failed efforts to redistribute, reform, and represent ordinary citizen's interests. It is also about the private sector- or, more appropriately, its absence.

During the period, 1996–2006, labor force in Middle East and North Africa (MENA) has grown three times as much annually as in the rest of the developing world, resulting in one of the largest rates of youth unemployment globally. Although youth unemployment is relatively lower in resource-rich countries with smaller populations, where the public sector can better absorb new labor market entrants, the challenge is more acute in labor abundant countries. This includes even fuel exporters, such as Saudi Arabia and Algeria, where youth unemployment is nearly 30%. In Syria and Jordan young people under the age of 30 constitute more than 70% of the unemployed workforce (Adeel Malik and Baseem Awadallah, 2012).

Over time the Arab world has not only grown younger, it has also become more educated. The region might have failed on multiple accounts, but it has had a resounding success in expanding access to, and closing gender gaps in, education.

Of the top ten countries that made the most impressive strides in human development during the last forty years, five were Arab countries (Rodriguez & Samman, 2010; United Nations Development Programme (UNDP), 2010). Starting from one of the lowest levels of educational achievement in the 1960s, adult education rose faster in the Middle East during 1980– 2000 than any other region in the World (Yousef, 2004). Despite reservations about the quality of education imparted, even this quantitative expansion of education has led to a silent revolution of sorts. It is a revolution of aspirations. Even as aspirations have become more mobile with the new gadgets of globalization, the local systems of governance remain ossified, offering limited economic mobility to the region's youth.

Even physical mobility across borders is restricted. Unlike Western Europe, where class-based struggles have historically driven political change, the Middle East is witnessing a truly generational struggle for inclusion.

While coping with these demographic trends is a challenge, they also offer an opportunity for economic advancement.

Other emerging market economies in Asia have successfully harnessed their youth bulges for development. The irony in the Middle East is that there is a vivid mismatch between demography and economic structure. While demography is evolving, the economic structure is unresponsive to the needs of growing populations. Middle Eastern economies are heavily dependent on hydrocarbons, dominated by the public sector, and are failing to keep pace with the growing labor force.

The limited economic opportunities that do exist are rationed by connection rather than competition. This leads to tremendous economic injustice for the young who see little hope for economic and social mobility.

While the need for a vibrant private sector is widely recognized, it is less clear how to develop it. The challenge of private sector development is traditionally viewed through a narrow technocratic and apolitical lens. When it comes to the Middle East, however, the limits of World Bank's recipes are particularly evident. Private sector development is not simply a matter of improving investment climate, reducing the cost of doing business, offering cheap credit, or introducing market friendly economic reforms (World Bank, 2005). It is also a political problem, since a private sector that generates income streams independent of the patronage network of the regime can be viewed as a political threat (Adeel Malik and Baseem Awadallah, 2012).

The absence of a vibrant private sector is also a regional failure. The Arab world remains fragmented in isolated geographic units with limited economic linkages between them. This fragmentation carries a heavy cost: for a private sector to survive and thrive, the size of the market matters. Fragmented markets prevent firms from realizing the benefits of producing for a bigger market and locating next to each other (UNIDO, 2009). These cost advantages, commonly termed as economies of scale and agglomeration, have fueled trade and growth in emerging economies, but are simply absent in the Arab world. Any blueprint for private sector reform must therefore include as one of its central objectives the creation of regional economic commons (Adeel Malik and Baseem Awadallah, 2012).

1.2.2 The MENA's gas in the global markets

Recent unrest in the Middle East and North Africa (MENA) region has affected international energy markets and put upward pressure on oil prices. MENA is home to some of the world's largest oil and natural gas producers and exporters. The region's exporter's account for roughly 40% of oil and 20% of natural gas traded internationally. MENA countries also hold some of the largest reserves of oil and natural gas (Figure 1. Shows MENA region map).

Figure 1 Map of the Middle East and North Africa

Source: Michael Ratner (2011) based on U.S. State Department information.

According to BP- statistical review in June 2014, MENA region's proved gas reserves increased from over 50 trillion cubic meter in 1993 to over 88 trillion cubic meter at the end of 2013, which represent 47.5% of the world's total known reserves in the end of 2013. In terms of the production, MENA's natural gas production increase from over 187 billion cubic meter in 1993 to 715 billion cubic

meter in the end of 2013, and in terms of the exports, MENA' gas exports in 2013 were over 215 billion cubic meter, 71% of the exports have been exported in LNG form and 29% by pipeline (BP, 2014).

One of the implications of this trend is that, overall, the MENA region will continue to play a relatively modest role in the international gas trade. Over the last decade, its share of global pipeline gas exports has not exceeded 12%, with Algeria, Egypt, Libya, Iran, and Qatar being the only exports of pipeline gas. Of the five MENA pipeline exports, only Algeria, Iran, and Libya send gas outside the region, mainly to Italy, Spain. And Turkey. However, in terms of LNG trade, MENA has played a more important role, accounting for about 44% of total shipment in 2010 (Figures 2, 3). This is in large part due to the recent expansion of Qatar's liquefaction capacity, which now tends at over 100 billion cubic meter per year, and the development over the last ten years of LNG production industries in Egypt, Oman, and Yemen (Darbouche H. and Fattouh B. 2011).

Recently, some of MENA countries witnessed decrease in the natural gas exports because increase their domestic use and decrease the production such as Algeria and Egypt. For instant, in this study Algeria shows gradually decrease in the production from 2006 until the present time. From the other hand, there is another countries witnessed booming in the gas exports such as Qatar and Yemen, this is can be attributed to increase the production, open new liquefaction natural gas and the low domestic demand of natural gas in case of Yemen and Qatar.

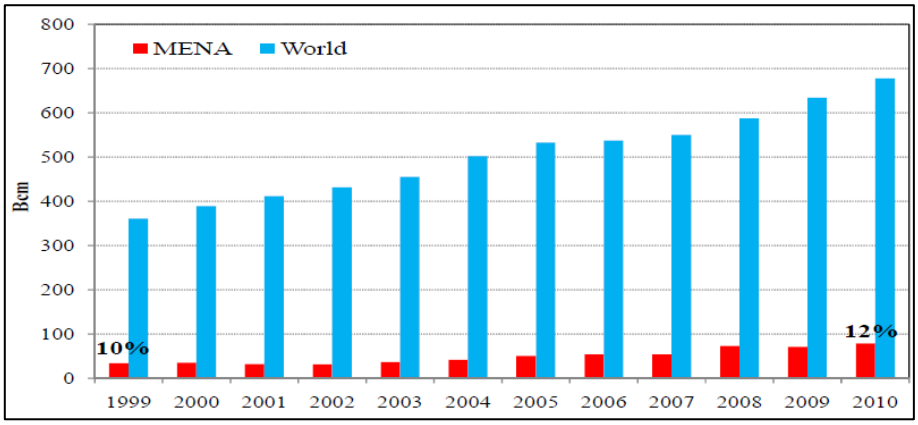


Figure 2. MENA vs. world gas pipeline exports, 1999-2010

Source: Darbouche H. and Fattouh B. 2011

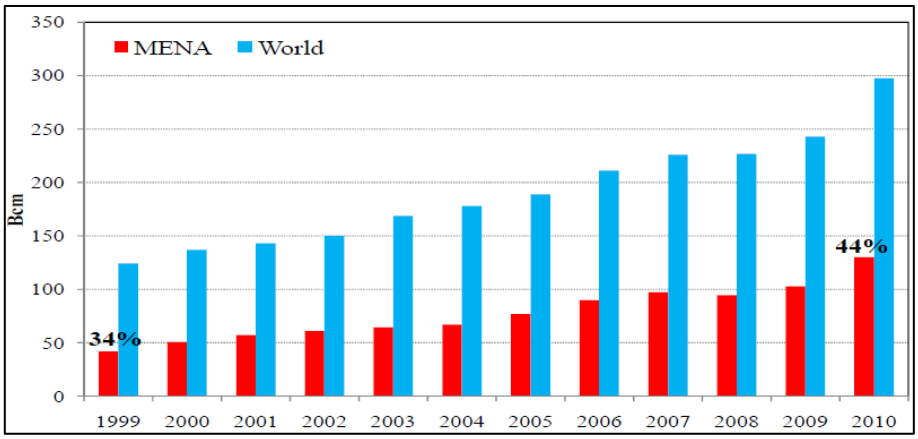


Figure 3 MENA vs. world LNG exports, 1999-2010

Source: Darbouche H. and Fattouh B. 2011

Global natural gas demand growth over the next two decades is expected to average 1.9% annually, his is twice that of oil. MENA will be the biggest contributor to meet this growth with an increased production of 31 billion cubic foot per day (Bcf/d), mainly to meet its increased demand for power generation and water desalination as well as meeting the demand of its rapidly growing petrochemicals industry. It is expected that LNG will contribute an increasing share

of the gas trade, and is estimated to grow at a rate of 4.3% annually meeting 15.5% of global gas demand by 2030. (Hisham Khatib, 2014).

Demand for natural gas in most countries of the Middle East and North Africa (MENA) region1 has, since the start of the 2000s, been growing at a much faster rate than supply, resulting in a costly deficit that has manifested itself in lower exports of gas, rising domestic oil consumption, chronic power shortages, and, inevitably for a growing number of countries, the need for high-priced LNG imports (Darbouche H., 2012 in Darbouche H., 2013).

The issue of domestic gas prices, which are kept at artificially-low levels by MENA governments, is a striking feature of regional gas markets. Not only is it one of the main drivers of gas demand growth, but it has also been an obstacle to the development of the region's abundant non-associated gas resources, both conventional and unconventional.2 Far from helping policymakers achieve efficiently their avowed objectives of rent distribution and economic diversification, low gas prices have been a source of distortion in the allocation of a resource that is increasingly scarce in MENA and preventing the region from playing a greater role in international gas trade (Darbouche H., 2012).

1.3 Research motivations

- The tremendous reserves of natural gas in the MENA region, and the international growing demand for natural gas,

- The abundance of economic resources in the MENA region, and the inability to attain economic development (poverty alleviation and lowering of unemployment ratio) therein, especially in Yemen and Egypt,
- The wasting of gas resources (especially associated gas) in Yemen either through re-injection to develop and enhance the country's oil production or by flaring them in the air,
- The sharp decline of oil production in Yemen on one hand and new gas discoveries on the other,
- The search for appropriate policies for improving the gas export revenue.

1.4 Research objectives

- To study the market shares of Yemen and MENA gas in the global markets,
- To determine the factors driving gas export revenue, and to analyze their effects on the gas export revenues of Yemen and the other MENA countries,
- To identify the factors that influence gas export revenue the most, and to recommend that the decision makers adopt appropriate policies to alleviate the negative effects of these factors on the country's revenue.

1.5 Research questions

- What are the factors that influence the gas export revenue of Yemen in particular and of the MENA countries in general the most?

- In the event of the collapse of some global markets of natural gas, what are the measures that maintain the sustainability of gas export revenues for Yemen and the MENA countries?
- What are the appropriate policies to promoting gas export revenue in Yemen and MENA countries?

1.6 Research structure

This paper consists of eight chapters. Chapter 1 includes an introduction on natural gas and an overview of the MENA countries in relation thereto. The chapter also includes the research motivations, objectives, questions, and framework. Chapter 2 discusses the economic situation of the Republic of Yemen and gives an overview of its hydrocarbon reserves. Chapter 3 highlights Yemen LNG Project and its contribution to the economic and sustainable development of the Republic of Yemen, and the role of the South Korean market in the development of Yemen's natural-gas industry and marketing. Chapter 4 presents a literature review, summarizing and presenting the past studies and works that applied the same methodology that was used in this study, and presenting a review as well of the past studies about MENA natural gas. Chapter 5 presents and summarizes the natural-gas data sources that were used in this study, and introduces the research methodology and approach that were likewise used in this study, with a brief explanation of the parts or components of the methodology. Chapter 6 discusses the empirical study that was conducted on the factors affecting the gas export revenue of Yemen and the MENA countries. Chapter 7 presents the decomposition analysis results obtained in

this study and discusses the changes in the factors affecting gas export revenue and their effects on gas export revenue, as well as the main and assisting factors influencing the gas export revenues of Yemen and the MENA countries. Chapter 8 presents the implications and conclusions of this study and provides some recommendations for maintaining the sustainability of gas export revenues for Yemen and the MENA countries.

Chapter 2. Overview of the Republic of Yemen

The political crisis of 2011 in Yemen has exposed a number of long-standing structural weaknesses in the country's economy, particularly the ability of its poorest people to access basic commodities - food, water, and energy - in times of economic and political strain. Some 43% of the population lived on $2 or less a day in 2010, according to the International Monetary Fund (IMF). This equates to roughly 10.3 million people on the basis of the World Bank population estimate of 24 million for the same year (Salisbury, 2011). According to the World Bank, Yemen's population is growing at 2.9% a year, making it one of the fastest-growing on the planet.

The state is excessively reliant on the production and export of oil and gas to generate revenues, build foreign currency reserves, fund subsidies to the cost of living and underwrite other costs, including state salaries. However, relative to its neighboring Gulf Arab states, Yemen has low oil output and revenues - it is the world's 32nd largest exporter of oil - and a large population.

Oil production is in terminal decline, and a lack of refining capacity meant that until 2010 Yemen imported around 20% of its fuel needs.

Between 2000 and 2009, the hydrocarbons sector, including refining, accounted directly for 20-30% of Yemen's overall gross domestic product (GDP), 80-90% of its exports and 70-80% of government revenues.

The sector, which since 2010 has included the export of liquefied natural gas (LNG), is Yemen's main source of foreign exchange. However, oil production is in sharp decline, and in recent years several analysts have estimated that demographic and economic pressures, coupled with a fall in output, will turn the country into a net oil importer by 2020, if not sooner.

Income from a major liquefied natural gas project, Yemen LNG, is likely to total little more than $250–300m a year in the period 2010 - 15. It will provide a much-needed boost to government revenues, but will not be enough to cover the fall in revenues associated with lower oil output.

Meanwhile, the cost of imports is rising in line with global commodity prices - which increased by 12.9% annually between 2001 and 2010 on average, according to the IMF - while the country's trade balance has been negative since 2007. Yemen's trade deficit rose from $1bn to $2.7bn between 2008 and 2010.

The government ran successive budget deficits in 2007 - 10 as spending overtook income, while the country's current account - the balance of international exchanges in goods, services, debt payments and remittances - has also been negative since 2007 as a result of falling oil output and increasing demand for commodities from abroad. Yemen has attracted little foreign direct investment (FDI), around $1.9bn at its peak in 2008, with capital outflows understood to far outstrip this figure.

2.1 Economic situation of Yemen

Yemen is one of the poorest countries in the world. Its economy depends on foreign aid and remittances from workers in neighboring Golf States. The most important sector of the economy is dwindling oil extraction, it accounts for around 70 % of government revenue and 25 % of GDP. Agriculture is also very important as it employs over 50 % of the population. In recent years, the government has engaged in efforts to diversify the economy from dependency on oil. As a result, there was a surge of investment in the development of infrastructure for natural gas extraction. Yet, the political instability in 2011 has undermined development efforts, resulted in damage of infrastructure, rising unemployment and high inflation (Figure 4).

The national accounts data of Yemen indicate that gross domestic product (GDP) achieved an annual growth rate of about 4.8% on average, at constant prices, during the period from 2004 to 2008. This is due to the significant growth achieved in the non-oil sectors, which grew by about 8.5% on average during the same period. In contrast, the oil sector's performance decreased significantly as the sector had a negative growth rate of about -7.1% on average. The negative growth of the oil sector is attributed to continued and unprecedented decline in the production of crude oil, which dropped from 147.5 million barrels in 2004 to 107.4 million barrels in 2008. Given the economic growth forecast for non-oil and oil sectors, there is a clear decline in the growth of non-oil sectors from about 8.5% on average for the period 2004-2008 to about 5.5% on average for the period 2009-2012. This decline is attributed to internal security and political problems on the one hand, and the

negative effects of the global financial crisis on economic activity on the other hand, in particular the decline in total investment, including FDIs, and decline in remittances and the vulnerability of external sectors of the economy.

In the oil and gas sector, the forecast by the Ministry of Oil indicate a continuing decline in crude oil production during the coming period, but the start of production and export of liquefied natural gas since the last quarter of 2009 will contribute to a positive growth rate for oil and gas sector during 2009-2010. However, the years following 2010 we will see negative growth rates in this sector due to continued decline in oil production and stagnancy in production and export of liquefied natural gas at about 6.7 million metric tons annually. The final outcome will be a retreat of the role of the oil sector in economic activities and support for the Public Budget as well as, the external sector as a major source which contributed over the years to the country's GDP by about 30%, (making up three-quarters of the public economic growth and stability of macro-economic balances, (internal and external).

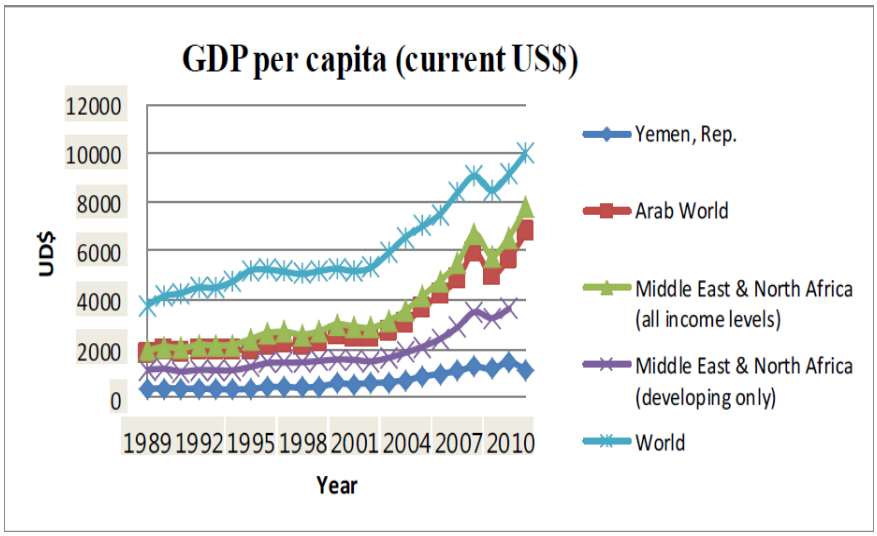


Figure 4. GDP per capita of Yemen comparing with MENA, 1989- 2011.

Source: Ali Aziz, 2013

2.2 Hydrocarbon Sector of Yemen

Yemen is a relative late-comer to the international oil and gas scene. However, it shares many of the challenges of other hydrocarbon-producing countries. The large population and requirements for economic development place a heavy responsibility on the government for sound development and utilization of natural resources. This entails difficult decisions in ensuring an appropriate balance between the needs of the country and its people and the requirement to maintain a sufficiently attractive economic and regulatory climate to attract international investors.

Yemen is a small oil producer and does not belong to the Organization of the Petroleum Exporting Countries (OPEC). Unlike many regional oil producers, Yemen relies heavily on foreign oil companies that have production-sharing agreements with the government. Income from oil production constitutes 75 % of

government revenue and about 85 % of exports. Yemen had proven crude oil reserves of more than 3 billion barrels in 2007, down from 4 billion in 2006, and these reserves are not expected to last beyond 2020; in addition, output from the country's older fields is falling.

Yemen has gone through significant structural changes in its economy in the beginning of 1990s, which have included rapid increases in the demand for energy use domestically which have increased from 76,000 barrel per day in 1990 to 177,000 barrel per day in 2012, growing at an annual average rate of 29.7%. Factors such as rising incomes, population growth, and cheap energy prices were the main sources for such increases. Petroleum product prices which do not reflect the real cost of production remained low comparing to international standards. These low prices permitted such inefficient use of energy and gave no such incentives for consumers to conserve energy (Dahan, 2014).

2.2.1 Oil sector

Producing crude oil in Yemen started in 1986 which was very low levels in that year and gradually increased production throughout 1987. According to statistical data that has been published by the Energy Information Administration, the country's first significant production was in 1988, when it produced reached to 171,000 barrels per day (bbl/d). The second significant production of oil was in 1994 (this year witnessed a civil war against the secession of the south from the north) which reached to about 345 barrel per day (bbl/d), and then the production growing gradually to reach to about 440 barrel per day (bbl/d) in 2001. Oil

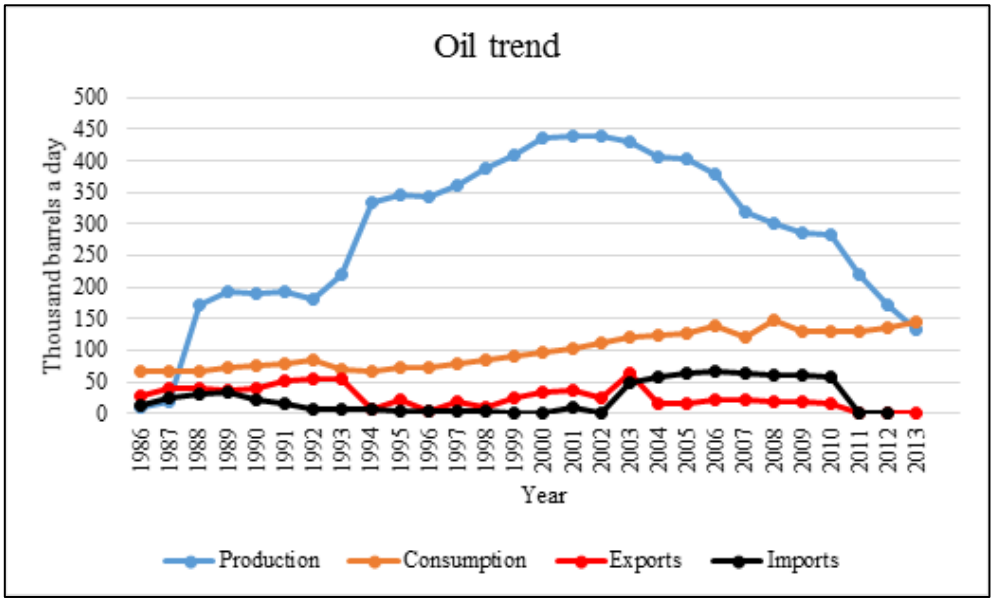
production experienced sharp decline after 2001, where it reached to 133 thousand barrel per day (bbl/d) in 2013 (Figure 5).

