

Abu Dhabi-UAE Petrochemical Cluster

Microeconomics of Competitiveness: Firms Clusters and Economic Development

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1 INTRODUCTION

The Emirate of Abu Dhabi is the capital of United Arab Emirates. It is divided into three administrative regions, City of Abu Dhabi, the Eastern Region and the Western Region, where oil and gas industries are concentrated. Abu Dhabi is located on the Arabian Gulf; it represents 87% of the total area of UAE and it is inhabited with around 1,967,659 million people in 2010 where immigrants are 70% of the population and represent 90% of the labor work force (SCAD, 2011).

Abu Dhabi is the richest among the seven emirates with a GDP of US \$168.8 billion accounting to 61% of UAE GDP and an income per capita of \$85,000 (SCAD, 2011). Abu Dhabi outperformed Gulf countries and other Arab states in human development index, world governance indicators, and global innovation index, and new global competitiveness index.

The backbone of the economy continues to be the oil and gas industry as Abu Dhabi has 13,000 million tons of oil reserves or 7.1% of world reserve oil share, 6 trillion cubic meters of natural gas or 3.2% of world natural gas (BP, 2011). However the petrochemical industry is still at its infancy, it was only conceived in 2002 by the creation of Abu Dhabi Polymers Company (Borouge) more than four decades after the birth of oil and gas industry in Abu Dhabi.

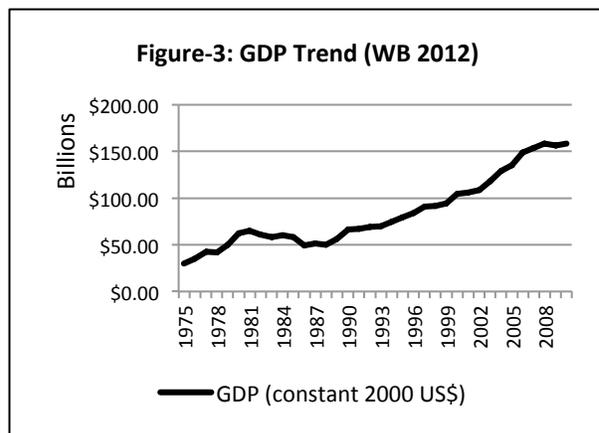
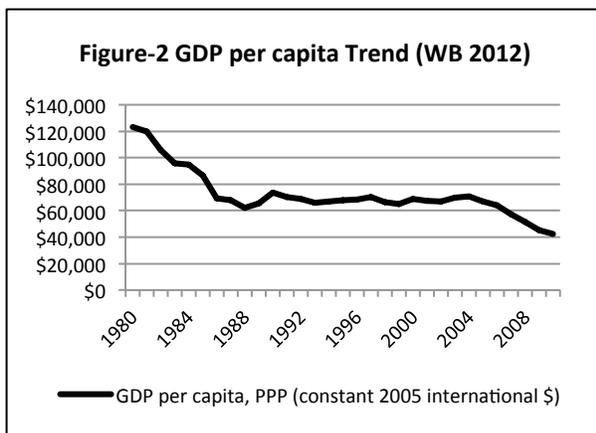
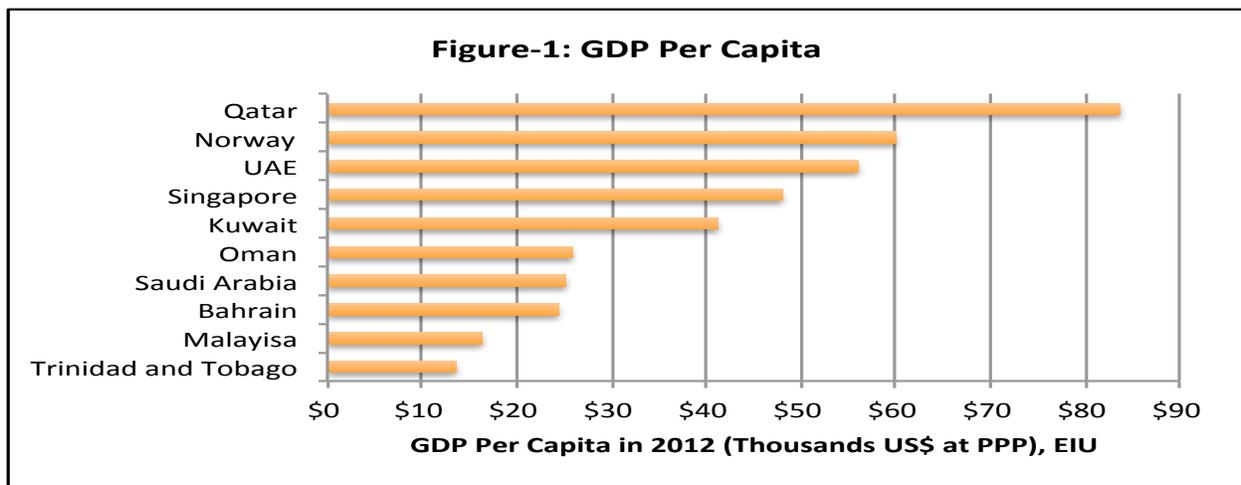
In 2006, the Chairman of the Executive Council of Abu Dhabi launched a series of reforms covering all government institutions. In 2007, the Executive Council approved the Abu Dhabi Policy and in 2009, it endorsed Abu Dhabi Economic Vision 2030, both set the policy direction towards creating a secure, diversified and sustainable economy and emphasized human development. Abu Dhabi has not been able to diversify its economy and exports basket, the non-oil and gas manufacturing sector and exports contributed only 5.5% to GDP and 10.4% of exports respectively in 2010 (SCAD, 2011).

Petrochemical cluster and associated converter cluster represent an opportunity to support economic diversification that would demand cluster based, collaborated and liberalized approach for economic development between government, national oil, gas and petrochemical companies and foreign investors.

2 ECONOMIC PERFORMANCE

2.1 UAE Economic Performance

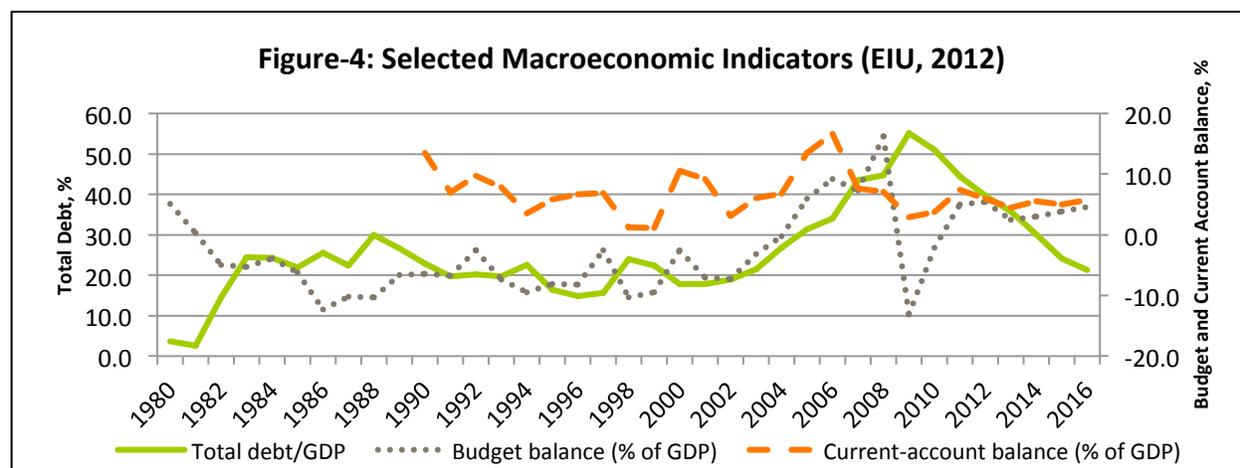
The track record of the UAE’s economic performance and macroeconomic policies constitute a solid basis for the development of its economy in general, and a petrochemicals cluster in particular. As demonstrated by Figure-1, at US\$ 56,050 GDP per capita (PPP), as predicted for 2012, the UAE is one of the richest countries (second only to Qatar) – both within the GCC and within a set of other comparative countries. This is the case despite a rather significant decrease in GDP per capita since early 1980s (Figure-2). Such decrease was brought about by a very rapid growth in population (CAGR for the period of 1960-2010



equals 9.26% (calculated from WB (2012)), which was largely fueled by the immigration of low skilled workers. Currently, international migrants constitute 70% of population (WB, 2012), placing the UAE in the second highest position (after Qatar) in the World in this regard (MPI, 2009). Increase in the total size of