Yemen is heavily relies on the foreign oil companies that have production-sharing agreements with the government (PSAs), which usually include 20-year concessions for production activities. The agreements between the government of Yemen and the producing companies dictate that on average, 58% of the total production is for government share, whereas 42% for companies shares. About 63% of government's share goes for export, whereas 37% goes for domestic use. In 2013, the government announced plans to transfer the expiration licenses state-own companies

With the continuing decline in oil production after 2001, Yemen has struggled to keep its export sector at normal operating levels. The pipeline, which runs from the Marib region in the center of the country to the export terminal at Ras Isa, is critical to Yemen's export operations. As such, it is one of the most frequent targets of sabotage.

Since Yemen does not have any overland pipeline connections to its neighbors, therefore all of the country's petroleum exports depart via tanker vessels. In recent years, more than three-fourths of their petroleum exports went to destinations in Asia. In 2013, Yemen exported just 124,000 barrel per day (bbl/d) of crude oil, according Energy Information Administration. Exports are down from more than 350,000 barrel per day (bbl/d) 10 years earlier. In addition to crude oil exports, Yemen exports limited amounts of refined petroleum products, averaging just 16,000 barrel per day (bbl/d) of refined product exports in 2013, according to Energy Information Administration.

Yemen regularly imports petroleum products, particularly distillate fuel oil and residual fuel oil. Between 2000 and 2013, Yemen's imports of all petroleum products grew from just 2,000 barrel per day (bbl/d) to 78,000 barrel per day (bbl/d), according to Energy Information Administration. The possibility of continuing attacks on its energy infrastructure and further production declines means Yemen's reliance on imported petroleum products will likely increase in the short term (EIA, 2014).



In terms of oil consumption, Yemen shows upward trending, reaching 144,000 barrel per day (bbl/d) in 2013. Unless major new discoveries are made, it is estimated that Yemen has about 10–12 years of remaining, but steadily declining, reserves. Much of the country's production in the near future (except for gas) will be consumed domestically and the country will turn increasingly to imports, as it did in 2011.

The country has two operating refineries with a total capacity of 140,000 barrel per day (bbl/d). While these refineries produce some of the petroleum

products Yemen needs, the refineries do not operate at full capacity, and the country imports additional petroleum products to help meet internal demand. The Aden Refinery is the largest in the country, accounting for almost all of Yemen's total refining capacity of 140,000 barrel per day (bbl/d). Figure 5 shows the trend of oil in Yemen according the published data in Energy Information Administration.

Figure 5 Oil production, consumption, exports and imports of Yemen

Data source: EIA, 2013

The first discovery of natural gas in Yemen was achieved during 1989-1990 by Hunt Company (American Company), and followed by the French company TotalFinaElf that made other major discoveries yielding a flow of 12.36 million cubic feet per day in 1991 and 1992 in Janah block, east of the country. Third major gas discovery was made in 2000 in block S-1 by the joint venture of U.S Vintage and Canadian Trans Globe. When this discovery was tested, it yielded 47.7 million cubic feet per day of natural gas, which then followed by another discovery obtaining a flow of 27.7 million cubic feet per day (Dahan, 2011).

2.2.2 Natural gas sector

According to the ministry of oil and minerals statistics, Yemen held a 16.9 trillion cubic feet (Tcf) of proved natural gas reserves. One of the larger natural gas deposits in Yemen is in the hydrocarbon-rich Marib-Jawf area, where there may be 18 Tcf in recoverable volumes of natural gas, according to Yemen's government.

Before launching gas export process in November 2009, Yemen was reinjected nearly all of the natural gas in order to develop oil production in Marib

area. In 2009, the Yemen LNG facility opened, and the country began to divert dry natural gas away from the oil fields and toward domestic and international consumers. Yemen's domestic market began consuming small amounts of natural gas in 2009, and there are plans to increase the use of natural gas in many sectors- particularly in power generation- to make up for diminishing petroleum supplies.

Production natural gas in Yemen started in the early 1990s, however, from 1993 until 2009-when the Yemen LNG facility came online- Yemen reinjected virtually all (98%) of the natural gas produced inside the country. With the opening of the country's only LNG facility in November of 2009, Yemen began producing commercial quantities of dry natural gas for the first time in its history. In 2013, Yemen produced 359 billion cubic feet (Bcf) of dry natural gas (Bp, 2014), up from just 28 Bcf in 2009 when the production of dry natural gas began.

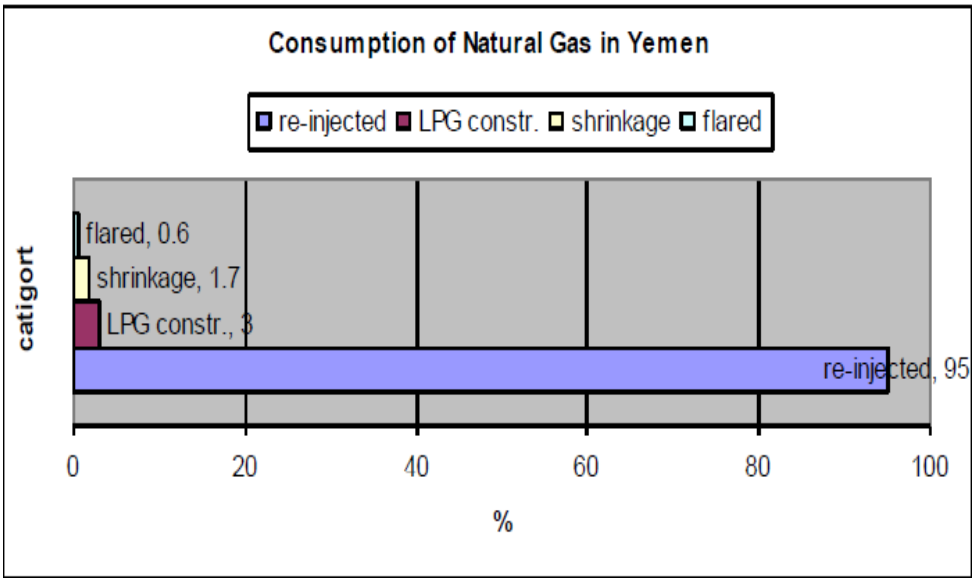
With the continued build-out of infrastructure to feed Yemen LNG, the possibility of diverting natural gas used in oil recovery to domestic consumers- such as the power sector-becomes more feasible. Further, exploration in Yemen's onshore and offshore blocks may yield additional recoverable quantities of natural gas, although, like oil exploration, the security environment in the country will play a big role in determining the interest of international investors.

The government of Yemen announced in 2013 about the new discoveries of natural gas in Al Gawf area which located in the north part of Yemen.

Figure 6 Gas consumption in Yemen.

Source: Dahan, 2011.

Since the discovery of oil and gas, the use of natural gas is limited to the operation process of oil production only, where natural gas re-injected to increase the pressures of reservoirs. About 30 billion cubic meter of associated gas is put back in reservoirs annually to increase the pressure of the existing oil reservoirs and to store gas for future use. In 2002, about 95% of the total gas produced was re-injected, whereas 0.6% was flared, 1.7% shrinkage gas, and 3% was used for the



extraction of the liquefied petroleum gas and condensate Figure 6 (Dahan, 2011).

Yemen has never been a natural gas importer, and, until 2009, never consumed natural gas domestically. Since 2009, Yemen's natural gas consumption has grown, but not nearly as fast as its natural gas exports. Based on the data that are published from Energy Information, Yemen's consumption of natural gas remains limited, peaking at just 34 billion cubic feet in 2010.

After the Yemen LNG project launching in November 2009, gas exports have grown significantly from 14.83 billion cubic feet in 2009 to 340.18 billion

cubic feet in 2013, representing over 90% of its total dry natural gas production. According to IHS Global Insight, Yemen LNG provided approximately 3% of global LNG volumes as of early 2013 (EIA, 2014). Figure 8 shows the production, consumption and exports of natural gas during 2009-2013, while Figure 9 shows the ratios of gas consumption and exports during the same period.

French company Total operates the 6.7 million ton per year (322 Bcf) Yemen LNG facility, and most of the exported LNG is under contract to GDF Suez, Total, or Korean Gas (KOGAS). Figure 7, shows that the production and exports work in parallel trend and associated to each other during all the period, that implicit means Yemen significantly relies on gas exports in the economic development. Actually, this meaning is right because Yemen suffering from the very sharp decline in the oil production from the past few years, so nowadays Yemen significantly relies on the LNG exports which contribute by 25% in GDP of the state. In 2012, the gas production stopped for 6 months due to the protests in that year which called Arab Spring, and this can be clearly seen from Figure 8.

2.2.3 Sector organization

The government of Yemen oversees the sector of oil and gas through Ministry of Oil and Minerals (MOM). The ministry sets oil and gas policies and manages relations with foreign operators, but any contracts with foreign companies also require parliamentary approval. The national oil company, Yemen General Corporation for Oil, Gas, and Mineral Resources, guides a number of state-owned subsidiaries that handle most day-to-day operations and deals with energy sector revenues (Table 1).

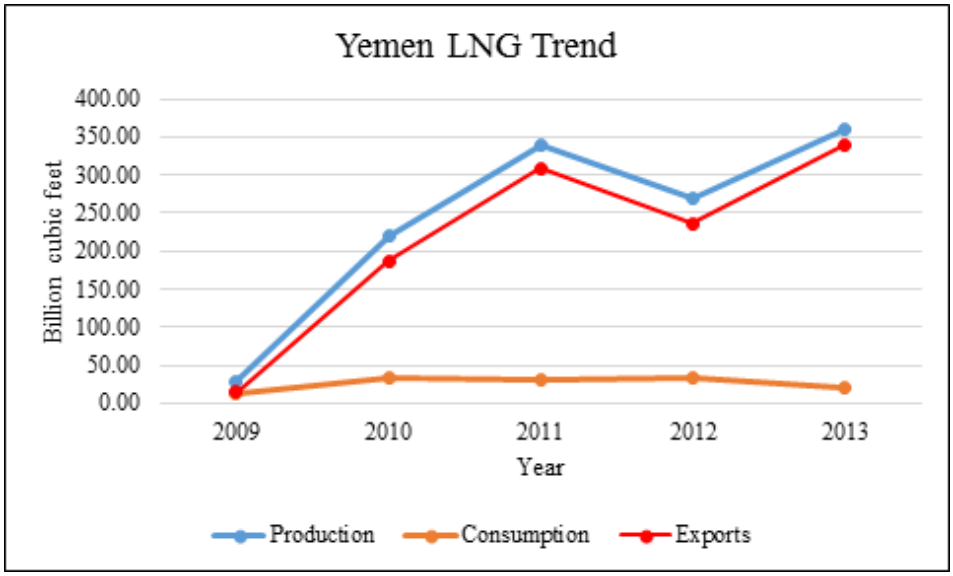


Figure 7 Gas production, consumption, and exports of Yemen

Data source: EIA, 2013

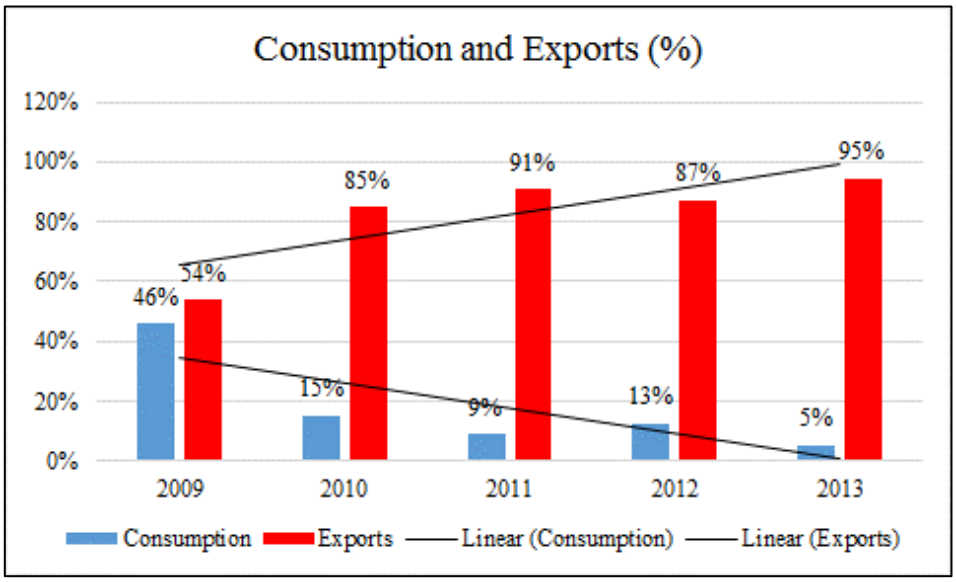


Figure 8 Gas consumption and exports ratio

Data source: EIA, 2013

Table 1 Selected subsidiaries of the Yemen General Corporation for Oil, Gas, and Minerals

Entity	Function
Aden Refinery Company	Overseas operations at the Aden refinery, including transport to international destinations
Petroleum Exploration and Production Authority	Manages petroleum exploration and production; oversees licensing rounds and contracts with foreign investors
Safer E&P Operations company	Upstream operator; second largest producer in Yemen
Yemen Gas Company	Responsible for sales, marketing, and supply of liquefied petroleum gases domestically
Yemen Investments Company for Oil and Minerals	Upstream operator; focused on Jannah and West Ayad areas
Yemen Petroleum Products Distribution company	Markets and distributes petroleum products in the local market
Yemen Refining Company	Oversees domestic refining operations

Sources: Yemen Ministry of Oil and Minerals, Yemen General Corporation for Oil, Gas, and Minerals, company websites

Chapter 3. Contribution of Yemen LNG Project to the Economic Development of Yemen

3.1 Background

Yemen LNG Project was launched in August 2005 to design, construct, and operate an LNG plant on the southern coastline of Yemen, with an associated land pipeline, for marketing and exporting the LNG produced by Yemen. This project, the largest-ever industrial project in Yemen's history, marks a significant milestone as it demonstrates the commitment of the Yemeni government and the company shareholders to Yemen's future development and economic growth (Hirst et al., 2010). The project area falls within two of the 21 governorates of Yemen, Shabwah and Marib, and the main project components include modifications of the Marib upstream gas processing facilities located in central Yemen, a 320-kilometer pipeline for transferring the gas from the Marib fields to Balhaf on the Arabian Sea, and a liquefaction plant situated at Balhaf, where the gas is liquefied and stored onsite before being transferred to LNG carriers for transport to international markets. Strategically located at the crossroads of international maritime routes, Yemen LNG Plant enjoys access to markets in the Far East, Middle East, Europe, and Americas.

With a more than US$4 billion project budget in addition to the anticipated revenue of US$30-50 billion during the lifespan of the project, Yemen LNG Project is the largest industrial investment ever undertaken in Yemen (Hirst et al., 2010).

Yemen LNG Plant was built and operated by Yemen LNG Company, and the plant technology is based on the proven C3/MR industry-standard APCI process and consists of two parallel processing trains with a total guaranteed production capacity of 6.7 million metric tons per year. In addition, two 140,000-m^3-capacity storage tanks are being operated, along with ancillary facilities, such as for power generation, desalination, wastewater treatment, and steam generation, to enable the project to operate on a self-supporting basis in an efficient, reliable, and environmentally compliant manner, in accordance with the applicable international standards. The proven production capacity of the plant has been reserved to supply Yemen's sales commitments in the Asian and European markets.

Yemen LNG Project is a fully integrated project. After years of study, planning, and negotiations with various stakeholders, Yemen LNG Project was launched in August 2005, bringing together the competencies of five experienced international shareholders in the LNG industry and of two government bodies.

The Yemen LNG shareholders are Total (39.62%), Hunt (17.22%), Yemen Gas Company (16.73%), SK Corporation (9.55%), KGAS (6.00%), Hyundai (5.88%), and General Authority of Social Security and Pensions (5.00%).

3.2 Yemen LNG's share in the global markets

Yemen LNG's specifications are compatible with the requirements of almost all the LNG markets worldwide, and with the plant output requirements for the movement of around 100 LNG carriers per year. According to Yemen LNG Company's 2013 data, approximately 90% of Yemen's LNG exports go to the Asian

market, and the remaining quantities are distributed to the Middle East, European, and American markets (Figure 9).

The significant global market share of Yemen's LNG exports began after the opening of the LNG plant towards the end of 2009. The first cargo was exported to South Korea, which was approximately 370 million cubic meters, followed by more than 100 million cubic meters to the European market and more than 90 million cubic meters to the American market in the same year. In 2004-2007, before the launching of Yemen LNG Plant (2009), Yemen exported some quantities of natural gas to the European and African markets. In 2008, Yemen had no gas exports as its available quantities of natural gas were used for the new electric-power plant, which entered into service that year.

Table 2 Yemen LNG exports by the market (Mm3)

Region	**2004**	**2005**	**2006**	**2009**	**2010**	**2011**	**2012**	**2013**
Americas	0.48	0	0	92	1,896	2,612	1,385	1,228
Asia	0	0	0	368	4,173	6,093	6,044	9,607
Europe	84.43	52.46	23.85	101	766	1,273	0	203
Total	84.91	52.46	23.85	560	6,835	9,978	7,429	11,037

Source: Yemen LNG Company, UN Comtrade.

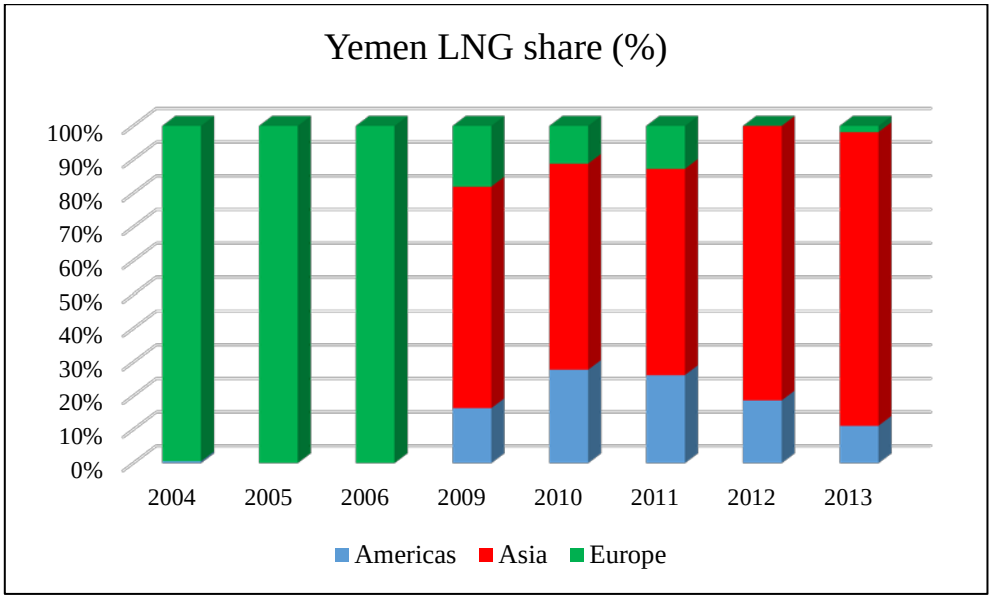


Figure 9 Yemen LNG share in the global markets.

Yemen LNG has played an important role in meeting the Asian market demand from 2009 to the present. According to the BP statistics data published in June 2014, Yemen ranked third among the MENA countries (after Qatar and Oman) in terms of LNG exports to the Asian market in 2013, and was the second country (after Qatar) that signed an export contract with all the Asian countries that had natural-gas demands.

3.3 The South Korean market and Yemen LNG

South Korea has played a key role in the development of Yemen's natural-gas industry and marketing since the early stages of Yemen's establishment of its LNG industry. After years of study, planning, and negotiations with various stakeholders, Yemen LNG Project was launched in August 2005, bringing together

the competencies of five experienced international shareholders in the LNG industry and of two government bodies. Among the five international shareholders are three important South Korean companies in the natural-gas industry: SK Corporation, KOGAS, and Hyundai. Together, these companies own 21.43% of the stocks of Yemen LNG Company.

In August 2005, Yemen LNG Company signed long-term sales & purchase agreements with the aforementioned three major buyers for the sale of LNG for a period of 20 years. KOGAS, one of the top five largest LNG importers in the world, was one of these buyers of Yemen's natural gas of.

According to Yemen LNG Company's 2013 data (Table 2), Yemen's gas exports to the Asian market in 2013 reached more than 9,600 million cubic meters, and most of Yemen's gas exports were sold to South Korea by KOGAS in 2009-2013 (Figure 10).