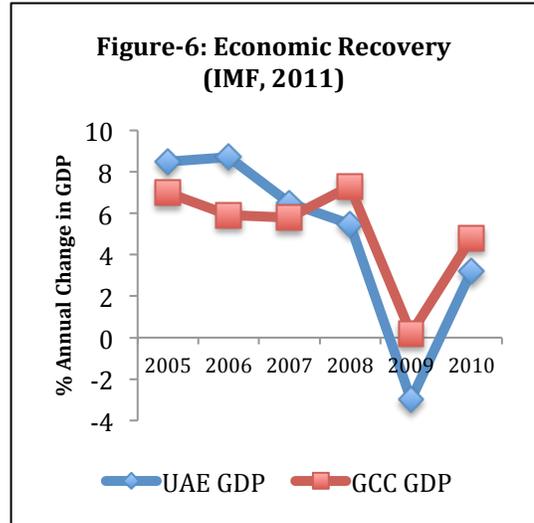
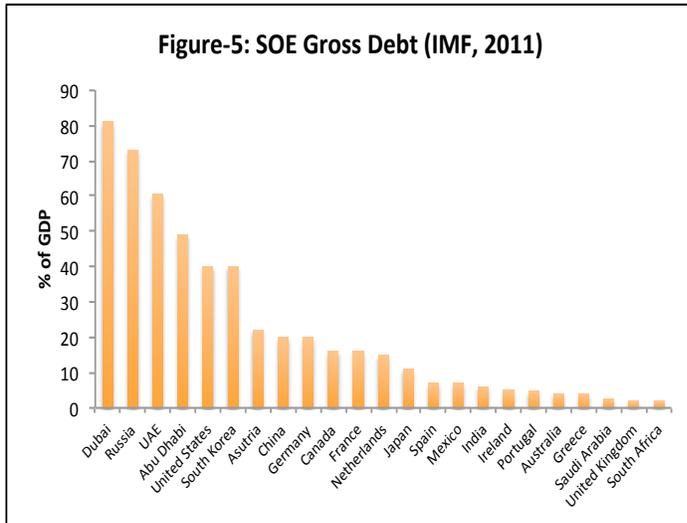
the economy (Figure-3; total GDP in current US\$ in 2010 stood at 298 billion (WB, 2012)), although very rapid, has not been keeping up with the population trends. Importantly, however, overall GDP per capita numbers hide a large disparity between incomes of national population (as well as high skilled foreign employees) and low skilled guest workers.

UAE's strong macroeconomic performance has been supported by solid macroeconomic policies (see Figure-4 for selected indicators). The Economist Intelligence Unit (2012:3) predicts that in the coming 5-year period of 2012-2016 the average fiscal surplus will be 3.9% of GDP, current account surplus - 5.3% of GDP, trade surplus - 15.3% of GDP, and real GDP growth - 5.1% per annum. Inflation is expected to be kept at manageable level of 2.4% per annum. Solid economic performance of the UAE is recognized by its sovereign debt rating of Aa2 by Moody's Investors Service (EIU, 2012:2).

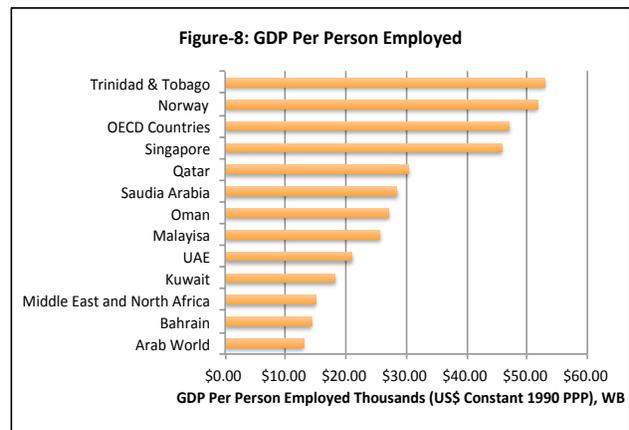
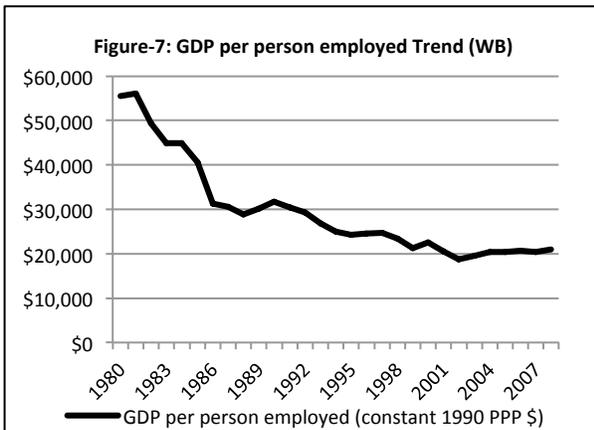


The UAE labor market is characterized by low unemployment at 4%. The unemployment rate for nationals is, however, much higher at around 14%. This seems to be largely caused by a lack of employment incentives in the private sector due to comparably very attractive public sector remuneration (EIU, 2012:3).

The UAE economy has been largely driven by the state owned enterprises (SOEs) (IMF, 2011), which resulted in the UAE becoming one of the World "leaders" in terms of SOE-related debt in the aftermath of financial crisis of 2008 (Figure-5). This presents a risk to government finances. Furthermore, SOE-driven diversification of the economy was one of the causes of generally slower recovery (Figure-6).

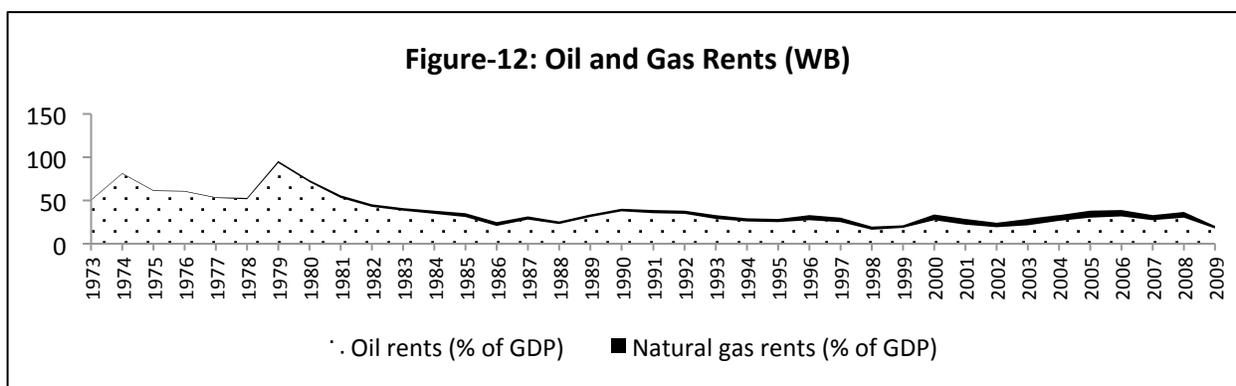
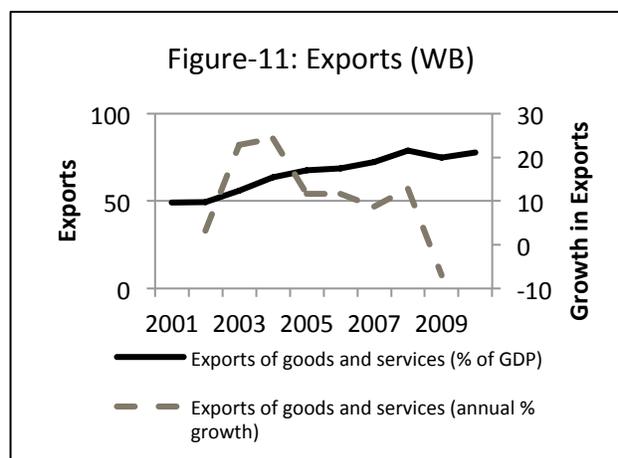
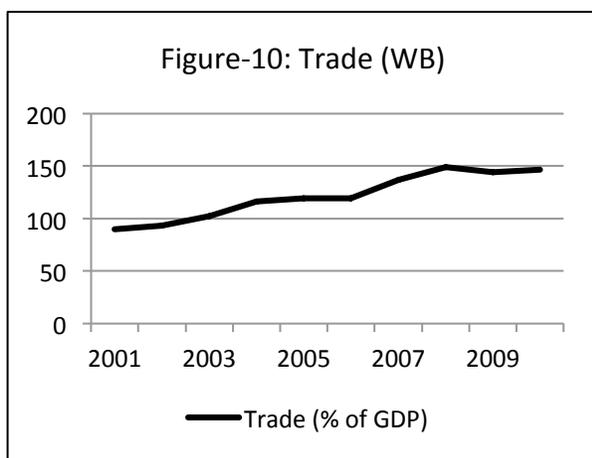
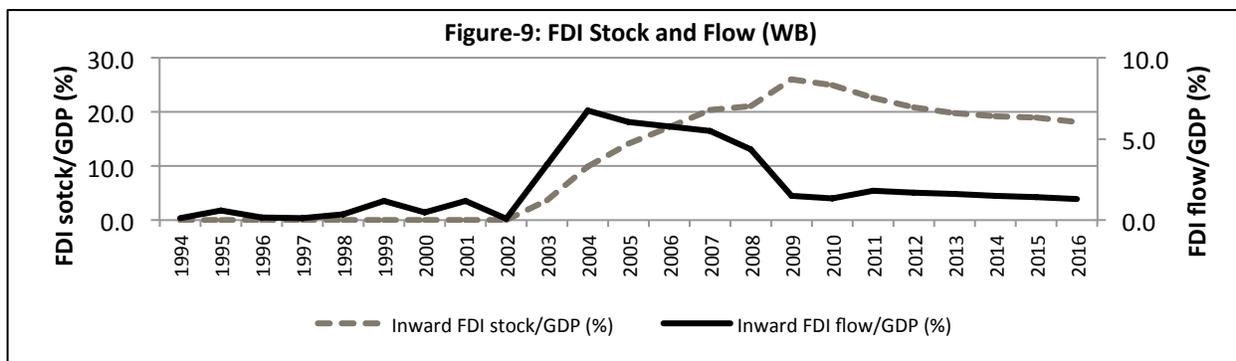


Risks for the UAE’s economic performance include a potential for escalation of Iranian conflict as (a) Iran is its major trading partner (EIU, 2008); and (b) traffic in the Strait of Hormuz, the strategic maritime channel, could be disrupted. The UAE has, however, been improving resiliency of its logistical infrastructure by enhancing the port of Fujairah (in the Gulf of Oman) (EIU, 2012:3). Furthermore, a need to replace demand for the Iranian oil might present an opportunity to the UAE (EIU, 2012:3).



Productivity may also become a constraint. As the UAE economy has been driven by the low-skilled workforce, its productivity has been decreasing (although has recently flattened; Figure-7). It still remains on par with regional peers, but is lower than the productivity in other benchmark countries (Figure-8).

In terms of the external sector, although FDI and trade were experiencing growth, over the last 3 years the trend seems to have reversed (Figures-9, 10 and 11). This points to a need to find new growth sectors.

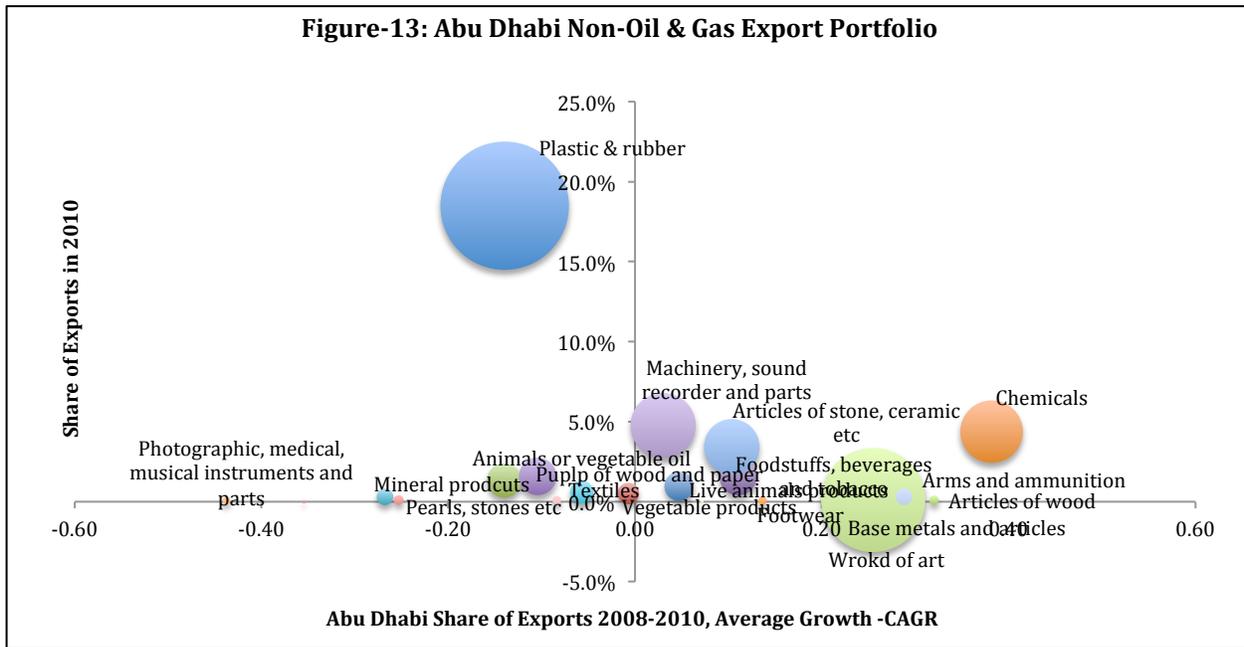


2.2 Structure of UAE Economy

Due to UAE's natural endowments, oil and gas remain the single most important part of the economy – both in terms of the GDP (Figure-12) and trade (IMF, 2011), despite the process of diversification as

evidenced by the 23% rise in the non-oil trade in the first nine months of 2011 (EIU, 2012:3).

Therefore economic health may be impacted by economic difficulties in consumer markets (e.g., Europe), which might present a pressure on prices. However, the Economist Intelligence Unit (2012:3) predicts that despite a slight decrease, oil prices will remain at the comfortable level, reaching US\$ 110/barrel in 2016.



2.3 Abu Dhabi Economic Performance

Abu Dhabi’s economy constitutes 61% of GDP of the UAE (in 2008; SCAD (2011)). Therefore general UAE macroeconomic conditions for the most part apply to Abu Dhabi. In 2010 GDP in current US\$ was 169 billion and GDP per capita - US\$ 85,840. This made Abu Dhabi not only the richest UAE emirate, but also surpassed the GDP per capita of the richest GCC country – Qatar. Inflation was at 3.1%. (SCAD, 2011).

Proportion of non-nationals in the labor force in 2008 was higher in Abu Dhabi than in the UAE generally and constituted 89.5% of the labor force. Unemployment was of the similar level as for the UAE in general – at 3.3% of total population, including 2.4% of non-nationals and 10.4% of nationals. (SCAD, 2011).

2.4 Abu Dhabi Economic Structure

As Abu Dhabi is the main holder of the UAE’s oil and gas endowments (produces around 90% of the UAE’s

oil and has 95% of the UAE's gas, its economy is less diversified than the UAE in general. Share of oil in its GDP in 2010 stood at 49.7%, and 92.5% of exports were hydrocarbons. Petroleum related revenue constituted 82.6% of total government revenue, despite decreasing trend. (SCAD, 2011)

As demonstrated by Figure-13 above, composition of the economy of Abu Dhabi provides for some seeds for diversification. However, none of those areas emerged as a strong alternative to the oil and gas sector.

2.5 Summary

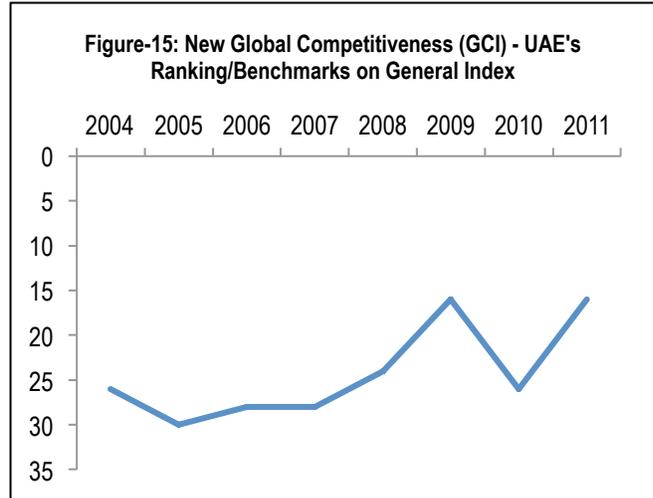
In summary, despite certain risks, the track record of economic performance of the UAE and Abu Dhabi and supportive macroeconomic policies present a solid base for further development of economy in Abu Dhabi in general, and petrochemicals in particular. Very strong dependency on hydrocarbons, weakening external sector as well as the revelation of risks incumbent in the SOE-driven economic development model, suggests that Abu Dhabi faces a need to find or strengthen sources of economic growth that would be less dependent (at least directly) on the oil and gas sector and were characterized by a higher level of private sector participation. It is important that such further development does not merely depend on cheap immigrant labor, but create higher-value added jobs thereby providing real private sector employment opportunities for the UAE nationals and increasing productivity. Other sections of this report would explore the role of the petrochemicals sector in this context.