Based on the foregoing, it can be said that the South Korean market is the main player in terms of Yemen's natural-gas industry and trading, especially from 2009. It is for this reason that Yemen is seeking to strengthen its bilateral ties with the Republic of Korea: to increase its gas exports to the South Korean market and to attract South Korean capital towards oil, mineral, and natural-gas field investments in the country.

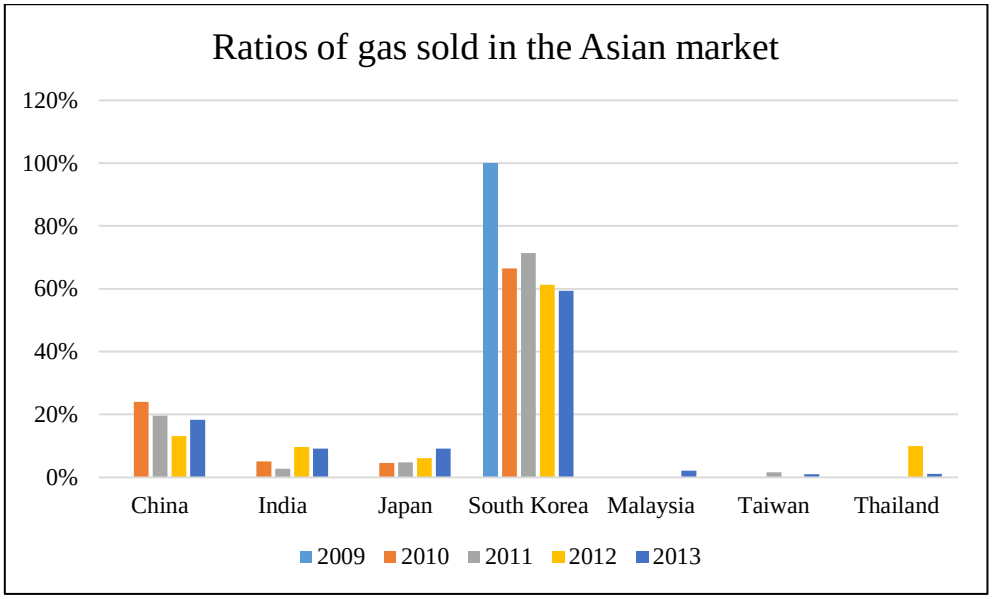


Figure 10 Ratios of the gas supply of Yemen into Asian countries.

3.4 Economic contribution of Yemen LNG Project

The economy of Yemen heavily relied on oil exports in the previous three decades, which the oil exports accounting for more than 70% of the state's revenue and more than 25% of the state's GDP. The sharp decline of oil production from 450 barrels per day in 2001 to approximately 100 barrels per day in 2013 (EIA, 2014), prompted the government of Yemen to diversify the country's national income resources to support the country's economy. Yemen LNG Project is the most important player in the diversification of the country's export revenue.

As a result, there was a surge of investment in the development of infrastructure for natural-gas extraction, and Yemen LNG project became the largest industrial investment ever made in Yemen, and one of the top contributors to the country's economic and industrial development, encouraging greater foreign

investment and increasing the opportunities for local investors to expand internationally.

Yemen LNG project has made a tremendous impact on the economy of Yemen since it came online in 2005. Having cost approximately $5 billion, Yemen's largest-ever industrial project built the first LNG facility in the country, which currently produces 6.7 metric tons of LNG annually and is expected to contribute about US$1 billion per year to the Yemeni economy (the current GDP is about US$26 billion) and about US$100 million in average annual tax income to the government for the next 25 years (out of a current annual budget of about US$6 billion, gas revenues are expected to make a significant contribution in the future). Most of the revenues from the gas project will go to foreign investors, but the ownership structure of the project will give the Yemeni government two steady income sources in the future. Unlike oil, where the government received a portion of the product in kind to sell (production sharing agreements), in the gas project, the government is an investor and will receive a portion of profits when the initial construction costs have been paid off. The state's Yemen Gas Company owns 16.73% of the project, and General Authority for Social Security and Pensions owns another 5%. The government will also receive progressive tax revenues, starting at 25% and reaching 90% late in the life of the project (Schmitz, 2011).

Apart from generating revenues, Yemen LNG Project brought and is still expected to bring value to the country in many other ways, including knowledge sharing, empowering local businesses, and supporting the development of the country and the Yemeni youth.

Yemen LNG project was a significant factor in creating job opportunities and in developing skills in a region that traditionally was not well served in such respect. A dedicated operator training and development program was set up to train a cadre of Yemeni plant operators who would be able to support plant operations throughout the planned 25-years lifespan of the plant.

3.5 Sustainable Development

Based on the Yemen LNG Company information, the company invested about $ 26 million US dollars during 2008-2012 in sustainable development projects in the target neighboring communities, particularly in Shabwa and Marib, where the project being operated. The projects range from those related to health, education, water, and electricity to those related to agriculture, women's development, beekeeping and sherry development.

Yemen LNG aims to continue operating as a responsible company locally, nationally, and internationally, and is making significant efforts in carrying out its social and environmental responsibilities. It has achieved much through its establishment of Yemen LNG project, such as raising the country's profile as an important player in the exclusive global LNG industry; raising the existing local technology structure, knowledge, and experience to higher levels; and providing international marketability for the local workforce of around 8,000 Yemenis trained during the plant construction.

Chapter 4. Literature review

Some of the notable advances in the IDA methodology since the early 1980s have been the introduction of the Divisia index concept and of what was later called the AMDI method in Boyd et al. (1988), the development of LMDI in Ang and Choi (1997), the application of the ‘‘jointly created and equally distributed’’ principle to the Laspeyres index method proposed in Sun (1998), and the introduction of the Shapley value in Albrecht et al. (2002). Based on these studies and those of other researchers, Ang (2004) classified the various IDA methods and developed guidelines on IDA application. He described application areas, the commonly used decomposition methods, and the methods adopted by some national agencies and international organizations. He presented a summary of the recommended ones in a simple framework based on the Divisia index and the Laspeyres index. He discussed the properties of these methods and concluded by recommending the multiplicative and additive LMDI I methods due to their theoretical foundation, adaptability, ease of use and result interpretation, and some other desirable properties in the context of decomposition analysis. As a follow-up to the study by Ang (2004), Ang B.W. (2005), gives a practical guide to the LMDI decomposition approach. He summarized the general and specific LMDI formulae for ease of reference, and present two examples using real data. Some application issues are also dealt with. The study that carried out by Ang B.W. et al. (2009), which deals with the properties and linkages of some popular IDA methods is an extension to Ang (2004). Ang B.W. and Liu F.L., (2001), propose a decomposition method that is perfect in decomposition and consistent in aggregation. They call this method the Log-Mean

Divisia Index Method I (LMDI) and they describe the formulation and properties of it. They studied two cases on energy- related CO2 emission one for the manufacturing industry in China and the other for energy consumption in world regions, to illustrate the concept of decomposition analysis. Lorna A. et al., (1997), applied six decomposition methods to aggregate energy intensity for the manufacturing sector in 10 OECD countries, including, Denmark, Finland, France, Germany, Japan, Italy, Norway, Sweden, the United Kingdom and the United States. Examination of the residual for both of the Laspeyres and the simple average fixed year Divisia indices over time indicates that the residuals increase with time. Fionn Rogan, et al., (2012), used the Log-Mean Divisia Index I (LMDI-I) methodology to decompose gas consumption trends in the gas-connected residential sector in Ireland from 1990 to 2008. The analysis decomposes this change in gas consumption into a number of effects, examining the impact over time of market factors such as a growing customer base, varying mix of dwelling types, changing share of vacant dwellings, changing size of new dwellings, the impact of building regulations policy and other factors such as the weather. The analysis finds the most significant effects are changing customer numbers and changing intensity; the analysis also quantifies the impact of building regulations and compares it with other effects such as changing size of new dwellings. By comparing the historical impact on gas consumption of policy factors and non-policy factors, this study highlights the challenge for policy-makers in achieving overall energy consumption reduction. Ang B. W. et al. (1998), applied decomposition analysis with three different energy and environmental indicators in Singapore, China, and Korea. Liu, et al., (2007), used the time series decomposition of the Log-Mean Divisia Index (LMDI), to

analyze the change of industrial carbon emissions from 36 industrial sectors in China over the period 1998– 2005. Around 124 studies used the index decomposition analysis methodology in the energy and gas emissions during the late of 1970s until 2000 (Ang B.W. and Zhang F.Q. 2000). Sheinbaum, et al., (2010), used logarithmic mean divisia index (LMDI) to analyze changes in energy use and carbon dioxide emissions in Mexico's iron and steel industry during 1970-2006. Kihoon Lee and Wankeun Oh (2006), used log mean Divisia method to decompose the changes of CO_2 emissions in APEC countries over time as well as the differences of CO_2 emissions among three income groups of APEC countries at a given period of time. Shyamal, Bhattacharya, (2004), used decomposition method to identifying the factors that have influenced the changes in the level of energy-related CO2 emissions. The study refers to the major economic sectors of India for the period 1980 - 1996. The results show economic growth has the largest positive effect in CO2 emissions changes in all the major economic sectors. John, Jekwu, (2006), used decomposition analysis to analyze CO2 emission intensity between oil and non-oil producing sub-Saharan African countries during 1971-1998. Hatzigeorgiou, et al., (2008), used decomposition analysis (The Arithmetic Mean Divisia Index (AMDI) and the Logarithmic Mean Divisia Index (LMDI) techniques) to analyze the change of CO_2 emissions in Greece during 1990-2002. Their study showed that the biggest contributor to the rise in CO_2 emissions in Greece is the income effect; on the contrary, the energy intensity effect is mainly responsible for the decrease in CO_2 emissions. Wang, et al., (2005), analyzed the change of aggregated CO_2 in China from 1957 to 2000 based on a complete decomposition approach - the logarithmic mean divisia index (LMDI) method. The study indicates

that China has achieved a considerable decrease in its CO_2 emissions mainly due to improved energy intensity. In addition, fuel switching and renewable energy penetration also exhibit positive effect to the CO_2 decrease. Ma, Chunbo, and David I. Stern (2008), used logarithmic mean Divisia index (LMDI) techniques to decompose changes in energy intensity in the period 1980 - 2003. They find that: (1) technological change is confirmed as the dominant contributor to the decline in energy intensity; (2) structural change at the industry and sector (sub-industry) level actually increased energy intensity over the period of 1980 - 2003, although the structural change at the industry level was very different in the 1980s and in the post-1990 period; (3) structural change involving shifts of production between sub-sectors, however, decreased overall energy intensity; (4) the increase in energy intensity since 2000 is explained by negative technological progress; (5) inter-fuel substitution is found to contribute little to the changes in energy intensity. Zhao Min, et al., (2010), used Log-Mean Divisia Index method to decompose the influencing factors of industrial carbon emissions (ICE) in Shanghai between 1996 and 2007. They found that the industrial output was the main driving force of ICE. The decline in energy intensity and the adjustment of energy and industrial structure are major determinants for reduction of ICE, with the former alone accounting for 90% of the reduction. Ediger Volkan Ş., Huvaz Ozkan (2006), used the additive version of the LMDI method to conduct decomposition analysis on the energy use in agriculture, industry and services sectors. Their study aims to investigate the sectoral energy use in the Turkish economy for the 1980 - 2000 period when significant changes occurred in the economic and demographic structure of the country. The study that carried out by Tunç G. İpek, Türüt-Aşık Serap (2009), aimed to identify the factors

that contribute to changes in CO_2 emissions for the Turkish economy by utilizing Log Mean Divisia Index (LMDI) method developed by Ang (2005). Akbostancı Elif, et al. (2011), used Log Mean Divisia Index (LMDI) method to decompose the changes in the CO2 emissions of manufacturing industry into five components; changes in activity, activity structure, sectoral energy intensity, sectoral energy mix and emission factors.

Donglan Zha, et al., (2010), applied the logarithmic mean Divisia index decomposition analysis to investigate the factors that may affect the changes of the CO2 emissions in residential sector in the urban and rural china. Jung Seok, et al., (2012), used logarithmic mean Divisia index (LMDI) to identify the factors driving energy-related CO_2emissions in five regions of South Korea, where substantial eco-industrial parks (EIPs) are operational. They found that increases in carbon emissions were due mainly to the production effect of both EIPs and the surrounding regions. Reduced energy intensity, on the other hand, was the main factor mitigating carbon emissions. Bhattacharyya and blake (2010), analyzed how oil export dependencies of Middle East and North African (MENA) oil producers have evolved over the past two decades and to identify the main driving factors from an energy policy perspective. By using the Laspeyres index their analysis shows that energy price and increasing energy intensity in the MENA countries have influenced the overall oil export dependency.

As for the studies carried out in MENA countries in terms of the contribution of natural gas in the economic development. Darbouche (2013), studied the MENA's growing natural gas deficit and the issue of domestic prices. This study analyses the political economy logic informing domestic gas pricing policies in the

MENA region and argues that unless these are revised to take account of the new regional gas market realities, MENA's role in international gas markets will in future be more that of a growing demand and import center than as a major source of new supply. Hussein Razavi, (2009), discussed the gas pricing policy in the countries of Middle East and North Africa (MENA), where gas prices are set directly or indirectly by the governments. This study includes that the price of gas in most MENA countries is substantially below its economic cost, resulting in wasteful use of gas and electricity, deployment of inefficient technologies, and huge burden on government budgets. The low gas price also causes a bias in favor of gas export projects while at the same time reduces investors' interest in the upstream and downstream gas sector. Khatib (2014), studied the Oil and natural gas prospects in the Middle East and North Africa (reserve, production, export, subsidy, future outlook, economic and social rewards, Income and fiscal benefits, investment,…,etc.). Akli and Kim (2014), updated Bhattacharyya and Blake's (2010) results and analyzed the oil and gas export intensities of the Middle Eastern and North African economies, by using the decomposition method to identify factors of the intensity changes. They applied the Logarithmic Mean Divisia Index (LMDI) method in their study and they extend the decomposition analysis to 'gas' export intensities for Algeria and Qatar.

Fengling Liu (2005), studied some methodological issues of decomposition analysis, from the underpinning theory to methodology improvement. He added a total of 63 new studies to the list of 109 studies reported in Ang and Zhang (2000). He also proposed a new method called the log-mean Divisia index method I

(LMDI I) which is consistent in aggregation and perfect in decomposition and modified Fisher Ideal index method (MFII).

Chapter 5. Data source and research methodology

5.1 Data source

The gas exports (volumes and prices) data of MENA countries during 2004-2013 have been collected from several references as the following:

Table 3 Summary of the sources of the data

No.	Data source	Data period
1	United Nations Commodity Trade Statistics Database website (UN comtrade)	2004-2006
2	International Energy Agency report (2012)	2007-2011
3	BP Statistical Review of World Energy reports (2010, 2011, 2012, 2013, and 2014).	2009-2013
4	Yemen LNG Company	2009-2013
5	US Energy Information Administration website (EIA)	2008-2013
6	Joohong Huh study (MSc 2013)	2004-2012
7	United Nations Statistics Division- National Account, for GDP at 2005 USD and Implicit Price Deflator	2004-2013

The breakdown data on quantities of gas exports (volume) have been collected firstly in million cubic meters (based on IEA), billion cubic meters (based on BP statistics), MMBTU (based on Yemen LNG Co.) and Kilogram (based on UN Comtrade). Since the 1 kilogram (kg) = 1.406 cubic meter (cm), and 1 cm = 35.3147 cubic foot (cf), and 1 cf = 1000 British thermal unit (Btu), then the volume has been

modified to million British thermal unit (mmbtu) to appropriate with the prices calculation later on.

5.2 Research methodology

In this study the general approach that use for analysis of gas export revenue in the Middle East and North Africa countries is the Index Decomposition Analysis (IDA). Since there are various types of decomposition analysis methodologies, this section addresses an overview of the decomposition analysis methodologies with focusing on the specific methodology that has been used in this study.

5.2.1 Index decomposition analysis approach

Although a large number of energy decomposition analysis studies have been reported in the last 25 years, there is still a lack of consensus among researchers and analysts as to which is the ‘‘best’’ decomposition method.

All energy decomposition work involves the application of various economic indices to decompose the change in energy consumption or aggregate intensity into various elements.

The popular decomposition methods among analysts can be divided into two groups: methods linked to the Laspeyres index and methods linked to the Divisia index. The methods used in the late 1970s and early 1980s are similar to the Laspeyres index in concept, where the impact of a factor is computed through letting that factor to change while holding all the other factors at their respective base year values. Representative examples are the studies by Jenne and Cattel l (1983) and Marlay (1984) which analyzed trends in energy use in industry in the UK and US,

respectively. Subsequently, extensions and refinement of methods linked to the Laspeyres index were made. Related studies include Reitler et al. (1987), Howarth et al. (1991), Park (1992), Sun (1998) and Ang et al. (2002). Boydet al. (1987) proposed the Divisia index approach as an alternative to the Laspeyres index approach in energy decomposition analysis. Thereafter, extensions and refinement of methods linked to the Divisia index have been made (Ang B.W., 2004).

Relevant studies include Boydet et al. (1988), Liu et al. (1992), Ang (1994), Ang and Choi (1997), Ang et al. (1998), and Ang and Liu (2001). As is well-known, the Laspeyres index measures the %age change in some aspect of a group of items over time, using weights based on values in some base year. The Divisia index is a weighted sum of logarithmic growth rates, where the weights are the components' shares in total value, given in the form of a line integral.

In simple terms, the building block of methods linked to the Laspeyres index is based on the familiar concept of %age change whereas the building block of methods linked to the Divisia index is based on the concept of log (i.e. logarithmic) change. T.ornqvist et al. (1985) presented the merit of using the log change and pointed out that it is the only symmetric and additive indicator of relative change, whereas the ordinary %ages are asymmetric and non-additive (Ang B.W., 2004).

As an example, assume the energy consumption of an industrial sector increased from 10 units in year 0 to 20 units in year T. The relative difference calculated in the ordinary %age depends on which of the two years is used as the point of comparison, i.e. the intensity in year T is 100% higher than in year 0, or the intensity in year 0 is 50% lower than in year T; which is asymmetric (Ang B.W., 2004).

In the case of the log change and using ‘‘ln’’ to denote the natural logarithm loge, the relative changes are, respectively, given by ln (20/10) =0.693 and ln (10/ 20) = -0.693. The changes are symmetric and Tornqvist et al. (1985) recommended the use of the term ‘‘log %’’ and in both cases 69.3 log % change (Ang B.W., 2004).

A numerous studies applied decomposition techniques to separate the changes in energy consumption into mainly three driving factors: (i) changes in economic structure; (ii) changes in efficiency; and (iii) changes in production. Many studies also used decomposition techniques to unfold the determinants of the emissions’ trends in countries (Inglesi-Lotz, 2012).

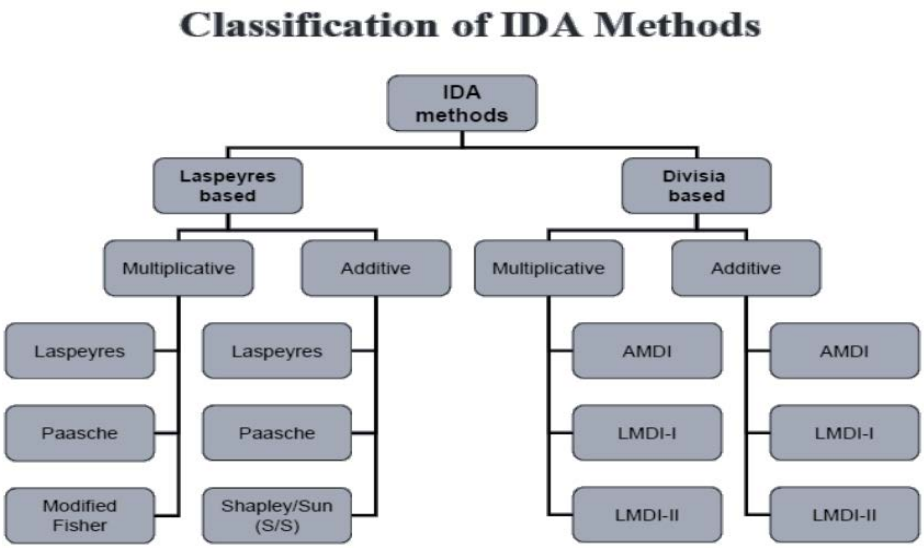


Figure 11. Recommended methods for energy decomposition analysis (Ang B.W., 2004)

5.2.2 Logarithmic Mean Divisia Index (LMDI) method

As the discussion aforementioned, several decomposition methods have been proposed previously. Two methods that have most often appeared in the energy literature are the Laspeyres index method and the Divisia index method which uses an arithmetic mean weight function. In 1997, Ang and Choi pointed out two major problems in the application of these two methods. The first problem is the existence of a residual in the decomposition result. This residual is often large in the case of the Laspeyres index method. The second problem involves zero values in the data set. Computational problems may arise in the application of the Divisia index method with an arithmetic mean weight function when the data set contains zero values.

To overcome these two problems, in 1997, Ang and Choi proposed a refined Divisia index method using a logarithmic mean weight function. This method gives perfect decomposition and can accommodate the value zero in the data set (Ang B.W., et al., 1998).