3 National Competitiveness Analysis

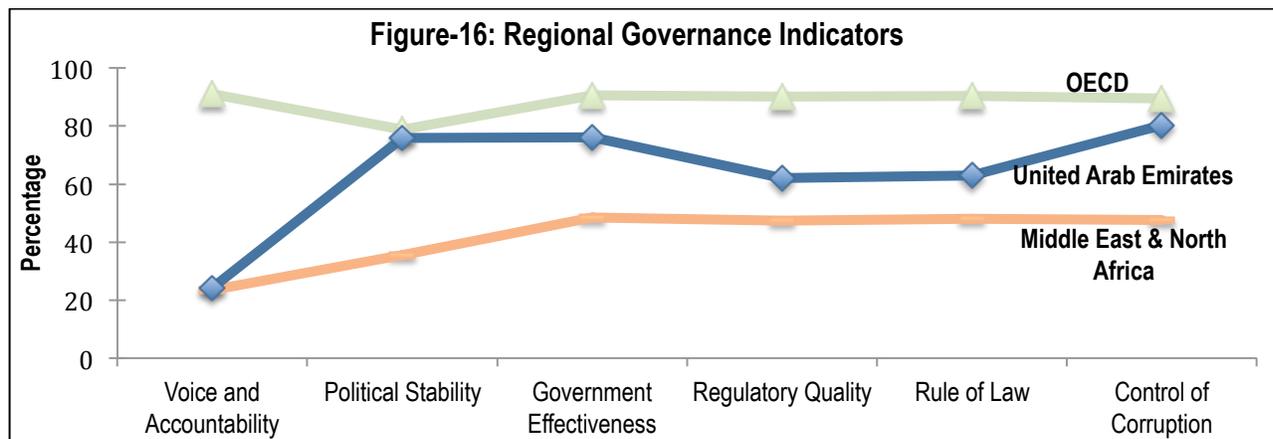
The business environment of the UAE is strong compared to the GCC countries and other benchmark countries. Key strengths of the UAE include its favorable tax policy. The UAE government demands no corporate or income tax and boasts one of the lowest tax payment rates in the world that counts 1.7% of GDP (WB, 2012). The government of Abu Dhabi uses an attractive tax policy to attract foreign investors despite the limits on foreign ownership of businesses to 49%, which is largely a rule designed to ensure UAE nationals remain primary stakeholders in the UAE's economy. The UAE also enjoys free trade zones, which stimulate trade and investment in the region, well-developed capital markets, and general political

stability. Looking into the New Global Competitiveness Index (NGCI) (ISC, 2012), UAE ranked the 16th (Figure-14). UAE ranking at the NGCI trend has been progressing over the last decade, with the exception of an interim slump in 2009/2010 (Figure-15).

On the microeconomic level, UAE also has a strong governance, trade environment with efficient and easy

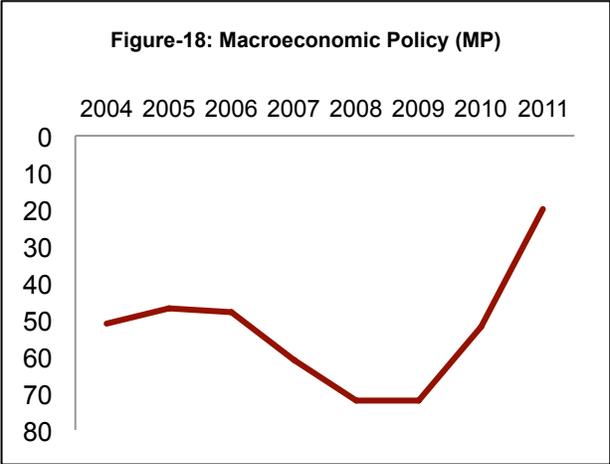
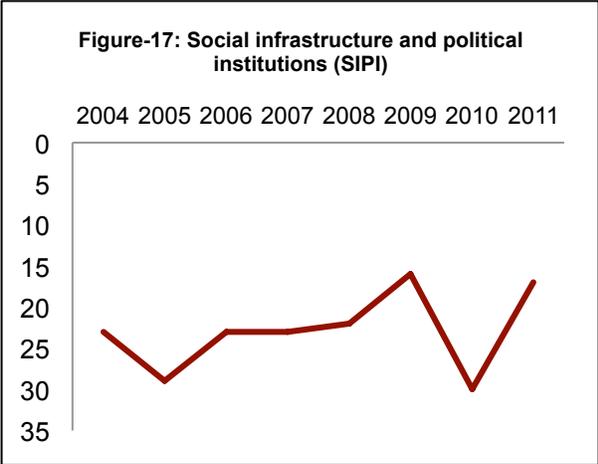


customs procedures. According to the World Bank's Global Governance indicators, UAE marked higher than the Middle and North Africa region in political stability, regulatory quality, control of corruption, and rule of law (Figure-16). In State of Cluster Development, the UAE currently ranks the 12th in the NGCI. This is supported by high value chain breadth and strong cluster policy. However on cluster collaboration and production process sophistication, the UAE performs only average compared to the region.



Source: World Bank Global Governance Indicators (2010)

On State of Private Sector on the Global Stage, the UAE has good breadth of international markets, low trade barriers, high internationalization of firms, and strong control of international distribution. The UAE has been improving on the macroeconomic level as well. The UAE's ranking in macroeconomic policy improved from 72nd in the world to top 20 in the world in just the last 3-4 years (Figure-18). The country also has experienced strong economic growth, a current account and budget surplus, and a relatively low level of debt at around 40% of GDP.



Source: NGCI-Institute for Strategy and Competitiveness

Looking into the World Bank's ease of doing business index (WB, 2012), UAE positively ranked the 33rd world country in the index, following Saudi Arabia in the GCC region (ranked 12th). However, UAE faces some key challenges in doing business, as it ranked the 42nd on starting business, the 151st in resolving insolvency; and ranked the 134th in legal enforcement of contracts. All of these factors contribute to building the competitiveness structure of UAE.

3.1 Abu Dhabi Vision 2030

In 2008, the Abu Dhabi government announced the Abu Dhabi Vision 2030. The vision statement reads, "Abu Dhabi as a sustainable, diversified, high-value added economy that encourages enterprises and entrepreneurship and is well-integrated in the global economy leading to better opportunities for all." There is a 2-tiered approach to this goal: building a sustainable economy, and ensuring a balanced social and regional economic development approach. Through this approximately 20 year plan, Abu Dhabi has

committed itself to improving the depth and stability of its economy and capital markets by diversifying fiscal revenue sources to reduce dependence on volatile oil revenues. The goal is to make Abu Dhabi's economy less prone to external shocks such as the one experienced during the global financial crisis of 2008, while simultaneously ensuring the nation's long-term foundations for competitiveness are enhanced.

3.2 The UAE Business Environment (National Diamond)

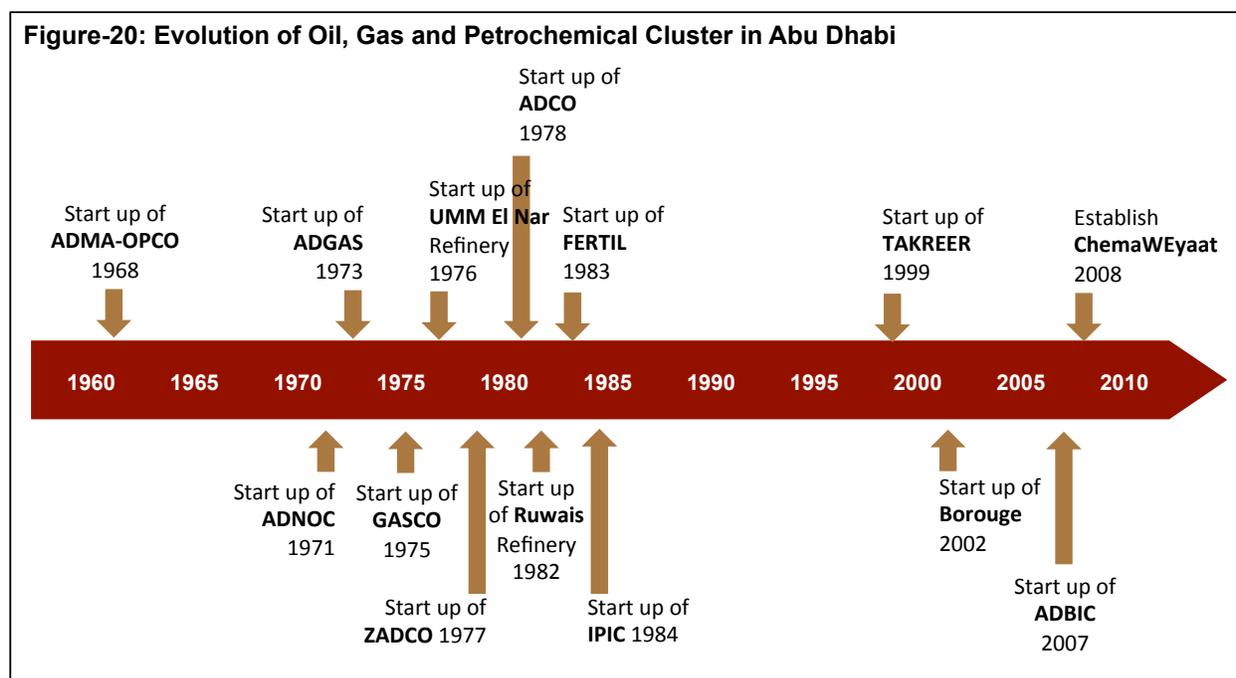
The national diamond for Abu Dhabi/UAE (Figure-19) highlights the rich natural and infrastructural factor conditions of the country, which is mainly attributed to the central location between continents, the large reserve of oil and gas, and the developed roads, telecom, educational, and health structures in the country. The UAE is an active member of major regional and international economic organizations, and has relatively managed to develop a liberal market for development, however, the country marked low at certain indicators, which affect inflow of foreign direct investment.



4 PETROCHEMICAL CLUSTER

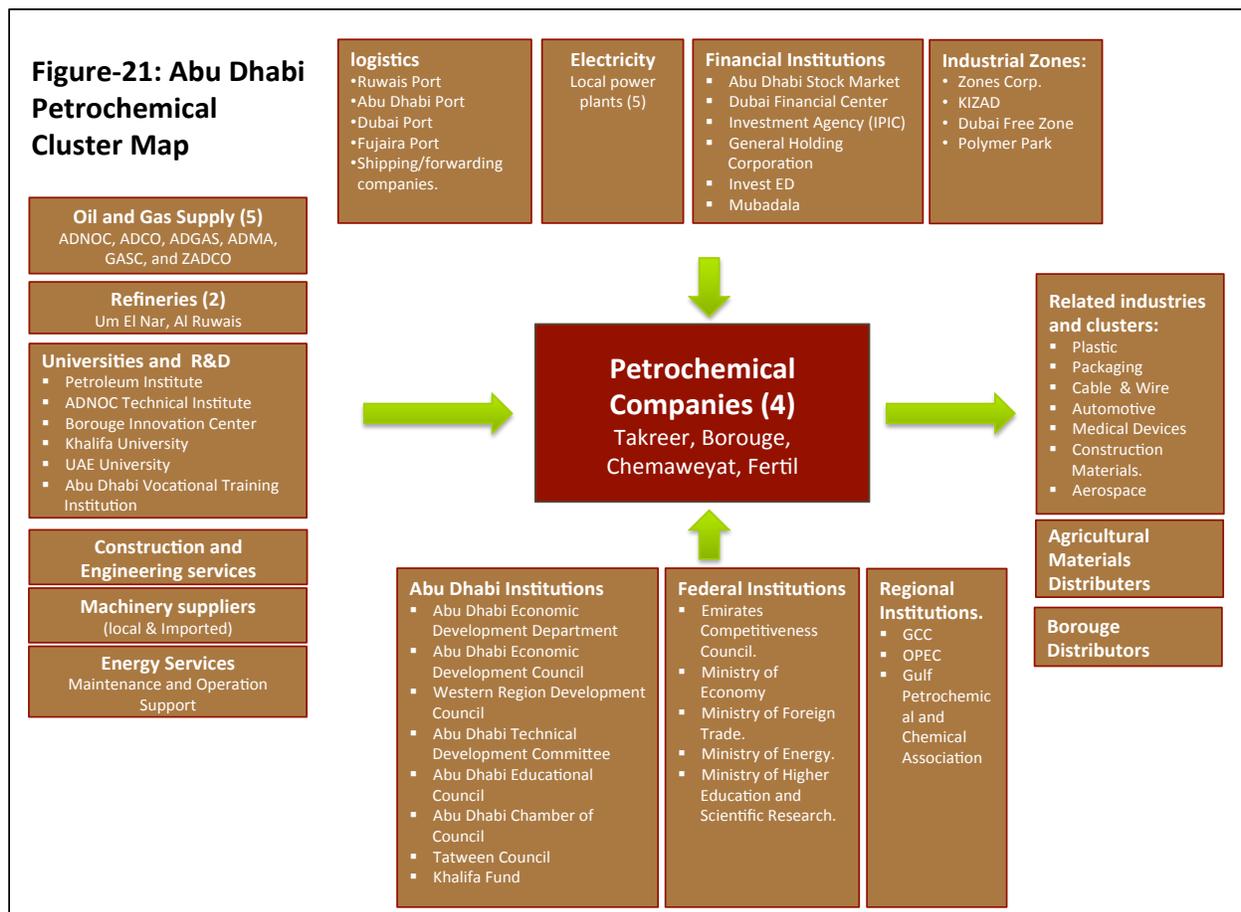
4.1 Industry Profile and Evolution

The Supreme Petroleum Council (SPC) was established in 1988 as the superior authority responsible for the petroleum industry in the emirate of Abu Dhabi. The Ruler of Abu Dhabi chairs SPC that formulates and oversees the implementation of Abu Dhabi's petroleum policy and follows up its implementation across all areas of the petroleum industry through Abu Dhabi National Oil Company (ADNOC), its National Oil Company (NOC).



Abu Dhabi has the world's fourth largest oil reserves (97.8 thousands million barrels) and fifth largest natural gas reserves (6 trillion cubic meters) (BP, 2011). The evolution of oil and gas industry in Abu Dhabi is illustrated in Figure-20. It started with the first concession that was awarded to Petroleum Development (Trucial Coast) on 11th January 1939, a non-national company, but geological work and exploratory drilling began in February 1950, the first commercial oil discovery was made on 1960 at Bab oil field, and the first shipment of crude was exported from Jebel Dhanna terminal in 1963 prior to the formation of the federation of the United Arab Emirates. In 1971, Abu Dhabi National Oil Company (ADNOC) was established as the State Owned Enterprise in charge of all oil, gas, petrochemical and

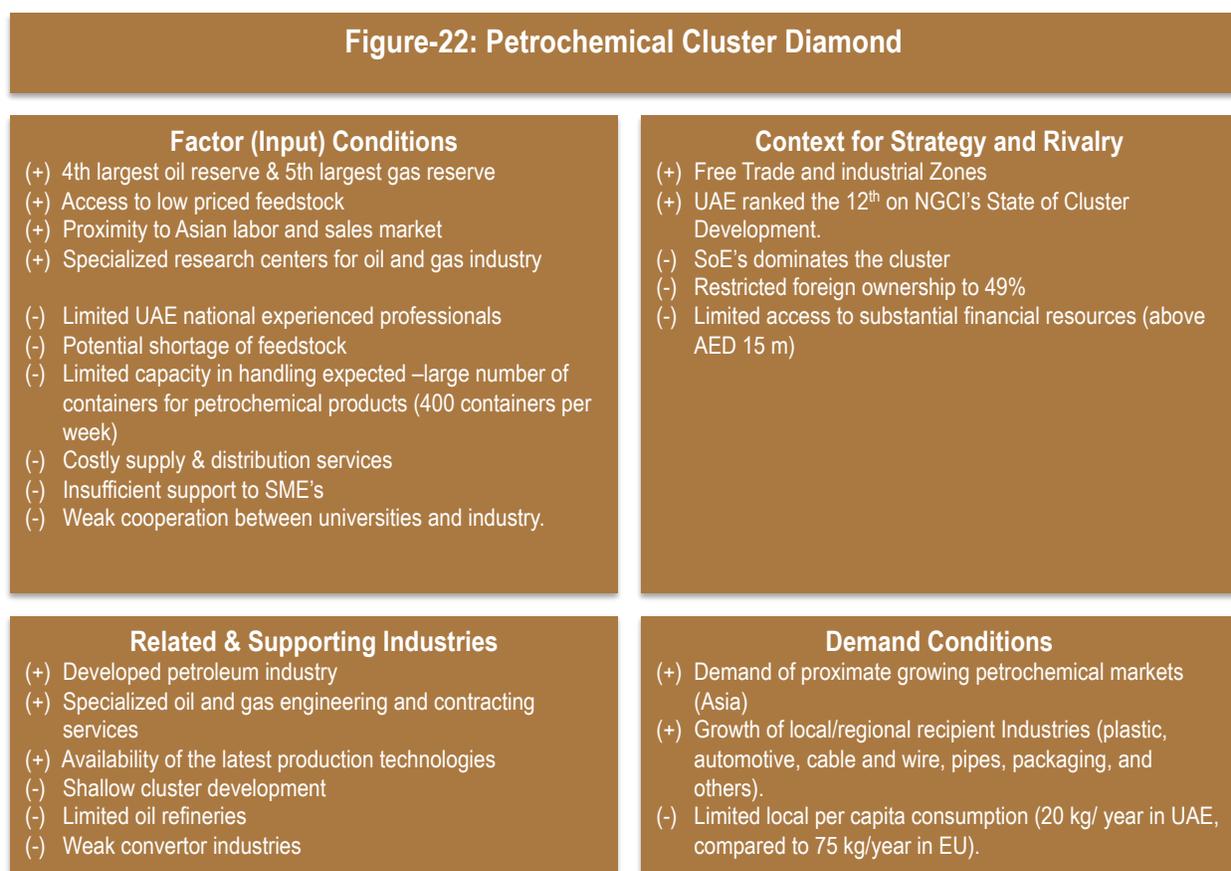
associated industries. The early 1980s, witnessed the creation of Ruwais Refinery, Fertil (fertilers) and International Petroleum Investment Company (IPIC) for undertaking international investment in oil and gas assets. For more than a decade long from 1985 to 1998, Abu Dhabi did not undertake any major oil and gas investments other than upgrading and refurbishment existing facilities. It took Abu Dhabi more than four decades to embark on its first down stream petrochemical investment through Abu Dhabi Polymers Company (Borouge) which sits at the center of the petrochemical cluster (refer to Figure-21).