In 2004, Ang compared various index decomposition analysis methods and concluded that the logarithmic mean Divisia index method is the preferred method (Ang B.W., 2005). Logarithmic Mean Divisia Index (LMDI) method will apply for analysis the gas export revenue in MENA countries. The core of this method can be summarize from Ang B.W. 2004 as the following:

Assume that there are ***n*** factors contributing to changes in ***V*** over time and each is associated with a quantifiable variable whereby there are ***n*** variables, X1; X 2; …. X n. if

$$V=\sum_i Vi= \sum_i X1,iX2,i \ldots Xn,i. \quad (1).$$

The aggregate changes from V^0 in period 0 to V^t in period *T*. In **multiplicative decomposition**, we decompose the ratio as the following:

$$Dtot = V^0/ V^t = Dx_1, Dx_2 \ldots Dx_n \quad (2)$$

In additive decomposition, we decompose the difference as the following:

$$\Delta V_{tot} = V^t - V^0 = \Delta V_{X1} + \Delta V_{X2} + \ldots + \Delta V_{Xn} \quad (3)$$

In the logarithmic mean Divisia index (LMDI) approach, the general formula can be write as the following:

$$Dx_k = \exp\left(\sum i \frac{L(V_i^T,V_i^0)}{L(V^T,V^0)} \ln\left(\frac{(X_{k,i}^T)}{(X_{k,i}^0)}\right)\right)$$

$$= \exp\left(\sum i \frac{(V_i^T - V_i^0)}{(V^T - V^0)} / \left(\frac{\mathbf{ln}}{\mathbf{ln}} \frac{V_i^T - \mathbf{ln}\, V_i^0}{V^T - \mathbf{ln}\ V^0}\right) \text{x} \frac{(X_{k,i}^T)}{(X_{k,i}^0)}\right) \quad (4)$$

$$\Delta Vx_k = \sum_i L\,(V_i^T, V_i^0) \ln\left(\frac{X_{k,i}^T}{X_{k,i}^0}\right)$$

$$= \sum i \frac{V_i^T - V_i^0}{(\ln V_i^T - \ln V_i^0)} \ln\frac{(X_{k,i}^T)}{(X_{k,i}^0)}) \quad (5)$$

Where $L(a, b) = (a - b) / (lna - lnb)$ is the logarithmic mean of *a* and *b*, and $L(a, b) = a$ (Ang B.W., 2004).

In this study, the components of gas export revenue - in our sample (MENA countries) – are the export price, market share, market structure and the total demand of the world. Thus, the revenues that any country of our sample would gain, will identify through these factors.

By applying the equation (6) will calculate the components of gas export revenue for each country in our sample, and then will apply the logarithmic mean Divisia index (LMDI) approach which is represented by equation (5) to calculate and analysis the effect change of the gas export revenue components or factors.

$$REV = \sum_{j} p_{ij} \frac{EXP_{ij}}{W_j} \frac{W_j}{W} W \qquad (6)$$

Pij: average price of exported country *i* to imported market *j*, *EXPij*: export of country *i* in regional market *j* (Volume), *Wj:* total demand (Total export) of regional market *j* (Volume), and *W:* World total demand (Total export).

Equation (6) identifies four drivers of gas revenue. The first term is the average export price ($/mmbtu in constant 2005) of each country into each market captures the gas export price factor. The second term is the gas export volume of the country to the total gas demand of the market captures market share factor. The third term is the total gas demand of the market to the total demand of world captures market structure factor. The fourth term is the total demand of the world captures the total demand factor.

Accordingly,

Gas Revenue = (price factor) (market share factor) (market structure factor) (Total demand factor) (7)

Thus, change of these factors or change some of them led to change of the gas export revenue in each country. This study applies the Logarithmic Mean

Divisia Index (LMDI) methodology to decompose the change of these factors and its influences on the gas export revenue.

Thus, change of gas export revenue = (change of export price) + (change of market share) + (change of market structure) + (change of the total demand); so the final decomposition structure of the gas export revenue could be as the following:

$$\Delta \mathbf{R}\text{tot} = (\Delta \mathbf{P}\textit{effect}) + (\Delta \mathbf{M}\text{sh}.\textit{effect}) + (\Delta \mathbf{M}\text{st}.\textit{effect}) + (\Delta \mathbf{D}\textit{effect}) \quad (8)$$

To return to the equation (5), we can calculate the change of price effect, the change of market share effect, the change of market structure effect and the change of the total demand effect as the following:

$$\Delta \mathrm{Vx_k} = \sum i \frac{V_i^T - V_i^0}{(\ln V_i^T - \ln V_i^0)} \ln \frac{(X_{k,i}^T)}{(X_{k,i}^0)}) \quad (5)$$

$$\Delta \mathrm{Vx_k} = \sum i \frac{R_i^T - R_i^0}{(\ln R_i^T - \ln R_i^0)} \ln \frac{(X_{k,i}^T)}{(X_{k,i}^0)}) \quad (5.1)$$

$$\Delta \mathrm{Vx_k} = \sum_i Wi * \ln \frac{(X_{k,i}^T)}{(X_{k,i}^0)}) \quad (5.2)$$

$$\Delta \mathbf{P}\textit{effect} = \sum_i Wi * \ln(\frac{\mathrm{Pt}}{\mathrm{P0}}) \quad (5.3)$$

$$\Delta \mathbf{M}\text{sh}.\textit{effect} = \sum_i Wi * \ln(\frac{\mathrm{Msh.t}}{\mathrm{Msh.0}}) \quad (5.4)$$

$$\Delta \mathbf{M}\text{st}.\textit{effect} = \sum_i Wi * \ln(\frac{\mathrm{Mst.t}}{\mathrm{Mst.0}}) \quad (5.5)$$

$$\Delta \mathbf{D}\textit{effect} = \sum_i Wi * \ln(\frac{\mathrm{Dt}}{\mathrm{D0}}) \quad (5.6)$$

$$\mathrm{Wi} = \frac{R_i^T - R_i^0}{\ln R_i^T - \ln R_i^0} \text{ Log mean weight} \quad (5.7)$$

Therefore, the change of the gas export price factor during 2004-2013, will be calculated based on equation (5.3), change of the gas market share during the same period will be calculated based on equation (5.4), change of the market

structure during the same period will be calculated based on equation (5.5), and change of the total demand of the world in the same period will be calculated based on equation (5.6). So, changing of any factor led to changing in the gas export revenue of each MENA countries. Chapter (VI) highlights and discusses the influences of these factor in detail.

Chapter 6. Recent Trends of Gas Export Revenue Factors

6.1 A glance on global gas markets

With the energy supply situation becoming tenser and climate change issues becoming increasingly severe, natural gas, as a type of the clean energy, has become an important component of national energy strategies for improving energy supply security and reducing carbon dioxide emissions. Especially, in recent years, the rise of the US shale gas revolution has caused widespread concerns in countries that produce and consume natural gas, which will likely drive the global energy market into the natural gas era in the future and have a profound impact on the global energy market and the natural gas trade pattern. At present, due to limitations in the types of transportation (pipelines and liquefied natural gas (LNG)), the global natural gas market has not been unified into an international market like the international crude oil market. Regionalization has become the most prominent feature for the global natural gas market, which is mainly divided into three major distinct regional markets: the North American market, the European market and the Asian market. Therefore, great differences in both the market supply–demand situation and the pricing mechanisms in these three regional markets create a realistic need for more research (Ji, Geng and Fan, 2014).

Compared with the relatively flexible and free form of the oil trade, the liquidity of the natural gas trade is restricted by the market structure of the regional

natural gas trade and is affected by the configuration of natural gas. First, the pattern of the natural gas market and the pattern of natural gas trade are closely related. Due to the different price standards that the different regional markets are based on, the international natural gas market is divided into three major, distinct regional markets: North America, Europe and Asia. In North America, there is a competitive market system, and the market controls risk through cash and derivatives markets; in the European market, the price is mainly based on those of competing energy sources, such as oil, and most of the trade is based on long-term contracts; natural gas trade in the Asia-Pacific region is priced mainly through oil indexation and is also based on long-term contracts. These different kinds of price formation mechanisms make LNG prices in Europe and Asia higher than the ones in North America (Neumann A., 2009 in Geng, et al., 2014). Second, there are two kinds of natural gas trade: pipeline gas trade and LNG trade, and each of these two trade forms has different characteristic. For a long time, due to being restricted by the configuration of natural gas, the natural gas trade was mainly conducted via pipeline, and the scope of trade and trade bodies were greatly hampered by this form of trade (Dieckhöner, et al., 2013). However, the emergence of LNG trade has greatly increased the flexibility and mobility of the international natural gas trade. With the increase of LNG trade, the pattern of international natural gas trade is bound to change, and the evolution of the natural gas trade will have an important impact on gas-exporting countries and importing countries. The natural gas market is the carrier of the natural gas trade, and the relationships between the different regional markets have a significant impact on the formation of international natural gas trade patterns. Therefore, this paper began the study from the two perspectives: the volume and prices of the

natural gas trade. This paper investigates the complex characteristics of natural gas trade pattern, its dynamic evolution and the relationship between the evolution of the international gas market structure and the evolution of the international gas trade in order to understand the distribution mode of the natural gas trade and the structural market characteristics of natural gas. It has very important practical significance for natural gas trading countries in terms of mastering international trade law and adjusting natural gas trade strategies in order to protect the supply security of natural gas.

6.1.1 American market

American market is one of the important natural gas markets, and consists of some importing and exporting countries. The most importing countries of natural gas are: Argentina, Brazil, Canada, Chile, Mexico and United States, and all of MENA' gas exports to American market purchased by the aforementioned counties. United States dominates this market, where it has been imported around 55% of MENA exports in 2011 (IEA, 2012). Figure 13 presents that the quantities of MENA gas exports to American market are almost steady during the entire period.

6.1.2 Asian market

Propelled in part by rising awareness of environmental issues, natural gas consumption is growing strongly in the Asia-Pacific region; while annual world growth averaged 2.7% over the ten years from 1997 to 2007, consumption in the region soared 5.9% (Miyamoto and Ishiguro, 2009).

Asia's share of global demand for natural gas has increased from 20% in 2004 to 26% in 2013 (Author calculations), and the overall consumption has nearly doubled. At the same time, there is a growing gap between regional natural gas demand and supply, with increasing reliance on imports. While a number of countries in the Asia-Pacific region - Australia, Brunei, Indonesia, Malaysia and Myanmar - are important exporters, a number of major economies - Japan, China, South Korea, India, Taiwan, Singapore and Thailand - are becoming increasingly reliant on natural gas imports. For example, India began importing LNG in 2004 and China in 2006. Although a large share of these imports is supplied from within the region, increasingly they are sourced from non-regional exporters (Vivoda V. 2014). Asian market import about 107.52 billion cubic meter (53% of total exports of MENA, 40% of total demand of Asian market) from MENA countries in 2013 (BP, 2014 and author calculations), Figure 12 shows that more than 50% of Asian market demand come from MENA region.

All the gas exports to this market delivers as LNG form, where in 2013, Asian states imported 75% of internationally traded LNG, but only 8% of piped gas (Viadom Vivoda, 2014), and about 70% of the exports go to Japan and South Korea (IEA, 2012). Figure 13 presents that the MENA' gas is witnessing rapid development in the Asian market during 2009-2013.

6.1.3 European market

European region dependence heavily on natural gas in many sectors for several considerations such as energy security, energy mix and environmental issues. Accordingly, European market witnessed a gradually increasing in natural gas

demand during the 20th century, therefore European countries sought to cover their gas demand through signing purchase contracts with several natural gas production countries, and MENA countries among of this production countries. According to the purchase contracts between European countries (demanding side) and MENA countries (supplying side), market share of MENA' gas is witnessed significant increasing in European market (Figure 13). Algeria is the second supplier of natural gas to the European market after Russia (see section 5.3.1.)

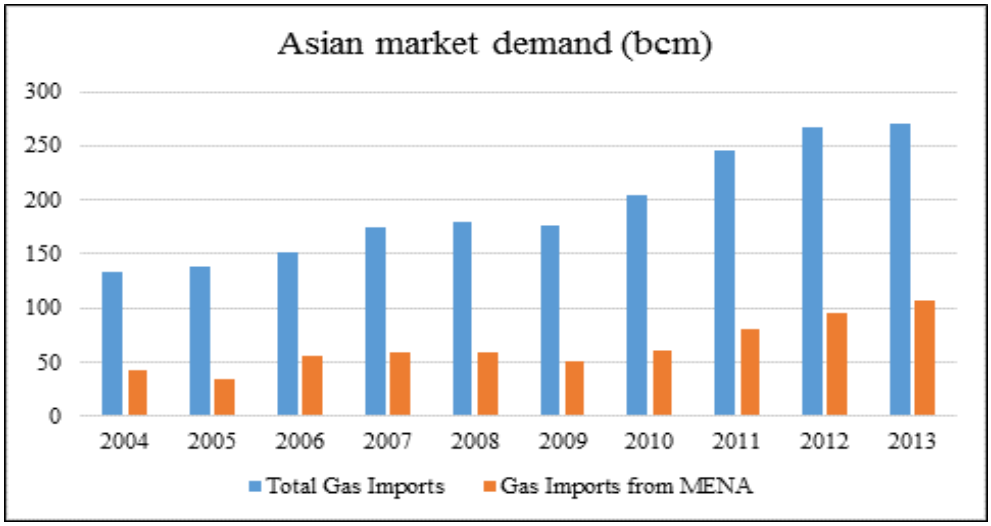


Figure 12 Demand of Asian market and MENA' share in this demand.

Data source: IEA, 2012, Bp, 2014, and UN Comtrade, 2004-2006

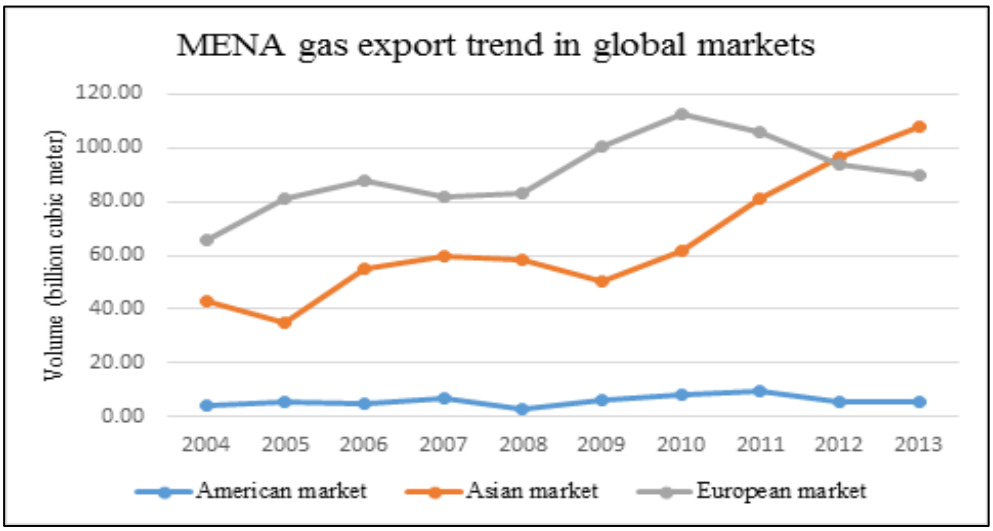


Figure 13 Market share of MENA' gas in the global markets.

Data source: IEA, 2012, Bp, 2014, and UN Comtrade, 2004-2006

6.2 Gas export price factor

The price of natural gas is of significant economic interest for various stakeholders. Natural gas not only plays a crucial role as a primary fuel in the residential and commercial heating market but also serves as an important input for industrial applications and electricity generation.

The demand and supply process of natural gas in the global market plays an important role in the gas export price determination. For instance, the lack of energy sources in conjunction with the growth of the heavy industries in the Asia-Pacific countries (Asian market) led to an increase in the demand for natural gas for use as fuel and energy, which drive these industries. As for the European market, based on the Kyoto Protocol, the European countries committed to slowing climate change and to reducing their gas emissions. These issues play an important role in

increasing the natural-gas demand in the European market. In the case of the American market, the factors driving the natural-gas demand are industrial growth, climate change, and seasonal weather (summer and winter). These factors are also significant factors indirectly affecting the gas export price determination. That is, the decision makers negotiate with the suppliers with regard to the price based on their commitments in relation to such factors. The volatility of the gas export price in each market for each country is due to the changes in these factors (indirect factors), along with market regulation, competition levels, energy security, transport costs, and short/long-term contracts, among others.

Figure 14 shows the variations in gas prices among the MENA countries. The year 2008 offered very different trends between Yemen on one hand and the other MENA countries on the other. In that year, Yemen had no gas exports and even imported some quantities of natural gas from its neighboring countries to cover the increase in the domestic demand due to the opening of a new gas-fired power plant. All the MENA countries, except Yemen, witnessed a boom in gas export prices in 2008, which implies that the global financial crisis did not lower the gas prices in these countries. On the contrary, an obvious increase in the prices occurred in this period. Yemen led the group in terms of gas export price in 2005-2006 (2007 was not included because the exports in that year went to Ethiopia and Somalia, which were not among the three global markets highlighted in this study). In 2009, Yemen exported the first cargo from its new LNG plant, but its gas export price became the lowest among all the MENA countries (see Figure 14).

Gas export revenue variation is sometimes related to gas export price variation. Figure 15 shows that there was an increase in gas export price in 2008 in

all the MENA countries, except Yemen, while there was a significant drop in gas export price in 2009 in Yemen in particular and in all the MENA countries in general.

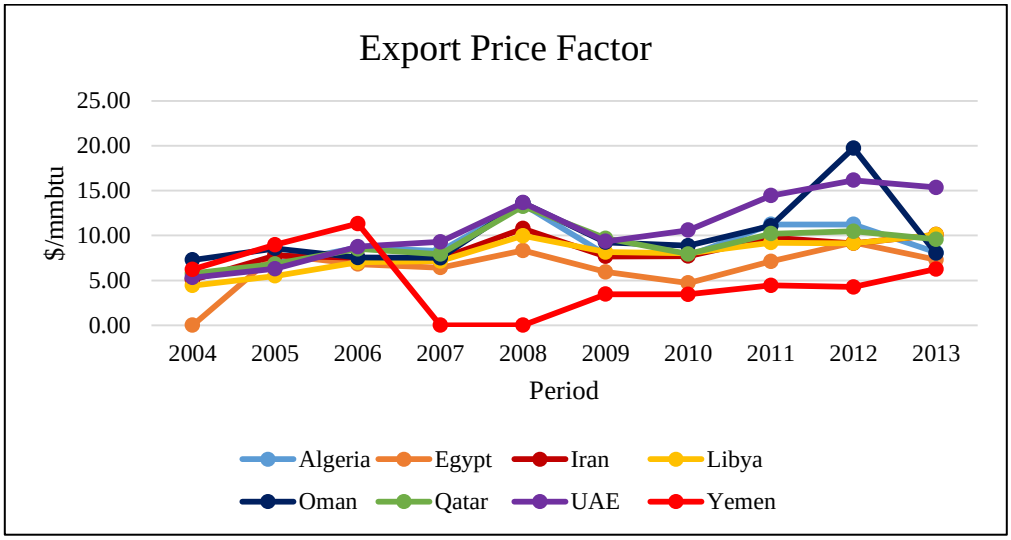
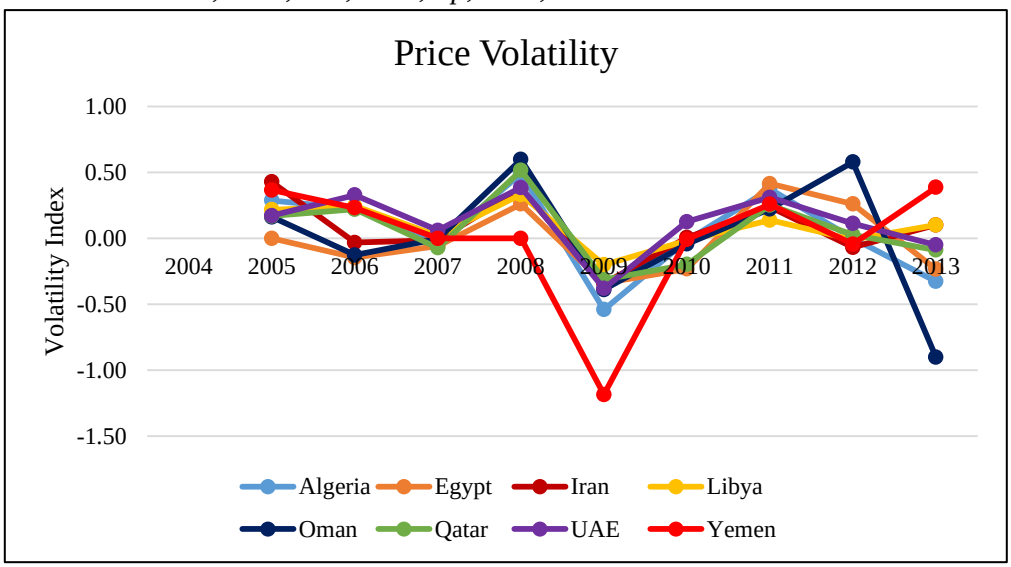


Figure 14. Gas export price of MENA countries.
Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN



Comtrade, 2004-2006

Figure 15 The price volatility index of gas export price of MENA countries.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

6.3 Market share factor

The market share was calculated annually using equation (6), where the gas exports of the MENA countries were aggregated annually, as with the demands of the global markets. Figure 16 presents the total market share of the MENA gas exports in the global markets in 2004-2013.

Yemen showed a remarkable increase in market share in 2009-2013 due to the opening therein, towards the end of 2009, of the first LNG export facility in the country, with an export capacity of 6.7 million tons per annum (mtpa). The new LNG export facility, the biggest-ever industrial project in the country, plays a key role in Yemen's natural-gas industry and marketing.

Qatar and Algeria dominate the picture in terms of gas exports and market share, but the two countries showed different trends in the periods covered by this study. Algeria and Qatar showed the same behavior in 2005, but thereafter, Algeria experienced a remarkable decline while Qatar experienced remarkable growth in terms of its share of gas exports. Algeria and Qatar were affected by the global financial crisis in 2007-2008, which can be clearly seen in Figure 16. Qatar's market share dropped from 23% in 2006 to 20% in 2007 and 2008 while Algeria's market share dropped from 14% in 2006 to 11% in 2008. After 2008, Qatar started to recover its market share, which reached 35% at the end of 2013. Qatar has witnessed a remarkable increase in market share from 2009 to the present, which is attributed to the increase in the country's production from North Field, one of the largest non-associated natural-gas fields in the world, and to the addition of five new LNG facilities in 2009 and 2010. Other new facilities (e.g., Qatargas IV Train 7) were

established in January 2011, with a capacity of 10.76 billion cubic meters per year (bcm/y).

In 2006-2009, almost all the MENA countries (except Yemen, Qatar, and Algeria) showed a steady trend, with some differences in their average market share ratios: 6% for Egypt, 1% for Iran, 2% for Libya, 7% for Oman, and 4% for UAE.

All the MENA countries, except Algeria and Qatar, had almost the same market share trends in 2010-2013. This can be seen in the average market shares of the MENA countries in such period: 5, 4, 3, 3, 2, and 1% for Oman, Yemen, Egypt, UAE, Iran, and Libya, respectively. The political events that transpired in the Arab world in 2010-2011 (Arab Spring) marked a watershed in the history of the MENA region. These events directly affected the natural-gas industries and marketing efforts of the MENA countries in general and of Egypt and Libya in particular. Even though Yemen experienced a broad uprising in 2011, which led to a change in the country's political system, unlike Libya and Egypt, Yemen's natural-gas industry and marketing were not affected. On the contrary, in 2012, Yemen experienced a decrease in market share due to some acts of sabotage that were staged against the country's gas transport pipeline, which led to the cessation of LNG production for six months as well as the stopping of the project by some of its operators due to the expansion of the uprising and protests in all the governorates of the country.

In 2013, Yemen experienced stability and calm, which prompted the LNG project to increase its gas production and exports. This led to an increase in market share, which reached the same level as in 2011 (Figure 16).

The political unrest (Arab Spring) in Yemen in particular and in all the MENA countries in general played a key role in determining the gas exports and market shares in 2010-2013, when the expansion of the uprising prompted the foreign companies conducting business in the region to suspend their operations in the areas where there was unrest, and to lay off some of their workers. Overall, the political unrest led to a rise in the economic and social issues in Yemen and the Arab Spring countries, which are still suffering from such issues until today.

A brief summary and statistics of the gas exports and market share of each MENA country will be given in the following sections.

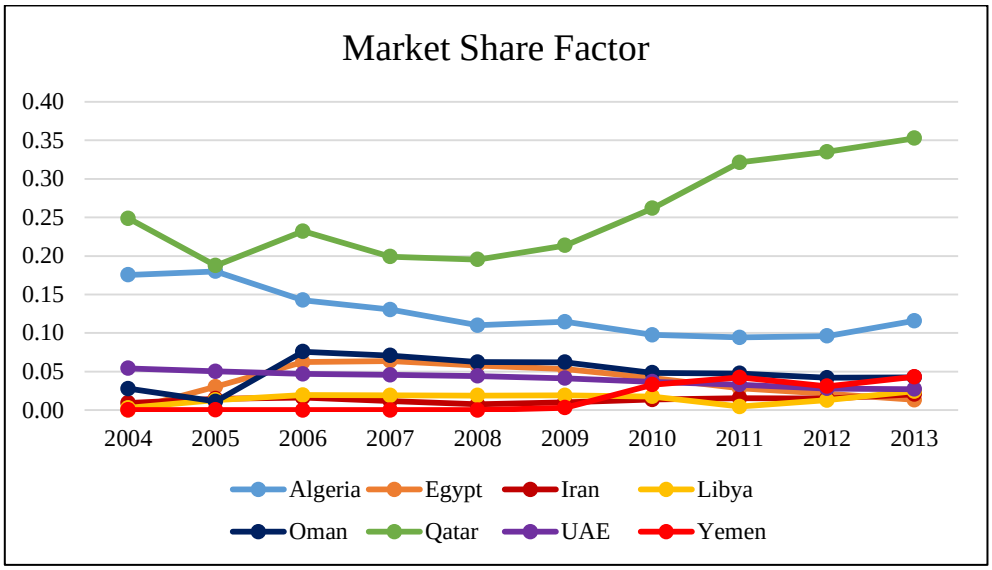


Figure 16 Market share of MENA countries in the global markets.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

6.3.1 People's Democratic Republic of Algeria

Algeria is the leading natural gas producer, the second-largest natural gas supplier to European market outside of the region after Russia. More than 95% of Algerian natural gas exports were sent to the European market in 2013. Around 65% of Algerian exports to European market in 2013 sent via pipeline to Italy and Spain mainly.

According to IEA and BP - Statistical data that published 2014, Algeria's natural gas exports declined from 60.66 billion cubic meter in 2004 to 39.7 billion cubic meter in 2013, which means decrease the exports to about 35% in 2013 from what it was in 2004 (Table 4).

Overall, Algeria's natural gas exports have gradually declined over the past decade, as gross production decreases and domestic consumption increases. Despite new export LNG infrastructure and increased capacity, Algeria's LNG exports have declined over the past few years. Algeria is facing pressure to boost natural gas output with new projects to meet growing domestic demand and to fulfill long-term contractual obligations to export natural gas to Europe.

Table 4 Algeria gas exports (billion cubic meter)

Region	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
America	3.62	3.16	0.52	2.27	0	0	0.17	0	0.05	0.1
Asia	0.25	0.89	0.71	2.69	1.91	0.32	0.16	0.36	0.99	1.3
Europe	56.8	63.3	58.2	53	54.7	58.8	54.3	49.1	46.3	38.3
Total	60.7	67.3	59.5	57.6	56.7	59.1	55.2	49.4	47.3	39.7

Source: IEA, 2012 and 2013, BP, 2013 &2014.

6.3.2 Arab Republic of Egypt

Egypt is the third highest in natural gas reserves in Africa after Nigeria and Algeria. Natural gas exports, had been rising rapidly during 2005-2008, with the completion of the first stage of the Arab Gas Pipeline (AGP) linking Egypt to Jordan and the startup of LNG production in 2004. However, after 2006 exports began to level off, and then the exports fell steeply during 2009-2013 due to increase the domestic consumption and decrease the production.

The peak of gas exports was in 2007, while the least exports was in 2013 (Table 5). The political unrest that happened during 2010-2013 in Egypt contributed significantly in the decline of natural gas beside to increase the domestic consumption and decrease the production. In 2011 and 2012, gas exports through the AGP were disrupted by repeated sabotage attacks and the amounts sent to Jordan and Israel were substantially curtailed. Growing domestic demand, stagnant

domestic production, and attacks and technical problems at the AGP have all contributed to reduced Egyptian exports of pipeline gas and LNG after 2009.

Table 5 Egypt gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.00	2.36	4.30	4.35	2.83	5.24	2.73	1.24	0.42	0.23
Asia	0.00	0.41	2.96	4.801	5.28	1.04	3.40	3.40	3.75	3.00
Europe	0.00	5.18	8.74	5.425	5.65	6.80	4.62	3.76	2.30	0.40
Total	0.00	7.95	16	14.579	13.77	13.08	10.74	8.39	6.47	3.63

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.3 Islamic Republic of Iran

Iran is the second-largest proved natural gas reserve holder in the world, behind Russia. Iran holds 17% of the world's proved natural gas reserves and more than one-third of OPEC's reserves. Most of the Iranian gas is used locally, additional quantities are imported from Turkmenistan (more than 90% of its imports) to cover the deficit due to the growing demand for energy.

According to International Energy Administration, Iran accounted for less than 1% of global natural gas trade in 2012. Almost all the Iranian gas exports go to the European market (100% go to Turkey). Table 6 presents the quantities of Iranian gas exports to the global markets during 2004-2013.

Despite ambitious plans, Iran has had to cancel or delay LNG projects because of U.S. and EU sanctions that made it impossible to obtain financing and to purchase necessary technology. Given the political constraints, Iran's LNG projects are years away.

Table 6 Iran gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.00	0.00	0.00	0	0	0	0	0	0	0
Asia	0.00	0.48	0.37	0	0	0	0	0	0	0
Europe	3.56	4.62	5.91	6.16	4.113	5.252	7.766	8.19	7.5	8.71
Total	3.56	5.1	6.28	6.16	4.113	5.252	7.766	8.19	7.5	8.71

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.4 State of Libya

In 1971, Libya was the third country in the world, after Algeria and the United States (Alaska), to begin exporting liquefied natural gas (LNG). Typically, the country exports a small amount of LNG to Spain. However, the LNG plant was damaged during the 2011 civil war, and Libya has not exported LNG since early 2011. According to the BP 2013 Statistical Review. Prior to 2012, Libya also exported small volumes in the form of liquefied natural gas (LNG) mainly to Spain.

Libya's capacity to export natural gas increased dramatically after October 2004, when the 370-mile Greenstream pipeline to Italy came online. Table 7. Shows the gas exports to the European market during 2004-2013.

Due to the civil war in 2011 the gas exports via Greenstream were completely suspended for nearly eight months from March 2011 to mid-October 2011, and this led to drop of Libyan gas exports to 2.43 billion cubic meter in 2011 from its peak of 9.98 billion cubic meter in 2010, while the exports recovered in 2012 to 6.50 billion cubic meter.

Table 7 Libya gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Europe	1.13	5.36	8.41	9.98	10.42	9.93	9.98	2.43	6.50	5.20
Total	1.13	5.36	8.41	9.983	10.42	9.93	9.98	2.43	6.50	5.20

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.5 Sultanate of Oman

In 2011, Oman was the 5th largest dry natural gas producer in the Middle East and the 26th largest producer worldwide.

Oman is a member of the Gas Exporting Countries Forum (GECF) and exports natural gas as LNG through its two liquefaction facilities near Sur, in the Gulf of Oman. In 2013, Oman exported approximately 11.6 billion cubic meter of

natural gas, which is roughly 63% of the country's total capacity. The vast majority of Oman's exports go to Asian market especially Japan and South Korea, in 2012 a small amount has exported to China. Oman exported a total of 131 LNG cargoes in 2012, as well as 45 cargoes of NGLs, according to the Middle East Economic Survey. A small quantities of Oman's gas exports go to European market especially to Spain. Table 8. Shows Oman's gas exports to the global markets during 2004-2013.

Table 8 Oman gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asia	3.45	1.36	10.97	12.20	11.11	10.44	9.72	11.62	11.20	11.4
Europe	0.59	0.38	1.27	0.32	0.17	1.42	0.34	0.17	0	0.20
Total	4.04	1.74	12.2	12.5	11.3	11.9	10.1	11.8	11.2	11.6

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.6 State of Qatar

Qatar was the second-largest dry natural gas producer in the Middle East and the fourth-largest producer in the world. With its relatively low domestic energy demand, Qatar is able to export nearly all of its natural gas production. As such,

Qatar has been the world's leading exporter of LNG since 2006, and is a member of the Gas Exporting Countries Forum (GECF).

Qatar is the world's second-largest exporter of natural gas, where in 2013 the gas exports of Qatar reached to 101.4 billion cubic meter (Table 9). Most of Qatar's exports go to Asian markets (Japan, India, Korea,…etc.) and this gas is exported in the form of LNG, while the country sends a small amount of natural gas through the Dolphin Pipeline to the United Arab Emirates (UAE) and Oman. Historically, most of Qatar's LNG exports were part of long-term, oil-indexed contracts, but over the past few years the country began to shift to more short-term contracts and spot market sales. In 2012, Qatar exported over one quarter of its LNG as short-term or spot market sales (19.9 MMt according to QNB), accounting for more than a third of short-term and spot-market sales in the world.

Table 9 Qatar gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.35	0.08	0.00	0.52	0.16	0.67	3.46	5.72	4.01	3.93
Asia	31.9	25.1	33.2	31.8	32.2	30.7	36.6	51.7	66.6	74.8
Europe	3.19	1.88	5.13	6.88	7.90	18.2	34.6	40.9	30.90	22.70
Total	35.41	27.1	38.34	39.2	40.3	49.51	74.71	98.3	101.5	101.4

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.7 United Arab Emirates

In 1977, the UAE became the first country in the Middle East to export LNG, and has exported more than 250 billion cubic feet of LNG annually, almost exclusively to Asia, where sending its first load to the Tokyo Power Company as part of a long-term supply agreement. The UAE signed a second contract in 1990 to double LNG exports to Japan, and in 1994, a third LNG train began operation to help fulfill the terms of the agreement.

In 2013 gas exports of the United Arab Emirates reached to 7.40 billion cubic meter, and approximately all natural gas exports have been exported in LNG form cargoes and all of export cargoes went to Japan.

With planned expansion at the terminal at Das Island and the country's new focus on developing its vast natural gas reserves, the UAE could experience export growth in the short to medium term.

Table 10 presents the gas exports of United Arab Emirates during 2004-2013 to the global markets, and shows that gas exports almost steady during the whole period.

Table 10 UAE gas exports (billion cubic meter)

Region	2004	2005	2005	2007	2008	2009	2010	2011	2012	2013
America	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Asia	7.18	6.83	7.08	7.95	7.93	7.29	7.46	8.15	7.50	7.40
Europe	0.20	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.38	7.14	7.08	7.95	7.93	7.29	7.49	8.15	7.50	7.40

Source: International Energy Agency (IEA), 2012 and 2013, BP-statistical review of world energy 2013 &2014.

6.3.8 Republic of Yemen

According to the ministry of oil and minerals statistics, Yemen held 16.9 trillion cubic feet (Tcf) of proved reserves of the natural gas. The larger field of natural gas deposits is located in the Marib-Al Jawf basin, where there may be about 18 Tcf in recoverable volumes of natural gas.

Before launching gas export process in November 2009, Yemen was re-injected nearly all of the natural gas in order to enhance the oil production in Marib area. In 2009, the Yemen witnessed the opening of Yemen LNG facility and the country began to divert the dry natural gas away from the oil fields and toward domestic and international consumers.

After the opening the liquefaction natural gas project in 2009, the domestic consumption of natural gas in Yemen increased gradually especially in the electricity generation sector, for instance, the first Marib gas turbine power station (341 MW) access to the service in almost 2009, and the second Marib gas turbine

power station (400 MW) is supposed to access to the service in the mid of 2014. Despite this effort, in 2011 Yemen still re-injected a significant quantities of natural gas in order to enhance the oil production, therefore Yemen is represented the ninth country in the world in this regards (Figure 17).

With the sharp decline in the oil production, Yemen became in dire need of increase their production from the natural gas to meet the domestic demand and to support the state budget of the foreign exchange. In this regards, Yemen must be increase the exploration processes in the onshore and offshore area and reduce the re-injected quantities of natural gas and use it for LNG production. The current political situation of Yemen in particular and MENA countries in general affected on the oil and gas sector and prompted some of the foreign companies that work in the sector, to suspend the activities in some areas which led to decrease the production and exports as well.

Yemen has never been a natural gas importer, and, until 2009, never consumed natural gas domestically. Since 2009, Yemen's natural gas consumption has grown, but not nearly as fast as its natural gas exports. Yemen's consumption of natural gas remains limited, and base on published data by EIA in 2013, peaking at just 34 billion cubic feet in 2010. In contrast, Yemen exported more than 11 billion cubic meter of LNG in 2013 (Table 11), representing over 90 % of its total dry natural gas production that year. According to IHS Global Insight, Yemen LNG provided approximately 3% of global LNG volumes as of early 2013.

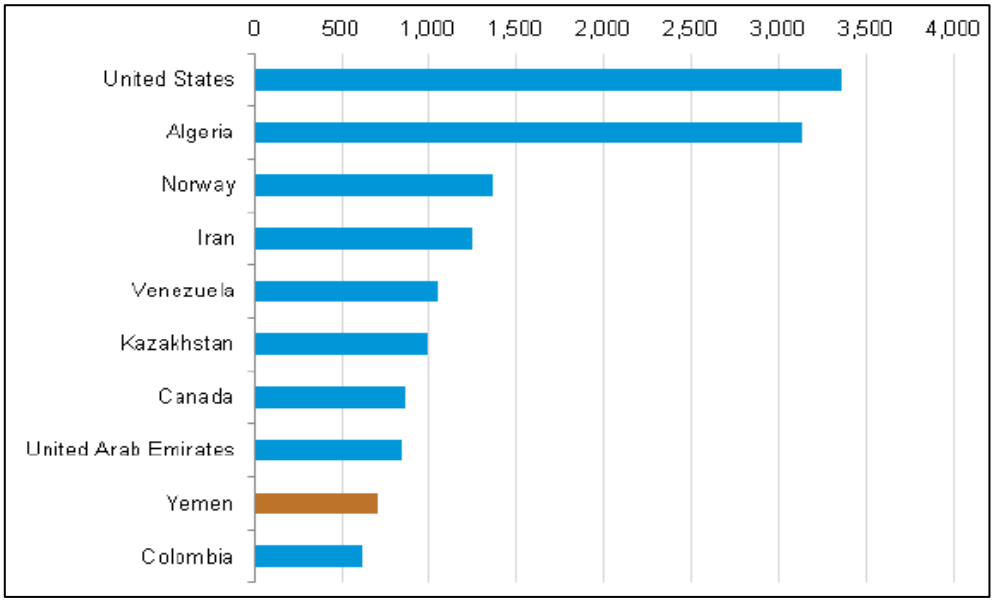


Figure 17 Top 10 natural gas re-injecting countries, 2011.

Source: EIA, 2013

French Company Total operates the 6.7 million ton per year Yemen LNG facility, and most of the exported LNG is under contract to GDF Suez, Total, and Korean Gas (KOGAS) Companies. The volumes purchased by GDF Suez and Total Companies are non-dedicated- meaning that they can go to any willing destination market- while the volumes contracted to KOGAS go to South Korea. In late of 2012, Yemen LNG renegotiated its contracts with GDF Suez and Total Companies, claiming that the prices it received for LNG were too far below prices elsewhere in the international market. In August 2013, Yemen's government began discussions with the government of South Korea over changing the KOGAS contract price. Yemen LNG is also in discussions with Turkey's Petroleum Pipeline Corporation (BOTAS) on a deal that could send up to 35 Bcf of LNG per year to Turkey.

Table 11 presents the gas exports of Yemen to the global markets during 2004-2013 in billion cubic meter.

Although the export process of Yemeni gas began in 2009, and the exported quantities are still limited, but it is noticeable that the Yemeni gas has reached all the global markets with varying quantities. Yemen LNG provided approximately 2% to 4% into the Asian market from its total demand, 1% to 2% to the American market from its total demand, and less than 0.5% to 1% to the European market from its demand of gas during 2009-2013 respectively.

Table 11Yemen gas exports (billion cubic meter)

Region	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
America	0.00	0.00	0.00	0.00	0.00	0.092	1.896	2.612	1.385	1.228
Asia	0.00	0.00	0.00	0.00	0.00	0.368	4.074	5.996	6.044	9.607
Europe	0.08	0.05	0.02	0.00	0.00	0.00	0.766	1.273	0.00	0.203
Total	0.08	0.05	0.02	0.00	0.00	0.46	6.736	9.881	7.429	11.038

Source: Yemen LNG Co.

6.4 Market structure factor

The market structure plays an important role in determining the gas export revenues of the MENA countries. This factor works based on the nature of the global markets of natural gas (number of buyers and sellers, competition levels, regulations, etc.), and on the demand conditions.

In this study, market structure was defined, based on equation (6), as the ratio of the global market demand conditions to the total demand. The market structure reveals that there are different demand conditions among all the global markets, but that all the global markets have high demands for MENA gas. The Asian and European markets, however, show greater tendencies to import MENA gas. The Asian market mainly relies on the Middle East LNG to cover much of its demand while the European market relies on the North African gas (Algeria is the second largest supplier of natural gas to the European market, after Russia; also, all the Libyan gas exports go to the European market) to cover its demand; this relation can also be clearly seen from the market share factor.

The analysis of the market structure factor showed that the European market is the largest global market in terms of gas demand, due to its commitment, based on the Kyoto Protocol (UNFCCC, 1998), to mitigate its greenhouse gas (particularly carbon dioxide) emissions. Natural gas has a lower carbon content compared to coal and oil (about 50% lower than coal and 25% lower than oil), which makes gas a favored fuel from an environmental perspective (IPCC, 1995). Besides environmental reasons, another important factor boosting natural-gas usage is the longer-term natural-gas supply situation (Rudolf et al., 2006). Figure 18 shows that

the market structure factor reached approximately 60% in the European market, 20% in the American market, and 20% in the Asian market.