4.2 The Petrochemical Business Environment (Cluster Diamond)

The petrochemical cluster is shallow, and dominated by four state owned enterprises. The cluster is clearly supported by the strong oil and gas cluster in the UAE, which provides access to cheap feedstock at the meantime. However, limited availability of feedstock in the future challenges the sustainability of the current privilege. The cluster is also supported by the strong logistics, financial, and educational cluster,

however, the domestic demand is insignificant due to absence of convertor industries. The cluster has limited international investments, due to the restrictions imposed on foreign ownership, which challenge the inflow of FDI to the cluster. UAE location supports growth in the emerging Asian markets, while local market consumption is still very limited compared to the European region. The following section details the competitiveness drivers and Figure-22 provides a summary.



4.3 Factor Conditions

4.3.1 Feedstock

Ethylene is the main building block for petrochemical industries, which is produced from a variety of feedstock that determines petrochemical cost structure and industry margins. Naphtha is the main feedstock used in Europe and Asia produced from refineries and offers higher proportion of co-products e.g. propylene and butadiene, which benzene can be extracted from. However, Abu Dhabi as well as other

producers in GCC region generate ethylene from gases such as ethane, propane and butane; a process that does not require a refinery (but it limits the proportion of co-products) which give Abu Dhabi and GCC countries a cost advantage for setting up petrochemical facilities over other regions.

Ethane prices are linked to international oil prices. However, for Abu Dhabi and GCC countries the actual cost of ethane is difficult to be determined exactly as it is integrated with the upstream oil and gas sectors.

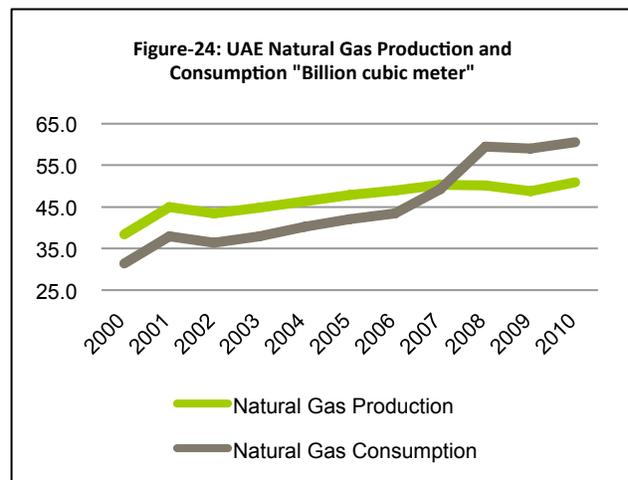
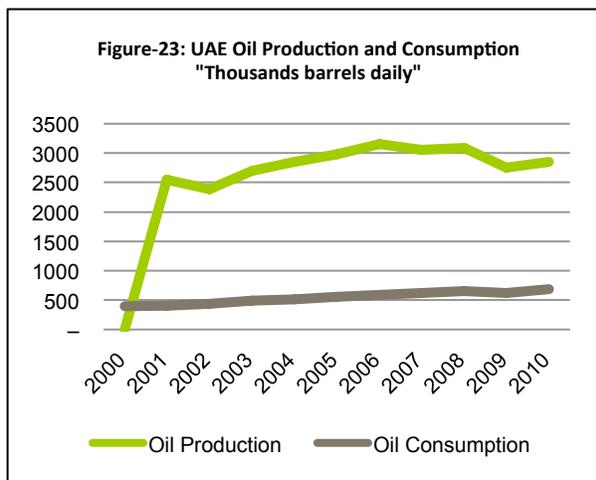
The ethane price in Abu Dhabi is estimated at around \$1.5/MMBTU compared to \$0.75/MMBTU in Saudi Arabia, \$1/MMBTU in Kuwait, \$1.5/MMBTU in Qatar (Diwan, 2009). Regionally, Abu Dhabi has no cost advantage over ethane feedstock. However it has a significant cost advantage over Western Europe and USA by a factor of 3. The ethylene cost of production from ethane in Abu Dhabi is not known, but it should be little higher than Saudi Arabia (\$114/ton) and Qatar (\$170/ton), and remains superior over other regions where prices stand at above \$400/ton (Diwan, 2009). Propylene (PE) and Polypropylene (PP) cost structure is derived from cracking processes where cost advantage could be gained from close proximity to markets and efficient operations that could be of stretch for state owned enterprises. Therefore, the competitiveness of Abu Dhabi comes mainly from cracking inexpensive ethane but as well as location due to its close proximity to growing markets in Asia.

Although Abu Dhabi has the world's fourth largest oil reserves and fifth largest natural gas reserves, it became a net importer of gas in 2007 due to high increase of demand for electricity which is fully generated from gas fired power plants (Figure 23&24). The country experienced feed gas shortage at power plants that led to electricity blackouts mainly in northern emirates while the capital city Abu Dhabi was saved by the arrival of Qatari gas through Dolphin Pipeline Project. Recently during summer 2011, another energy crisis unfolded as the northern emirates experienced shortage of gasoline at the pumping stations that signals limited coordination between petroleum industry and other industries. The growing economy, increase of population and highly subsidized utilities caused domestic oil and natural gas consumption to rise reaching 685,000 b/d and 60.5 billion cubic meters respectively in 2010 as shown in Figures-23&24.

The demand for electricity in Abu Dhabi will increase by 12% per annum reaching 22,356 MW by 2020 from a baseline figure of 6,885MW. Consequently, power generation feed gas demand will increase from 563,432 million cubic feet to 1,539,729 million cubic feet (ADWEC, 2011). The UAE also has become among the top ten countries consuming electricity in the world at a rate of 12,000 kwh per capita according to World Bank Indicators (WB, 2012), and it has recorded the largest per capita ecological footprint globally of (10.68 gha/person) according to Global Footprint Network (GFN, 2010).

Source: BP Statistical Review (BP, 2011)

The UAE is a member of Organization of the Petroleum Exporting Companies (OPEC) that coordinates



petroleum policies among its member countries effectively limiting oil production of Abu Dhabi. It is particularly troublesome for Abu Dhabi as most of the gas reserves are of associated gas type thus increasing production of gas would require increase in oil production. Abu Dhabi however progressed ahead with several projects to increase oil production to 3.5 million b/d up from 2.8 million b/d enabling an increase in gas production from 51 billion cubic meter to 77 billion cubic meters by 2020 (Krane, 2010). The Shah Sour Gas Development Project is an investment of \$10 billion in partnership with Oxy that will provide additional gas volumes to the market. The adoption of CO₂ Capture Technology if proven successful through the pilot projects being implemented in Abu Dhabi will enable freeing up large volumes of associated gas (currently being re-injected into oil fields for the purpose of enhanced oil recovery) for domestic consumption. However these developments still fall short from meeting future gas demand. It is

forecasted that by 2020, around 872,500 oil b/d will be consumed domestically and around 107.5 billion cubic meters of natural gas will be imported (Dargin, 2010).