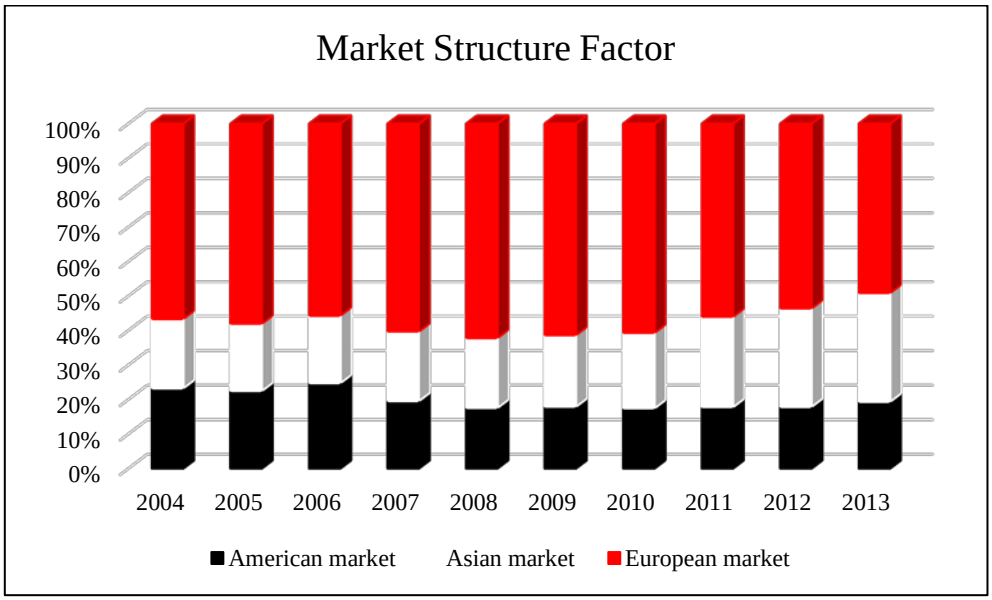


Figure 18 Market structure of natural gas.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

6.5 Total demand factor

Total demand is the main factor that affects all the above factors, notably gas export revenue, and it is affected by some natural and artificial conditions and activities, such as population and economic growth as well as changes in policies, legislations, weather, and climate.

In this study, total demand was defined, based on equation (6), as the world's total natural-gas demand. The total natural-gas demand of the world will change if the total natural-gas demand of any market changes, and vice versa. Therefore, a change in this factor will directly affect the main global natural-gas

markets (the Americas, Asia, and Europe), which will in turn affect the natural-gas-producing and exporting countries.

Figure 19 shows that the total natural-gas demand in the second period investigated in this study (2007-2009) exhibited an opposite trend compared to the other periods. The change in the total natural-gas demand in the second study period can be attributed to the recession in the global markets in such period due to the global financial crisis, and also to the change in some policies related to the environment, such as in the European market, which pays more attention to renewable energies than to conventional energies. The change in the total natural-gas demand led to a change in the other factors investigated in this study in general, and in the gas export revenues of the MENA countries in particular. In the entire study period, the total natural-gas demand witnessed a significant increase.

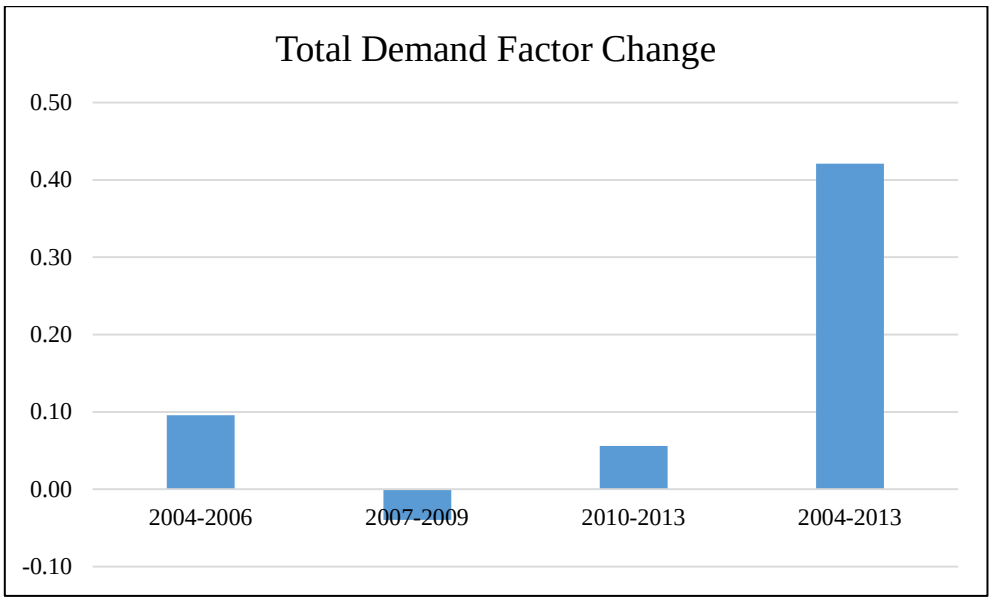


Figure 19 Change of the total demand factor.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

6.6 Gas export revenue

The variances in gas export revenue among the MENA countries are attributed to the changes in the gas export revenues or to the gas export revenue components' effects (gas export price effect, market share effect, market structure effect, and total demand effect). Chapter 7 analyzes the factors influencing gas export revenue and determines the factor(s) that influence the gas export revenues of the MENA countries the most.

To understand the behavior change, the whole study period (2004-2013) will be divided into three periods (2004-2006, 2007-2009, and 2010-2013), as in Figure (19), and the influence of each factor on the revenue in each of such periods as well as in the entire study period (2004-2013) will be analyzed. After the calculation and analysis of the gas export revenue factors in the previous section, this section highlights the gas export revenues that were gained by the MENA countries from the three main global markets during the study period. Gas export revenue showed different trends in the whole study period in the MENA countries. In the first study period (2004-2006), the gas export revenue witnessed a remarkable increase, which continued until the middle of the second study period for all the MENA countries. In the second study period (2007-2009), despite the occurrence of the global financial crisis in this period, all the MENA countries, except Iran and Yemen, achieved a qualitative leap in gas revenue due to the high gas export price especially in 2008 compared with that in all the previous years and in some of the following years. In the case of Yemen, the export activity started towards the end of 2009; as such, no change occurred between the base and end years of the second study period. This

period represented a significant stage for Qatar and Algeria as before this period, the gas export revenues of the two countries witnessed remarkable growth while towards the end of this period (2009), a significant divergence between them occurred, as can been seen in Figure 20. From the middle of the second study period to the beginning of the third study period, the rest of the MENA countries experienced a drop in gas export revenue.

In the third study period (2010-2013), Qatar experienced significant growth in gas export revenue, with the peak revenue reached in 2012. All the other MENA countries experienced a steady trend in gas export revenue (Figure 20). Egypt, Libya, and Yemen suffered a bit in this period due to the protests and demonstrations that happened in such countries in 2010-2011 (Arab Spring). Iran did not show a significant gas export revenue value in such period because most of the Iranian gas then was used to cover the domestic demand, and because Iran had no infrastructure in place for exporting LNG.

6.6.1 Revenue gained from American market

There is much less risk to the United States from MENA-related disruptions of natural gas supply. The United States imports about 16% of the natural gas it consumes, nearly all via pipeline from Canada. In 2009, MENA liquefied natural gas (LNG) accounted for less than 1% of U.S. Ratner, M. (2011). The average of MENA exports to American market about 6 billion cubic meter per year. Figure 21, shows that there are a significant variation in the revenue between MENA countries, where the first and second periods witnessed a decrease in the revenue, while the third period witnessed a significant growing for Qatar and Yemen in this market. The rest

countries don't offer any revenue because have no gas exports into the American market.

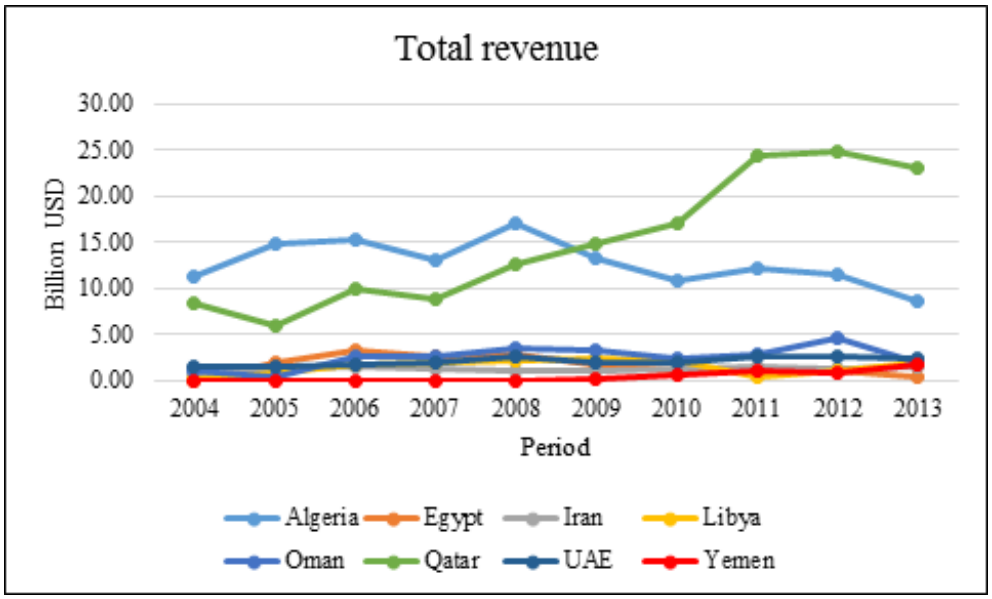


Figure 20 Total revenue of gas export of MENA countries.
Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

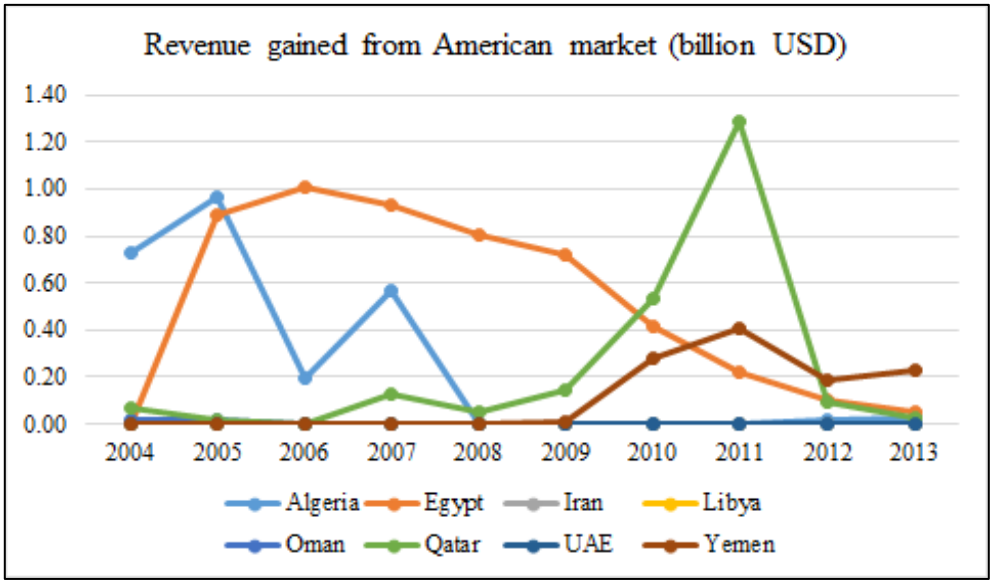


Figure 21 Revenue of gas export from American market.
Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

6.6.2 Revenue gained from Asian market

Natural gas has become an increasingly valuable resource and a global commodity. The demand for it has significantly increased. Japan, Korea and Taiwan heavily rely on liquefied natural gas (LNG) imports for their gas supplies from Malaysia, Brunei, Indonesia, Australia and the Middle East (Helen Cabalu, 2010).

Middle east and north Africa region plays an important role in the Asian market in terms of natural gas supply, where provides this market with almost 65 billion cubic meter annually.

Qatar and Yemen play a key role in the gas demand of all Asian market members (Japan, South Korea, China, India, Taiwan, Thailand and Malaysia), but in case of Yemen, more than 60% of its gas are sold in the South Korea market. Oman and United Arab Emirates also play an important role in the gas demand of Asian market, but in the specific countries of this market such as Japan and South Korea.

The calculated gas export revenue of the eight MENA countries show that, the best revenues from Asian market went to Qatar, Oman, UAE and then Yemen and Egypt. The least revenue that gained by Yemen is attributed to the least gas export price of Yemen comparing to all MENA countries (Figure 22).

6.6.3 Revenue gained from European market

European market plays an important role in the total demand of natural gas in the world. This market consumes approximately 60% from the total demand of the world. The highest demand of natural gas in the in the European market can be

attributed to the several economic and environmental issues as we discussed in the previous sections.

Europe is the region most vulnerable to a natural gas shutdown in MENA, particularly from North African countries. The complete cut off by Libya of its natural gas exports, which almost exclusively go to Italy, has contributed to a 12% increase in European spot prices since major protests began.

If supply from Algeria - Europe's third-largest supplier of natural gas behind Russia and Norway - were for some reason reduced or cut off, Europe would be hard-pressed to replace this gas. Ratner, M. (2011).

In terms of gas export revenue, Algeria gains the best revenue followed by Qatar and Libya, while Egypt and Iran have almost the same revenue with a noticed growth in the revenue during 2009-2013 in case of Iran. Yemen occupied the least country in terms of the gas export revenue, because the low price of the gas export (Figure 23).

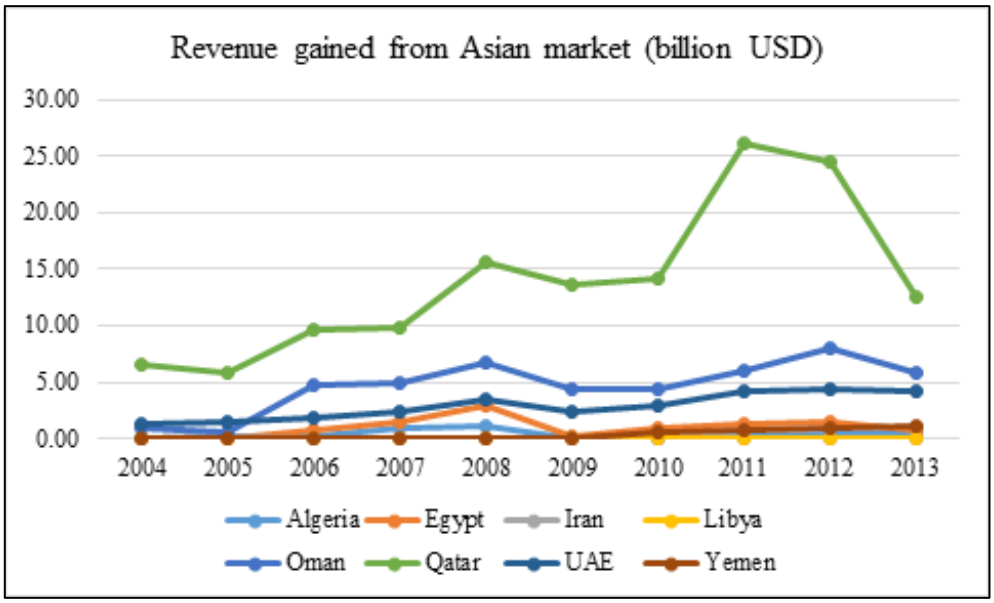


Figure 22 Revenue of gas export from Asian market.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

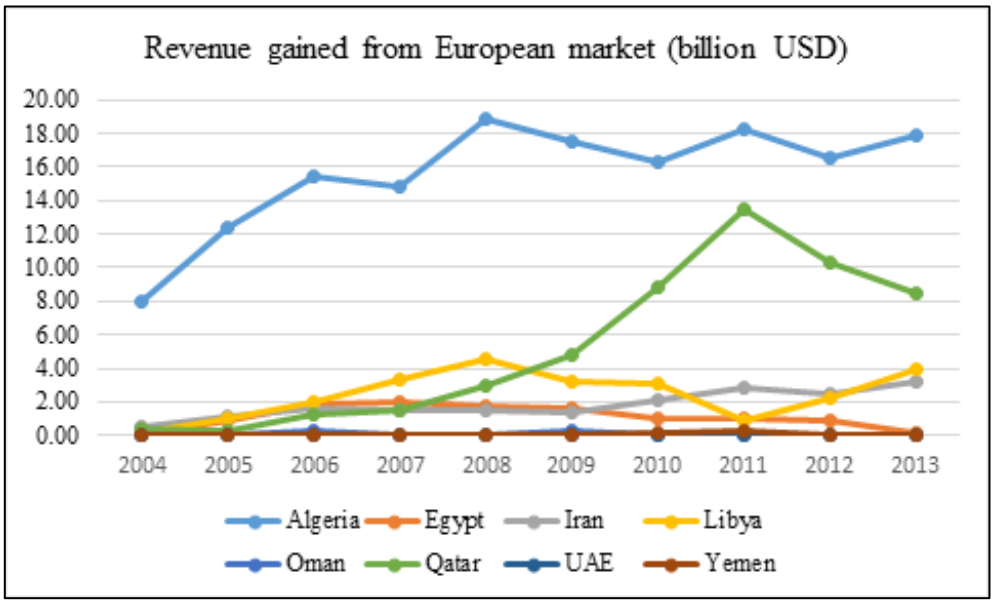


Figure 23 Revenue of gas export from European market.

Data source: IEA, 2012, EIA, 2013, Bp, 2014, and UN Comtrade, 2004-2006

Chapter 7. Decomposition Analysis of Gas Export Revenue Influences

The previous section analyzed and discussed the gas export revenue factors or components, which drove and controlled the gas export revenues of the MENA countries in 2004-2013.

This section addresses in some detail the effects of the changes in the gas export prices, market shares, market structures, and total demands on the gas export revenues of the MENA countries, using the logarithmic mean divisia index (LMDI) method, one of the index decomposition analysis approaches used in energy sector analysis.

Equations (5.3) to (5.6) will be used in this section for calculating the changes in the gas export prices, market shares, market structures, and total demands, and the influence of such changes on the gas export revenues.

The following subsections address in detail the results of the decomposition analysis of the factors influencing gas export revenue.

7.1 Influence of gas export price change on gas export revenue

If the gas export price is considered in isolation from the other factors (keeping the other factors constant), it will be found that the gas export price has the

most dominant influence on the gas export revenue contribution in all the study periods in the MENA countries.

Table 11 shows that in the first study period (2004-2006), Yemen witnessed a very slight increase in gas export price (0.04%) due to the constant price and very limited exports (to only one country) in such period. Algeria and Qatar experienced a remarkable increase in gas export price, 37 and 8%, respectively, which, along with the other factors, contributed to the increase in the total gas export revenue in this period. UAE, Iran, and Libya experienced a slight increase in gas export price while Egypt and Oman experienced a decrease.

In the second study period (2007-2009), Yemen did not record any value for the gas export price as it did not export natural gas at all in this period, and used all its available quantities of natural gas for domestic consumption. Qatar witnessed a significant increase in gas exports, which led to an increase in its gas export revenue from US$8 billion on average in the first study period to more than US$16 billion in the second study period (a more than 100% increase). Even though Oman and Libya witnessed a remarkable increase in gas export price, the changes in their gas export revenues offered a different picture, which means that the other factors (market share, market structure, and total demand) rather than the gas export price play an important role in determining the gas export revenues of these countries. In the case of Algeria and Egypt, both experienced a decrease in gas export price in this period.

In the third study period (2010-2013), Yemen showed a significant increase in gas export price, although Yemen's gas export price is very low compared to those of the other MENA countries. The increase in gas export price in the case of Yemen was due to the opening of a new LNG facility and the increase in gas export

activities. UAE, Egypt, and Iran saw an increase in gas export price in this period while the other MENA countries experienced a decrease.

Overall, in the entire study period, only UAE witnessed a significant increase in gas export price; Oman, Qatar, Yemen, and Algeria witnessed a decrease. Figure 24 presents the gas export prices of the MENA countries in the three individual study periods and in the entire study period.

Table 12 Export Price Effect

ΔP effect (%)				
Countries	**2004-2006**	**2007-2009**	**2010-2013**	**2004-2013**
Algeria	37%	-4%	-39%	-12%
Egypt	-4%	-47%	11%	-18%
Iran	2%	-3%	4%	1%
Libya	1%	32%	-10%	8%
Oman	-3%	56%	-25%	-40%
Qatar	8%	262%	-7%	-26%
UAE	4%	4%	19%	49%
Yemen	0%	-2%	21%	-18%

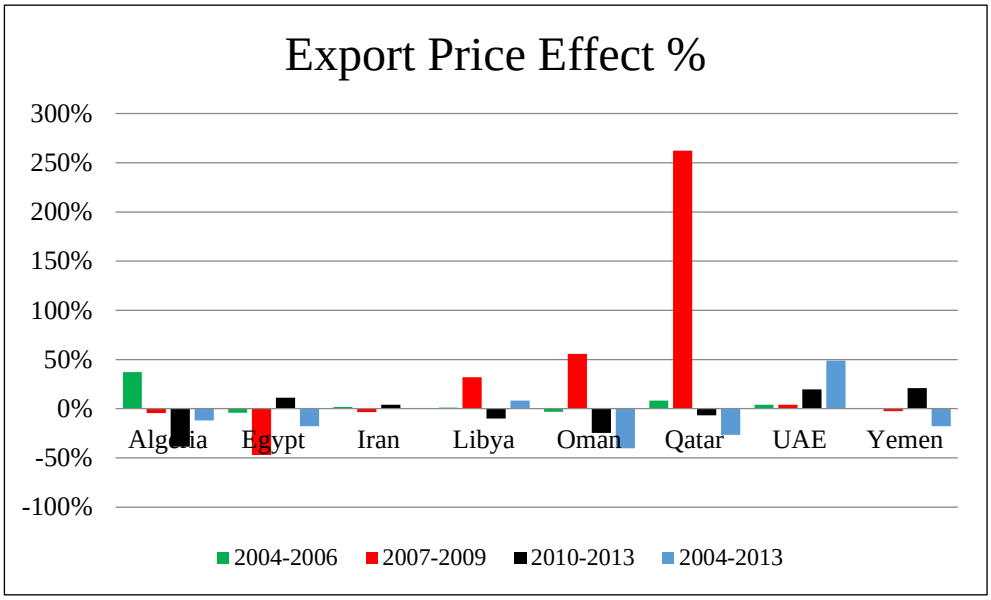


Figure 24 Change of price effect of gas export.