The potential growth of petrochemical industry in Abu Dhabi is limited without massive investment in the upstream oil and gas sector as available ethane capacity is already fully committed to either power generation plants or Borouge facilities.

Alternatively, Abu Dhabi can consider using naphtha as a feedstock, but as a result the industry margins will be significantly reduced. While this maybe not an attractive option for state owned enterprise, it may offer an opportunity to further open up both upstream and petrochemical sectors for direct foreign investments. However, Abu Dhabi would have to provide foreign investors comparatively cheap feedstock prices noted above or other incentives on absence of domestic industries that demand ethylene derivatives of LLDE, PE and PP.

4.3.2 Human Capital

Abu Dhabi has undertaken several initiatives to develop the scarce human capital. The Petroleum Institute (PI) was created in 2001 with the goal of establishing itself as a world-class institution in engineering education and research in areas of significance to the oil and gas and the broader energy industries. The PI is affiliated with the Colorado School of Mines, the University of Maryland (College Park), the University of Minnesota, the University of Texas at Austin, Rice University, and China University of Petroleum. The PI's sponsors include Abu Dhabi National Oil Company (ADNOC) and four major international oil companies (BP, JODCO, Shell, Total). PI graduated total of 967 students by 2011, with undergraduate degrees in in chemical, electrical, mechanical and petroleum engineering, metallurgical and polymer science & engineering and petroleum geosciences. PI also offers graduate degrees, a total of 138 graduate students were enrolled into these programs in 2011.

ADNOC Technical Institute (ATI) was established in 1978 to offer vocational training to UAE nationals that meet the needs of state owned oil, gas and petrochemical enterprises for skilled national manpower. In

mid 2000s, ADNOC launched the Competency Assurance Management System (CAMS) across its associated companies to prepare and develop newly hired university graduates and built around mentoring and coaching principles. Khalifa University of Science, Technology and Research was established in February 2007 as an attempt by the government to close the technical skills gap; total of 853 undergraduate and 84 graduate students are enrolled into science and engineering programs.

Abu Dhabi Vocational Education and Training Institute (ADVETI) was established in 2007 and has six entities named Al Jazirah Institute of Science and Technology in Abu Dhabi, Al Jaheli Institute of Science and Technology in Al Ain, Baynounah Institute of Science and Technology in Al Gharbia, and Al Reef Institute of Logistics and Applied Technology in Al Shahama. ADVETI offers a diverse range of applied Certificates and Diploma programs that fit the job market needs including business, information technology, travel & tourism, design, environment studies, industrial technology, logistics and engineering. The programs were designed in consultation with Abu Dhabi industry and businesses.

Abu Dhabi Tawteen Council (ADTC) is a government entity that was established in December 2005 to focus human development of UAE nationals and integrating graduates into private sector. Despite these efforts, local skill shortages remain to be a challenge for key industrial players including Borouge, and industries continue to be dependent on foreign labor force.

4.3.3 Innovation Capacity

The innovation capacity of Abu Dhabi and UAE is low, the World Intellectual Property Organization (WIPO) recorded for the UAE zero patents registered in 2010 by the regional office but 100 patents were registered abroad, compared to Saudi Arabia that applied for 634 patents through regional office and 442 patents registered abroad (WIPO, 2011). Saudi Arabian Oil Co. (Aramco) and Saudi Basic Industries Corporation (SABIC) were the most active accounting for 57 patents in 2010 while none of oil, gas and petrochemical companies in UAE registered any patents over four decades of operations (WIPO, 2011). The Petroleum Institute is undertaking research projects in partnership with other institutions e.g. Colorado School of

Mines, the University of Maryland, the University of Minnesota, and CIM and has direct research contracts with various oil, gas and petrochemical companies in Abu Dhabi in energy efficiency, gas treatment, plastics and renewable energy. Borouge facilities are built around the licensed Borstar Technology of Borealis, a company that was acquired by Abu Dhabi based state owned enterprises. Borouge is establishing its own innovation center in Abu Dhabi to be opened end of 2012 that will provide research and development activities on plastics benefiting and building on the three innovation centers of Borealis, the International Innovation Headquarters in Linz, Austria; the Porvoo Innovation Centre in Finland; and the Swedish Innovation Centre in Stenugsund, Sweden.

4.4 Strategic Context and Rivalry

The establishment of Borouge in 2002 ended a decade long of silence in oil and gas investment through a coordinated effort by the ADNOC and IPIC. IPIC acquired Borealis, a Scandinavian firm which operates crackers in Finland and Sweden through its own licensed Borstar Technology that produces ethylene, polypropylene (PP) and polyethylene (PE), a necessary step to launch the petrochemical cluster in Abu Dhabi. Borouge became a joint venture of state owned enterprises i.e. ADNOC (60%) and Borealis (40%). Borouge is the central player of the petrochemical cluster, it is actually an extension of the upstream oil and gas cluster and it receives its feedstock from other state owned companies with majority shares by ADNOC and minority shares by international oil companies (IOCs) such as BP, ConocoPhillips, ExxonMobil, Mitsui Total, and Shell. The most recent partnership was awarded to Oxy in 2010 for the \$10 billion Shah sour gas development project. The partnership approach between NOCs and IOCs has been a crucial element of integrating UAE into the international arena and ensuring security of oil and gas facilities. The same approach could be replicated to grow the petrochemical cluster by allocating them feedstock as well as creating partnership in expanding feedstock production.

ADNOC as the national oil company remains to be the main investment vehicle for oil, gas and petrochemical industries, while the joint venture agreements with foreign partners are determined by SPC.

The energy planning is administered by SPC and it is not integrated with the mainstream economic policy making of the government that represents a challenge to coordinate government effort on developing the downstream sectors. The Abu Dhabi Policy Agenda and Abu Dhabi Economic Vision 2030 set broader goals to diversify the economy but does not offer solutions on the future developments of the energy sector nor oil, gas and petrochemical based recipient industries.

The direct ownership of national oil companies has the advantage of supplying cheap feedstock. However, the main disadvantages come from the NOC's focus on maximizing production and sales of crude oil and natural gas that make petrochemical clusters as secondary priorities which explain the late development of the cluster in Abu Dhabi. The integrated natural gas, oil refinery and petrochemical complexes however may offer advantages for direct ownership by a single national oil company, as it should maximize the value of petrochemical derivatives.

Abu Dhabi launched several new free trade industrial zones - particularly Higher Corporation for Specialized Economic Zones (ZonesCorp) for wide ranges of industries and Khalifa Industrial Zone (KIZAD) which is structured around the cluster concept targeting aluminum, steel, petrochemical and industries and others. KIZAD has been developed along with a modern deep-water port, which is opening at the end of 2012 to serve potential clusters. KIZAD is also located in close proximity to the massive logistic center of Dubai as well as international airports of Abu Dhabi and Dubai. KIZAD will be connected with petrochemical locations in western region through the proposed Etihad Rail. It offers tax-free environment, customs exemption and long-term land leases. The government would need to find ways to ignite growth of industrial sectors including petrochemical converters.

On regional collaboration; the Gulf Cooperation Council (GCC) offers its members a platform for coordinating foreign policies as well as economic policies including oil, gas and petrochemical clusters. Its members are key players in OPEC, which coordinates the petroleum policies among member countries. The Gulf petrochemical and Chemical Association (GPCA) represents the only institution that offer a

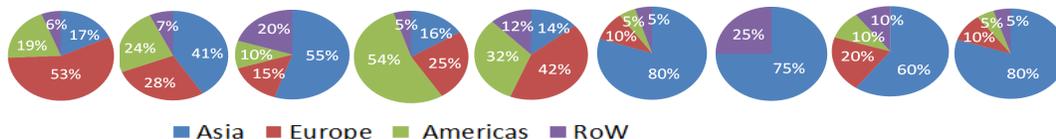
collaborate media for the petrochemical industry in the region. GPCA formed in 2006 by its eight founding members: SABIC (Saudi Arabia), Tasnee (Saudi Arabia), Qapco (Qatar), QVC (Qatar), Borouge (UAE), GPIC (Bahrain), PIC (Kuwait), and Equate (Kuwait). The Founding Members' vision foresaw a need for a voluntary and non-profit association focused on providing the resources, aid and technical assistance, needed by the petrochemicals and chemicals industry of the Gulf. This early insight proved to be accurate, enabling GPCA to come into existence speedily and be immediately accepted in the Gulf. Today it is the Gulf's sole trade association, respected and recognized as the collective voice of the petrochemicals and chemicals industries on regional and international issues of common interest. It is also the trusted source of authoritative data on the Gulf region's petrochemicals and chemicals industries, and has steadily expanded its influence and membership base to offer multiple platforms for stakeholders to network and share best practice.