7.2 Influence of market share change on gas export revenue

The market share is the ratio of the gas exports of each MENA country to the total demand of each global mar.

The market share factor has been discussed in detail in chapter (VI). This section discusses the results of the decomposition analysis of the market share factor and its effect on the gas export revenues of the MENA countries. Table 12 and Figure 25 present the results of the decomposition analysis of the market share of MENA gas during 2004-2013.

In the first study period (2004-2006), Yemen showed a very small market share (-0.15%, due to the rounding off to an integer, the value is equal to zero in Table 12) due to its very limited export activities. Egypt, Oman, Libya, and Iran experienced an increase in market share effect while Algeria, Qatar (a major MENA

exporter), and UAE experienced a decrease. Even though Algeria experienced a 24% decrease in the market share effect in this period, it saw an increase in gas export revenue due to the increase in gas export price. Qatar also witnessed a 5% decrease in market share effect, but this is an insignificant effect in terms of gas export revenue because this decrease is not on account of the decrease in gas exports but on account of the increase in the demands of the global markets. As such, the gas export revenue of Qatar was not influenced by the market share.

In the second period (2007-2009), only Qatar and Yemen recoded an increase in the market share due to the opening of new LNG facilities towards the end of 2009, which led to an increase in gas production and exports. Towards the end of 2009, Yemen's natural gas industry witnessed a quantum leap, which led to an increase in the revenue of the oil sector after such sector witnessed stagnation and a big drop in production from 2002. On the contrary, Algeria, Egypt, Oman, UAE, Iran, and Libya recorded a decrease in market share effect due to the decrease in production and the lowered demand in European market in this period with regard to Algerian gas. The decrease in market share effect of the six MENA countries can also be attributed to the global financial crisis (which made the global markets rigid) on one hand and to the increase in domestic consumption in most of the MENA countries on the other.

In the third study period (2010-2013), Yemen witnessed a remarkable increase in the market share effect due to the new expansion of its LNG plant and the fact that plant was being run with an estimated capacity of 6.7 million tons per year. According to HIS Global Insight, Yemen LNG accounted for approximately 3% of global LNG volumes as of early 2013.

Qatar, Algeria, Iran, and Libya, experienced an increase in the market share effect while Egypt, Oman and UAE experienced a decrease (Table 13 and Figure 25). Qatar recorded a higher market share effect in this period than in the previous two periods due to the addition of five LNG trains in 2009-2011. The increase in domestic consumption in Egypt, Oman and UAE led to a decrease in the market share effect and import of extra quantities of natural gas from the neighbors, such as Oman and UAE, which import natural gas from Qatar through dolphin pipeline project.

The remarkable increase in the market share effect of Algeria, Libya and Iran implies that there was an increase in the demand of European market. This is because these countries rely only on the demand of the European market owing to the U.S. embargo on Iranian and Libyan exports.

Overall, the entire study period showed that market share effect recorded high positive values for Qatar and Yemen due to the addition of new LNG facilities, which led to an increase in gas exports. Also, the increase in the market share effect in Libya was due to the increase in production and exports towards the end of the third study period to compensate for the gas export deficit during the political unrest. Algeria recorded a significant decrease in the entire study period due to the decline in its production and the European market recession in the second study period. UAE recorded a decrease in the market share effect due to the increase in the domestic demand. Iran and Oman witnessed a remarkable increase in the entire study period.

Table 13 Market Share Effect

ΔM.sh. effect (%)				
Countries	**2004-2006**	**2007-2009**	**2010-2013**	**2004-2013**
Algeria	-24%	-129%	68%	-165%
Egypt	16%	-29%	-35%	-25%
Iran	5%	-13%	24%	46%
Libya	11%	-1%	-21%	128%
Oman	16%	-29%	-11%	37%
Qatar	-5%	62%	243%	285%
UAE	-2%	-15%	-27%	-62%
Yemen	0%	8%	12%	227%

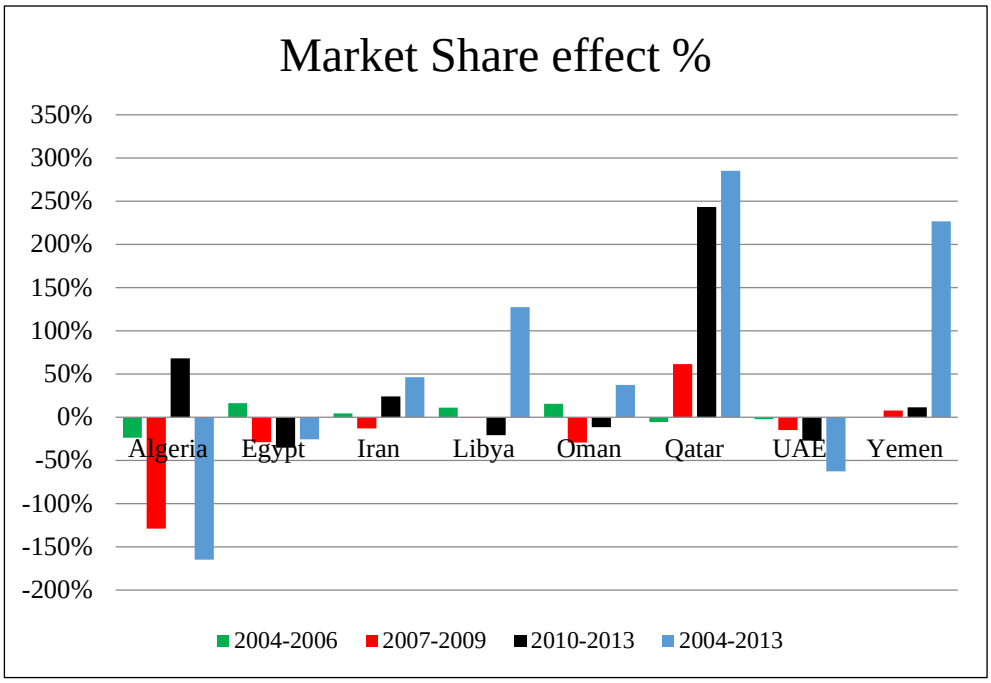


Figure 25 Change of market share effect of gas export.

7.3 Influence of market structure change on gas export revenue

Equation (6) defines market structure as the ratio of the specific global market demand to the world demand (e.g., the American market demand to the world demand).

In the first study period (2004-2006), all MENA countries experienced insignificant change in the market structure effect, except Algeria and Qatar, which experienced a slight increase in market structure due to their significant exports to the global markets. Therefore, any change in the global markets' structure will be felt mainly by the major gas exporters.

The second and the third study periods showed a significant decline in market structure effect, which means that there was a significant drop or collapse in the global markets due to the financial crisis that occurred in the second study period as well as the changing energy policies in the global markets in terms of the demand (especially in the European market) for the use of renewable energy instead of oil and gas. This decrease in the market structure directly or indirectly affected the MENA gas exports and then the MENA gas revenues, especially in the case of Algeria and Qatar (the largest MENA gas exporters). In other words, the entire study period showed a sharp decline in the market structure effect due to the global financial crisis and the energy policy that encouraged renewable-energy use as a commitment of the Kyoto protocol. Table 14 and Figure 26 present the results of the market structure effect.

Table 14 Market Structure Effect

ΔM.st. effect (%)				
Countries	**2004-2006**	**2007-2009**	**2010-2013**	**2004-2013**
Algeria	6%	-15%	-54%	-65%
Egypt	1%	-2%	-4%	-5%
Iran	0%	-1%	-8%	-10%
Libya	0%	-3%	-11%	-14%
Oman	1%	-3%	-12%	-14%
Qatar	4%	-13%	-111%	-134%
UAE	1%	-2%	-12%	-15%
Yemen	0%	0%	-6%	-7%

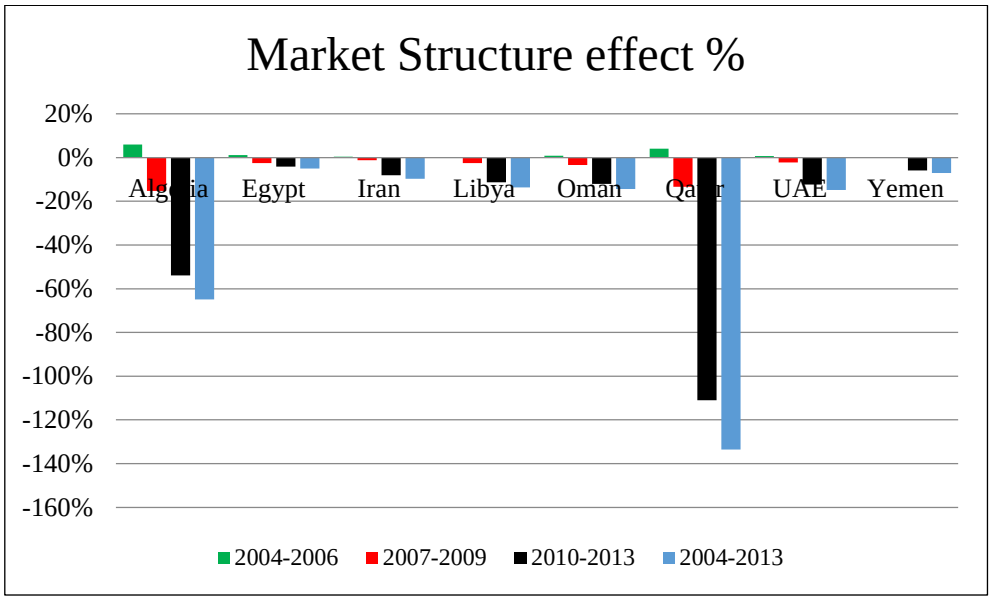


Figure 26 Change of market structure effect of gas export.

7.4 Influence of total demand change on gas export revenue

Supply and demand play an important role in the natural-gas market. An increase in demand will lead the natural-gas producing countries to increase their gas production to meet the growing demand in the global markets. On the contrary, a decline in demand due to the recession in the global markets will adversely affect the natural-gas producing countries, which will be reflected on the revenue from this sector. Based on this role, this study clearly showed that the total demand factor plays an important role in determining the gas export revenues of major exporters like Algeria and Qatar. The first and third study periods clearly showed that all the MENA countries experienced an increase in the total demand effect, and that Algeria and Qatar led the group in this regard. Conversely, in the second period (2007-2009), all the MENA countries clearly experienced a decrease in the total demand effect, which can be attributed to the global financial crisis.

Generally, the entire study period showed that the total demand effect witnessed a remarkable increase for all MENA countries in the 10-year study period (Table 15 and Figure 27

In Figure 27 it can be clearly observed that the total demand factor influenced all the MENA countries and played a key role in increasing the gas export revenues of the MENA countries. What is most important, however, can also be seen in this figure: the major natural-gas exporting countries, such as Qatar and Algeria, were influenced more, which implies that the global economic changes occurring at any time will have a greater effect on the major natural-gas-producing and exporting countries. Appendices 11-15 summarize the factors that influenced

the gas export revenues of the MENA countries the most in the entire study period (2004-2013) and in the individual study sub periods (2004-2006, 2007-2009, and 2010-2013).

Table 15 Total demand Effect

ΔD effect (%)				
Countries	**2004-2006**	**2007-2009**	**2010-2013**	**2004-2013**
Algeria	11%	-4%	22%	167%
Egypt	2%	-1%	2%	13%
Iran	1%	0%	3%	25%
Libya	1%	-1%	5%	35%
Oman	1%	-1%	5%	37%
Qatar	7%	-4%	46%	344%
UAE	1%	-1%	5%	38%
Yemen	0%	0%	2%	18%

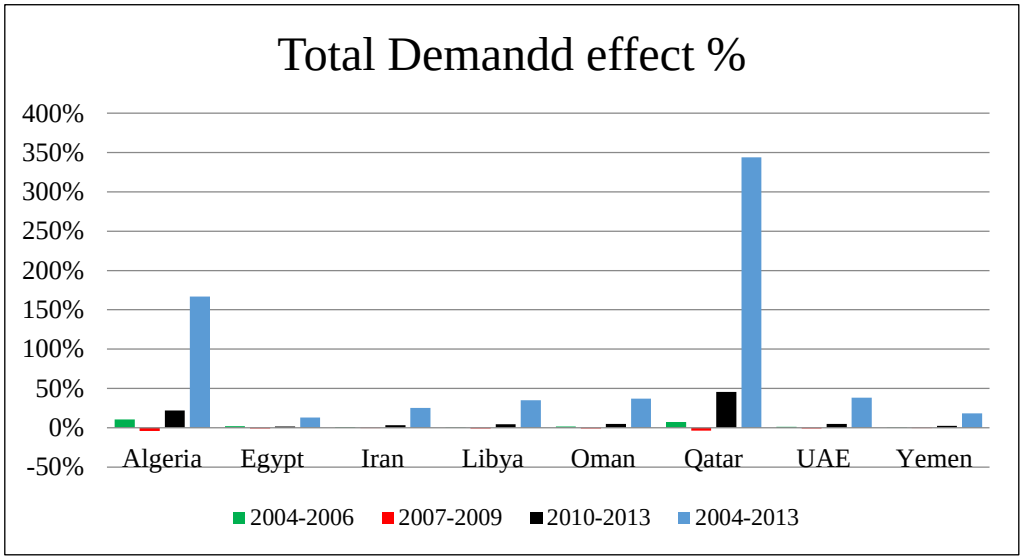


Figure 27 Change of total demand effect of gas export.

Chapter 8. Implications, Conclusions and Recommendations

Equation (6) identifies four drivers or factors of influencing gas export revenue: gas export price, market share, market structure, and total demand for natural gas. Using logarithmic mean divisia index (LMDI) method, an index decomposition analysis approach, to decompose or analyze the changes in these drivers or factors in the period 2004-2013 as well as the effects of such changes on gas export revenue, it was found that all these factors affected gas export revenue either positively or negatively.

The study results confirmed that the factor that influenced the gas export revenue of all the MENA countries the most in the entire study period was market share, followed by total demand. Gas export price and market structure were found to be the assisting factors, especially during the global financial crisis (2007-2009).

The study results also confirmed the attainment of the objectives of this study and answered some of the research questions. This section answers the remaining research questions.

This section highlights the implications of the factors affecting the gas export revenues of the MENA countries and recommends appropriate policies for addressing such countries' weaknesses so as to set the aforementioned factors in the right direction and to maintain the sustainability of gas export revenue for the MENA countries.

8.1 Implications

Market share is the main factor that plays a key role in determining the gas export revenues of all the MENA countries, while the other factors play the role of an assisting factor. For instance, total demand plays the role of an assisting factor in the case of Yemen, Qatar, Oman, Libya, and Iran; market structure plays such role in the case of Algeria; and gas export price plays such role in the case of Egypt.

Yemen is the latest comer among the MENA natural-gas-exporting countries, starting its commercial exportation of natural gas only towards the end of 2009, after opening the Yemen LNG facility. Although Yemen is a newcomer in the natural-gas industry, this study showed that Yemen ranked second (after Qatar) in terms of market share among the MENA countries in the entire study period. The increase in the market share of Yemen was due to the fact that it exported the highest quantity of natural gas (95% of the production) and due to the decrease in the domestic consumption of natural gas (5% of the production) despite Yemen's efforts to increase its domestic consumption of natural gas for power generation in 2008-2013.

Even though the main driver of gas export revenue in Yemen is the market share factor, the low gas export price represents a significant barrier to the improvement of Yemen's gas export revenue. The low gas export price represented a serious problem two years after the launching of gas export activities, which led to massive protests that prompted the government in 2012 to start negotiating with the buyers to raise the gas export price to the international level.

In the case of Algeria, its gas exports recorded a gradual decrease from 2006 to 2013, which led to a decrease in the Algerian gas share in the global markets. The

decrease in the country's gas export volume can be attributed to many factors related to the upstream and downstream activities, mainly the decline in production and the decrease in the European market demand (Mohand & Kim, 2014). The statistical data showed that in 2013, about 97% of the Algerian gas exports went to the European market and only 3% went to the Asian market, which implies that the changes in the European market structure during and after the global financial crisis affected the Algerian gas market share and market structure, which led to a change in Algeria's gas export revenue in this period.

In the case of Egypt, it witnessed a decrease in gas export revenue in the entire study period, although Egypt gas had a good distribution in all markets. The decline in gas export revenue can be attributed mainly to the decrease in market share, which can be attributed to the growing domestic demand, stagnant domestic production, and some technical problems at the Arab Gas Pipeline. All these reasons contributed to the reduction of the Egyptian exports of pipeline gas and LNG after 2009, which led to a decrease in market share and gas export revenue. In addition, large quantities of Egypt's gas exports in the entire study period went to Israel, Jordon, Syria, Lebanon, and Kuwait, which were not included in this study.

In the case of Iran, the changes in its market share in the whole study period played a key role in changing the country's gas export revenue. The entire study period showed an increase in Iran's market share, which led to an increase in the country's gas export revenue even though Iran is not an important country in terms of natural-gas exports. Iran depends on the pipeline in the export process, and around 90% of Iranian gas goes to Turkey. The increase in Iran's market share in the last few years was due to the expansion of the export process to Armenia and

Azerbaijan. Iran needs to build an appropriate infrastructure for LNG exports, which will help strengthen its share in the global markets.

In the case of Libya, the study results showed that market share was the factor that influenced the country's gas export revenue the most in the entire study period. The increase in Libya's market share in the first study period led to an increase in the country's gas export revenue. Conversely, the decrease in Libya's market share in the last study period led to conflicts and civil wars in the country in this period, which damaged the LNG facility (plant). For instance, in 2011, Libya's dry natural-gas exports fell to 2.43 Bcm from their peak of 9.98 Bcm in 2010, and the exports gradually increased and became 10.40 Bcm in 2013, driving the revenue to recover and to increase again. The total demand factor played an important role in the last study period. Thus, overall, it was shown that the change in Libya's gas export revenue can be attributed mainly to the change in the country's market share and to the total natural-gas demand especially in the last study period.

In the case of Oman, all the factors played an important role in changing the country's gas export revenue. The increase in the country's market share in the first study period led to an increase in the country's gas export revenue, while the increase in the country's gas export revenue in second study period is attributed to the increase in gas export price. The third study period showed a decrease in gas export revenue, which was due to the decrease in gas export price, market structure, and market share. Overall, it was shown that in the entire study period, market share was the factor that influenced Oman's gas export revenue the most, with the help of total demand.

In the case of Qatar, its gas exports witnessed a quantum leap especially after 2009, due to the increase in gas production from North Field and the opening of new LNG facilities in 2009-2011, which enabled Qatar to increase its exports to over 105 billion cubic meters in 2013 based on BP 2014, with 71% of these exports having gone to the Asian market. In the first study period until the middle of the second study period, the gas export price played an important role in controlling Qatar's gas export revenue, but due to the global financial crisis, Qatar began to increase its production and exports to maintain its revenue from the sector. Increasing the export volume implies increasing the market share, which played an important role in increasing the gas export revenue of Qatar in the entire study period, but especially in the last five years.

With the growing global LNG, Qatar began to shift its exports from long-term and oil-indexed contract sales items to short-term and spot market sales items to maintain the sustainability of its revenue in the future. In 2012, Qatar exported over one quarter of its LNG as short-term or spot market sales items, accounting for more than a third of the short-term and spot-market sales in the world. In addition, Qatar possesses a strong LNG infrastructure, which enables the country to deliver its LNG to the global market easily, leading to an increase in the total demand for Qatar gas worldwide.

In the case of UAE, its gas export revenue did not change much and can be seen as steady in the whole study period. Gas export price was the factor that influenced UAE's gas export revenue the most in the whole study period, and this can be clearly seen in the second study period. That is, when the prices dropped in 2009, the revenue of UAE also dropped.

8.2 Conclusion

The Middle East and North Africa (MENA) region plays an important role in meeting the global natural-gas demand. The contribution of MENA gas to the world supply reached 215.4 billion cubic meters in 2013, according to the 2014 BP statistical review, which means that this region supplies about 21% of the world's total natural-gas needs.

This study concentrated on the case of Yemen gas's market share in the global markets, and analyzed the factors influencing the gas export revenue of Yemen, highlighting the natural-gas-exporting MENA countries: Algeria, Egypt, Iran, Libya, Oman, Qatar, and United Arab Emirates (UAE).

This study employed the logarithmic mean divisia index (LMDI) method to study the changes in the gas export price, market share, market structure, and total natural-gas demand as well as their effects on the gas export revenue of Yemen in particular and of the other MENA countries in general.

The study results revealed that market share is the factor that influences Yemen's gas export revenue the most, and that gas export price is the factor that influences the gas export revenues of the other MENA countries (except UAE) the most.

In the entire study period, Yemen ranked second (after Qatar) in terms of market share, due to the increase in its natural-gas production and exports, especially after the opening of Yemen LNG Plant in 2009. Even though Yemen ranked second in the MENA region in the entire study period in terms of market share, which was responsible for maintaining the sustainability of the country's gas export revenue in

such period, the low gas export price represented a major obstacle to the growth of the country's gas export revenue.

The decrease in gas production and the increase in domestic demand in Algeria and Egypt in the entire study period led to a decrease in market share and then to a decrease in gas export revenue. On the other hand, the increase in gas production in Qatar, Iran, Libya, and Oman in the same period led to an increase in market share, which led to an increase in gas export revenue.

The study results showed that total demand plays the role of an assisting factor in influencing gas export revenue in the case of Iran, Libya, Oman, Qatar, and UAE, and that market structure plays the same role in the case of Algeria due to the change in the European market structure after the global financial crisis, which affected the Algerian gas market and led to a decrease in Algeria's gas export revenue.

8.3 Recommendations

This section highlights some recommendations that are believed will help maintain the sustainability of the gas export revenue of Yemen in particular and of the MENA countries in general.

In the case of Yemen, market share is the factor that influences gas export revenue the most. According to the results of the entire study period, Yemen ranked second (after Qatar) in terms of market share in such period; therefore, to strengthen and support the contribution of gas in the state's economic development, the following recommendations must be taken into account. First, expand the

exploration processes for associated and non-associated gas in the eastern and western parts of Yemen (offshore and onshore). Second, reduce the re-injected quantities of the gas in the Marib field in conjunction with the increased production from this field. Third, adopt Qatar's LNG pricing policy to reduce the risks posed by the long-term contracts. Fourth and last, strive to open the neighboring countries in the Horn of Africa (Djibouti, Somalia, Ethiopia, Eritrea, etc.) as new markets for Yemeni gas.

In the case of Algeria, expanding the natural-gas exploration and increasing the production should be among the priority tasks for increasing the country's market share and supporting the country's gas export revenue, and the LNG exports to the Asian and American markets should be increased to increase the country's gas export diversity and to avoid the demand recession in the European market.

In the case of Egypt, expanding the natural-gas exploration and increasing the production should also be among the priority tasks for increasing the country's market share and supporting the country's gas export revenue, and Egypt should reduce its domestic natural-gas consumption to increase its market share.

In the case of Iran, it should establish infrastructure for supporting LNG exports, overcome the international sanctions imposed on it, and attract foreign capital for investment in its natural-gas fields. Also, it should diversify its markets to break its dependence on a single market.

In the case of Libya, it should be open to other global markets to break its dependence on a single market, and it should update its infrastructure for LNG exports.

In the case of Oman, it should diversify its markets to break its reliance on a single market and to avoid the lowering of the demand for natural gas or the collapse of the prices in the single market. Also, it should decrease its domestic natural-gas consumption.

In the case of Qatar, its gas export market witnessed a rapid development in many aspects, such as in the natural-gas exploration and production processes, infrastructure updating, and marketing processes. For instance, Qatar's LNG exports were stipulated in a long-term and oil-indexed contract. Over the past few years, however, Qatar began to shift more to short-term and spot market sales to maintain the sustainability of its gas export revenue. In 2012, Qatar exported over one quarter of its LNG as short-term or spot market sales items, accounting for more than a third of the short-term and spot market sales of natural gas in the world (EIA, 2013). With regard to updating its natural-gas infrastructure, Qatar installed 14 LNG trains, the last five installed in 2009-2011, and regarding natural-gas exploration and production, Qatar possesses the largest field of non-associated natural gas in the world, known as North Field, and the vast majority of Qatar's natural-gas production comes from this field. Thus, it is suggested that Qatar diversify its exports by establishing a pipeline for its gas exports to the European market through Turkey, to increase its share in the European market and to strike a balance with the long-term LNG-related contracts.

In the case of UAE, gas export price is the factor that influences gas export revenue the most; therefore, to avoid price collapse in the future, UAE should expand its natural-gas exploration and increase its natural-gas production to increase its market share and to maintain the sustainability of its gas export revenue. Also, it

should diversify its markets and break its reliance on a single market so as to avoid the price collapse and the slowing of the demand in the single market.

The foregoing recommendations are based on the results of this study, but some of the policymakers in the MENA countries have a different vision based on the situation and demand. For instance, according to the 2014 International Energy Administration Report, Oman intends to change all its gas export quantities to meet the growing domestic demand by the end of 2024.

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Appendixes

Appendix 1. Export Price Factor ($US/mmbtu) *

Year	Algeria	Egypt	Iran	Libya	Oman	Qatar	UAE	Yemen
2004	4.57	0.00	4.46	3.89	6.41	5.07	4.68	5.48
2005	6.28	7.16	7.05	4.99	7.77	6.20	5.73	8.16
2006	8.10	6.38	7.04	6.57	7.06	7.97	8.20	10.60
2007	7.94	6.17	7.13	6.88	7.22	7.62	8.94	0.00
2008	13.22	8.16	10.56	9.76	13.37	12.98	13.40	0.00
2009	7.77	5.86	7.57	8.06	9.13	9.56	9.23	3.42
2010	7.73	4.70	7.70	8.03	8.86	7.94	10.60	3.44
2011	11.46	7.26	9.97	9.39	11.29	10.41	14.73	4.54
2012	11.66	9.58	9.46	9.46	20.48	10.86	16.75	4.41
2013	8.53	7.69	10.63	10.63	8.44	10.08	16.17	6.60

* This prices before correction to GDP constant 2005 and price deflators

Appendix 2. Market share factor

Year	Algeria	Egypt	Iran	Libya	Oman	Qatar	UAE	Yemen
2004	0.18	0.00	0.01	0.00	0.03	0.25	0.05	0.00
2005	0.18	0.03	0.01	0.01	0.01	0.19	0.05	0.00
2006	0.14	0.06	0.02	0.02	0.08	0.23	0.05	0.00
2007	0.13	0.06	0.01	0.02	0.07	0.20	0.05	0.00
2008	0.11	0.06	0.01	0.02	0.06	0.20	0.04	0.00
2009	0.11	0.05	0.01	0.02	0.06	0.21	0.04	0.00
2010	0.10	0.04	0.01	0.02	0.05	0.26	0.04	0.03
2011	0.09	0.03	0.02	0.00	0.05	0.32	0.03	0.04
2012	0.10	0.02	0.01	0.01	0.04	0.34	0.03	0.03
2013	0.12	0.01	0.02	0.02	0.04	0.35	0.03	0.04

Appendix 3. Market structure factor

Year	American market	Asian market	European market
2004	0.23	0.20	0.56
2005	0.22	0.19	0.57
2006	0.26	0.20	0.58
2007	0.19	0.19	0.57
2008	0.16	0.19	0.58
2009	0.17	0.19	0.57
2010	0.17	0.21	0.58
2011	0.16	0.24	0.52
2012	0.16	0.26	0.49
2013	0.16	0.26	0.41

Appendix 4. Total Effect Explained

Countries	**ΔRtot**			
	2004-2006	**2007-2009**	**2010-2013**	**2004-2013**
Algeria	3.53	-2.01	-0.05	-1.82
Egypt	1.81	-1.04	-0.64	-0.86
Iran	0.9	-0.23	0.56	1.51
Libya	1.5	0.37	0.27	5.00
Oman	1.7	0.29	-1.05	0.48
Qatar	1.7	4.04	4.17	11.40
UAE	0.5	-0.18	-0.36	0.24
Yemen	0.0	0.072	0.71	5.35
MENA	11.58	1.32	3.61	22.37

Appendix 5. Real change

MENA Countries	$Rt-R_0$			
	2004-2006	2007-2009	2010-2013	2004-2013
Algeria	4.06	0.19	-2.12	-2.55
Egypt	1.37	-0.85	-0.56	-1.51
Iran	0.76	-0.22	0.26	0.94
Libya	1.52	0.41	-0.16	1.76
Oman	1.58	0.57	-0.30	0.88
Qatar	1.67	6.16	5.91	14.68
UAE	0.41	-0.12	0.45	1.02
Yemen	-0.01	0.05	1.03	1.63
MENA	11.36	6.19	4.51	18.87

Appendix 6. Residual

MENA Countries	(Rt-R0)-(Rtot)			
	2004-2006	2007-2009	2010-2013	2004-2013
Algeria	0.53	2.20	-2.08	-0.73
Egypt	-0.44	0.19	0.09	-0.65
Iran	-0.12	0.02	-0.31	-0.57
Libya	-0.01	0.04	-0.43	-3.24
Oman	-0.11	0.28	0.75	0.40
Qatar	0.01	2.11	1.74	3.28
UAE	-0.08	0.06	0.81	0.78
Yemen	0.00	-0.02	0.32	-3.73
MENA	-0.22	4.88	0.90	-3.50

Appendix 7. Most influential factors on the gas revenues 2004-2006

MENA countries	**2004-2006**			
	Δ**P** effect	Δ**Msh.** effect	Δ**Mst.** effect	Δ**D** effect
Algeria	+*	-	+	+
Egypt	-	+*	+	+
Iran	+	**+***	0	+
Libya	+	+*	0	+
Oman	-	**+***	+	+
Qatar	**+***	-	+	+
UAE	+*	-	+**	+**
Yemen	0	0*	0	0

* The main influential factor, ** The assistant infuential factor.

Appendix 8. Most influential factors on the gas revenues 2007-2009

MENA countries	**2007-2009**			
	Δ**P** effect	Δ**Msh.** effect	Δ**Mst.** Effect	Δ**D** effect
Algeria	-	- - -*	-	-
Egypt	- - *	-**	-	-
Iran	-	**-***	-	0
Libya	+*	-	-	-
Oman	**+ +***	-	-	-
Qatar	**+ + + + +***	**+ +****	-	-
UAE	+	-*	-**	-**
Yemen	-	+*	0	0

* The main influential factor, ** The assistant infuential factor.

Appendix 9. Most influential factors on the gas revenues 2010-2013

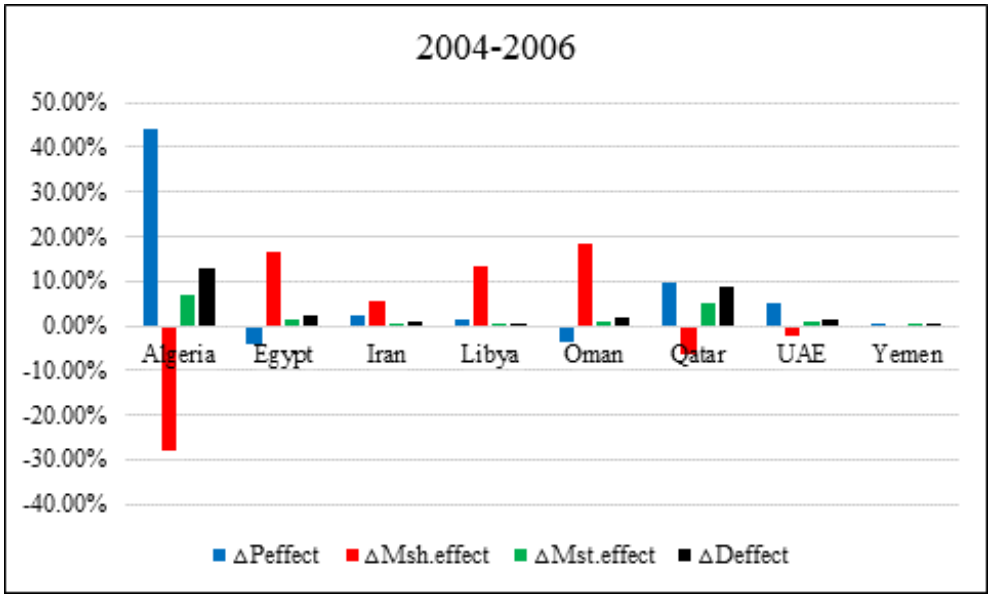
MENA countries	**2010-2013**			
	Δ**P** effect	Δ**Msh.** effect	Δ**Mst.** effect	Δ**D** effect
Algeria	-	+ +	- -*	+
Egypt	+	-*	-	+
Iran	+	+*	-	+
Libya	-	-*	-	+**
Oman	-*	-**	-**	+
Qatar	-	+ + + +*	- -	+**
UAE	+*	-	-	+**
Yemen	+	+*	-	+

* The main influential factor, ** The assistant infuential factor.

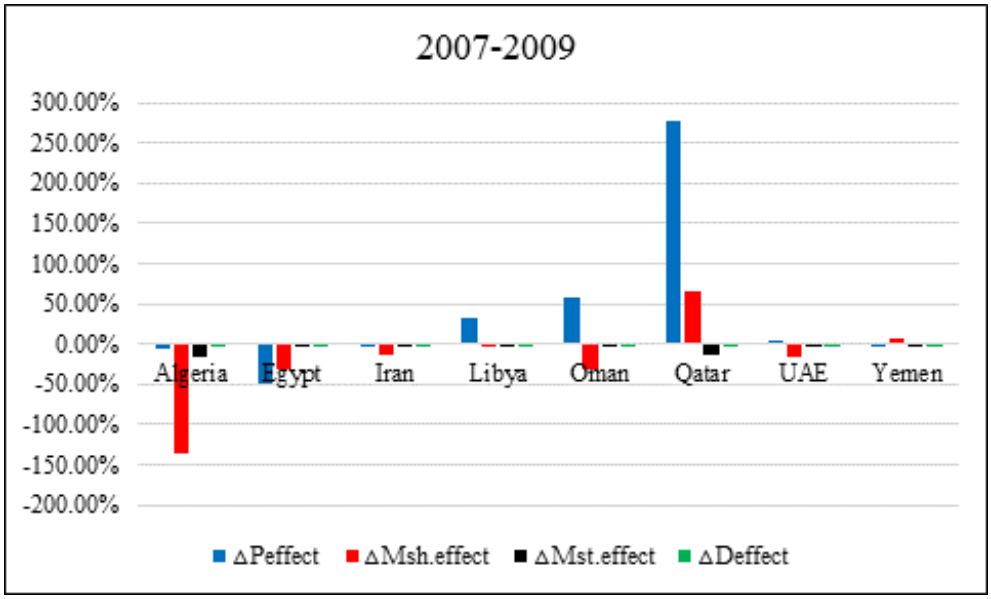
Appendix 10. Most influential factors on the gas revenues 2004-2013

MENA countries	**2004-2013**			
	Δ**P** effect	Δ**Msh.** effect	Δ**Mst.** effect	Δ**D** effect
Algeria	-	- - -*	- -**	+ + +
Egypt	-**	-*	-	+
Iran	+	+*	-	+
Libya	+	+ +*	-	+**
Oman	-	+*	-	+**
Qatar	-	+ + + + +**	- -	+ + + + + +*
UAE	+*	-	-	+**
Yemen	-	+ + + +*	-	+

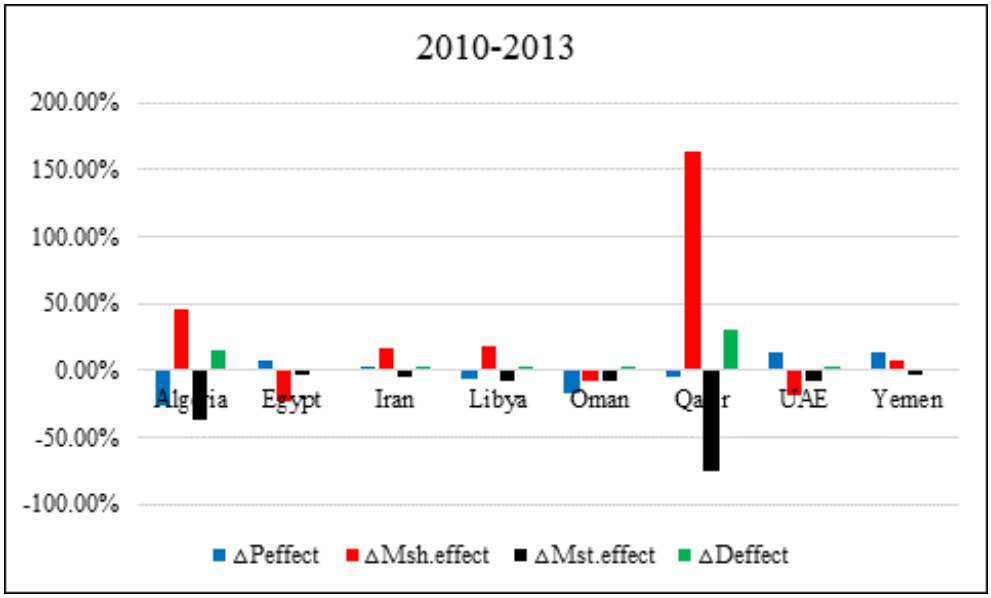
* The main influential factor, ** The assistant infuential factor.



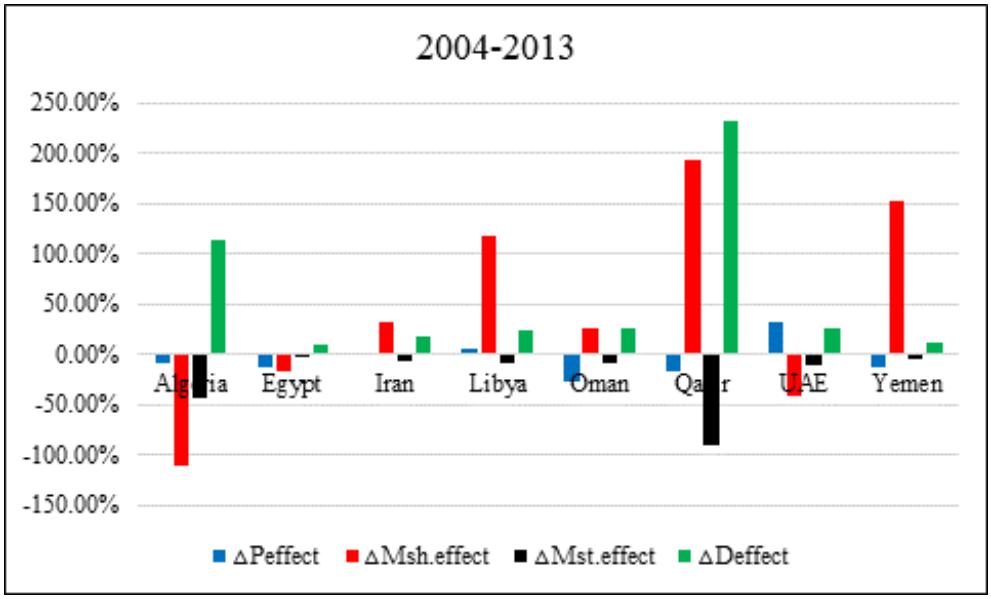
Appendix 11. Most influential factors on the revenue in the 1st period.



Appendix 12. Most influential factors on the revenue in the 2nd period.



Appendix 13. Most influential factors on the revenue in the 3rd period.



Appendix 14. Most influential factors on the revenue in the entire period

초 록

중동과 북아프리카 지역은 세계 천연가스 시장에서 매우 중요한 역할을 하고 있다. 이들은 2013 년 국제 송유관 가스 수출량의 8.8 퍼센트, LNG 수출량의 40 퍼센트를 차지하고 있다(BP, 2014). 해당 지역의 주요 가스 수출국은 알제리, 이집트, 이란, 리비아, 오만, 카타르, 아랍에미레이트, 그리고 예맨 등이다. 예맨의 경우 가스 산업에 있어 가장 후발국에 속하지만, 예맨에서 산출되는 가스는 매우 신뢰도가 높고 좋은 평판을 유지하고 있어 안정적인 가스 공급자에 속한다. 본 연구에서는 예맨을 비롯한 중동 및 아프리카 지역(MENA) 국가들의 가스 수출 매출액 인자의 변화와 이에 따른 가스 수출 매출의 변화를 LMDI(Logarithmic Mean Divisia Index)모델을 통하여 분석한다.

가스 수출 매출액에 영향을 미치는 주요 인자를 가스 수출 가격, 시장 점유율, 시장 구조와 총 수요 등으로 간주했을 때, 가스 수출 매출액에 가장 큰 영향을 미치는 영향 인자는 시장 점유율 인자였고, 총 수요, 시장 구조, 그리고 가스 수출 가격 등의 인자가 각각 가스 수출 매출액에 영향을 미치는 보조 인자로 분석되었다.

예맨은 카타르에 이어 두번째로 높은 시장점유율의 성장을 이룩하고 있었고, 이는 액화 천연가스 산업의 급격한 성장과 2009 년 예맨 내부의 LNG 공장 설립 등의 영향이 크다.

예맨이 매우 높은 시장 성장률을 보여주고 있지만, 예맨에서 산출되는 가스의 수출 가격은 다른 MENA 소속 국가에 비해 매우 저렴하다. 이러한 상황은 예맨의 가스 수출 매출액을 신장하는 데에 있어 커다란 장애물로 작용하고 있다. 따라서, 본 연구에서는 예맨의 에너지 정책 입안자들에게 카타르의 가스 가격 책정 정책을 채택하여 가스 수출 매출을 신장하는 방안을 모색해야 함을 제안하고 있다.

핵심 단어: MENA 국가 , 예맨, 가스 수출 매출액, Logarithmic Mean Divisia Index, 수출 매출액 인자, 시장 점유율 인자, 시장 구조 인자, 총 수요 인자