On a global level, petrochemical clusters are concentrated in Europe and North America. Since the early 20th century the petrochemicals were dominated by MNCs such as Dow Chemical, Du Pont, and BASF. However, the 21st century changed the competitive landscape with the emergence of companies from Arabian Gulf countries (KSA, UAE and Qatar). Table-1 provides a snapshot of the largest global players in petrochemical industry.

Borouge, due to its proximity to growing markets of Asia, its cheap feedstock, strong established cooperation with global petrochemicals (e.g. Dow Chemical), and ramping up capacity quickly, gained a market share of US\$ 2.3 billion in annual sales (Table-1). Although Borouge has relatively low market share in global markets, its higher profit margins (19%) and return on capital (13%) relative to its peers is set to help it to gain more market share in coming years (Table-1). In general, Borouge and other companies within GCC are competing among each other for market share with SABIC (KSA) leading the pack, followed by Industries Qatar and Borouge (UAE). In a capital-intensive sector, where Borouge operates, it is important to have a large-scale international presence. In this direction Borouge is being

Table-1: Global Competition Landscape for Petrochemical Industry

Indicator	BASF	Dow Chemical	SABIC	Lyondel Bassel	Ineos	Formosa	Sumitomo	Industries Qatar	Borouge*
Founded (yr.)	1865	1897	1976	1953	1890	1990's	1913	2003	1998
Headquarters	Germany	USA	S.Arabia	Netherlands	UK	Taiwan	Japan	Qatar	UAE/AD
Employees	111000	51700	33000	14000	15500	5600	29380	3400	1600
Relative Share (%)	28%	17%	12%	15%	12%	7%	7%	1%	1%
Market Cap. (\$BN)	80.5	41.5	Private	24.4	Private	29.5	7.1	20.5	Private
Revenues (\$BN)	95.6	60.0	40.5	51.0	40.0	25.7	24.0	4.8	2.3
Net Income (\$BN)	8.0	2.7	5.6	2.2	0.48	1.4	0.3	2.3	0.4
R&D % of sales	2.18%	2.74%	0.43%	0.38%	-	1.63%	6.96%	-	-
Segments	6	6	6	5	6 (16)	6	7	3	2
P.Margin (NI/Sales)*	8.4%	4.6%	13.8%	4.2%	1.2%	5.4%	1.2%	47.9%	19%
ROE*	27.5%	13.1%	12.7%	19.3%	-	17.0%	4.5%	29.8%	13%
ROA*	11.0%	4.0%	6.6%	8.9%	3.4%	8.9%	1.7%	21.6%	-



Source: Annual reports of companies

* Borouge numbers and some other numbers are estimates

aggressive in two fronts through quick organic expansion of new capacity and via foreign acquisition of related companies and strategic investments. Relative to its peers UAE petrochemical cluster is smaller, but fast growing with already 1% of global market share of petrochemicals and 2% in polymers. Borouge also has different strategy in terms of geographic coverage and product segmentation, where it is focusing in global polymer markets in Asia (China) and targeting dominance in global polymer markets. Recently, however, taking advantage of cost-cutting program adopted by large US petrochemicals, the Abu Dhabi petrochemical sector has strengthened its international presence by acquiring styrene (styrene is the precursor to polystyrene and several polymers) productions in the US. This was done through NOVA chemical owned by IPIC (Abu Dhabi, UAE) and INEOS, which formed INEOS NOVA LLC, now the largest producer of styrene and polystyrene in Europe and North America, and second largest in the world.

The critical factor for petrochemical clusters is R&D spending and research facilities. The clusters in Europe and North America serve as home to leading research facilities in the world, set the benchmark for innovation productivity, and hold most of the petrochemical patents. Clusters in the US and Europe spend the equivalent to 2-3% of annual sales on R&D (Table-1). Meanwhile, the largest player in Arabian Gulf SABIC spends only 0.43% of its sales on R&D (Table-1) undermining its future growth and setting negative example for Borouge and other regional players.

4.5 Demand Conditions

The demand for petrochemicals in Abu Dhabi and UAE is very low and stands at 20kg per person annually compared to 70kg per person annually in Europe (Al Hajri, 2012). The domestic industries that demand polyethylene and propylene produced by Borouge are negligible as the plastic conversion industry in Abu Dhabi and across GCC is still at its infancy. However, the global plastic converter industry is growing and changing focus towards Asia instead of Europe.

The global petrochemical market is estimated to be a \$2 trillion in sales, making it larger than the oil market (Diwan, 2009). However the global demand is mainly concentrated in developed markets (US, West Europe and Japan) amounting to 60% of the global market.

Chemicals are main components of many industrial and day-to-day personal items e.g. plastic packaging, wire & cable systems, medical devices, automotive, piping systems, agrochemicals, paints and others. According to Cefic Chemdata International, during the last ten years the growth rate of global production in chemical industry was in the range of 4-4.6%, with Asia-Pacific region substantially outgrowing established markets of Europe and North America. Abu Dhabi, with its 14% of regional share, significantly lags behind the leading player (SABIC) on the production capacity of ethylene. The key for success for Abu Dhabi Borouge will be its ability to increase its capacity and stimulate domestic demand for its products.

4.6 Related and Supporting Industries

The petrochemical cluster is supported by strong logistical and transport clusters in UAE, ranked 24 worldwide by World Bank Logistic Performance Index (WB, 2010) that enables efficient shipment of products to international markets. Abu Dhabi Petroleum Ports Authority overseen by SPC owns and operates Jebel Dhana-Ruwais Port that is fully dedicated to serve oil and gas industries located on western region of Abu Dhabi. Borouge products introduce a level of complication to the port management, as it requires expanded handling capacity of 400 containers on weekly basis that would need revamping existing handling facilities and operations (Al Hajri, 2012). The UAE has embarked on building the first 1,200 km

industrial rail “Etihad Rail” that will connect all ports and industrial zones across UAE including Jebel Dhana-Ruwais enabling future growth in petrochemical and other clusters. The growth of petrochemical cluster should be coordinated with the expansion of the logistics cluster in order to accommodate expansion of exports. The petrochemical cluster in Abu Dhabi has not yet ignited the development of sizable and sophisticated related domestic conversion industries, a challenging priority that should be placed on top of government agenda.

4.7 Summary

The strengths of the petrochemical cluster in Abu Dhabi are mainly typified in its abundant reserve of oil and gas, which provided access to cheap feedstock, and its central geographic location, which provided access to emerging growing petrochemical consumer markets and labor markets in Asia. The petrochemical cluster is an extension of the mainstream and strong oil and gas industry value chain but it remains to be very shallow despite of abundance oil and gas reserves. The overall oil, gas and petrochemical value chain is fully owned by state owned enterprises with minority shares held by international oil companies.

The potential shortage of feedstock is expected to challenge the growth of petrochemical industry in the future coupled with government restriction on foreign investments in domestic market, inadequate capacity of the logistics cluster to handle large number of potential containerized exports in the future and absence of sophisticated domestic converter industries that create unfavorable underlying conditions that may inhibit formation of competitive petrochemical cluster in Abu Dhabi.

What matters most is for Abu Dhabi to stimulate creation of converter industries and clusters that can utilize the petrochemical products in order to lessen impact of full dependence on external markets. Abu Dhabi should also expand its refinery capacity, and move towards expansion of refined and added value petrochemical products and make every effort to profit from every stage of the oil and gas value chain. The

facilitation of further development and sophistication of downstream production, such as biopharmaceuticals could be a new course for upgrading the cluster.

5 POLICY RECOMMENDATIONS

5.1 Conclusion

Abu Dhabi has achieved good track record of economic performance and has been able to create underlying conditions of human development, governance and institutions favorable for unlocking economic diversification and growth. The diversification of the economy towards non-oil and gas industries is a challenging task that would require cluster based, collaborated and liberalized approach for development between government, industries and foreign investors.

Over the last forty years, Abu Dhabi and UAE has managed to develop an efficient logistics, financial, educational, and telecommunication infrastructure that supported the evolution of the petrochemical cluster. Abu Dhabi is relatively a liberal market supported by progressive government policies, and the petrochemical cluster is specifically supported by the oil and gas industry, which is the main driver for Abu Dhabi economy.

The shallow petrochemical cluster and its associated converter industries represent a potential economic diversification opportunity that could be pursued progressively by Abu Dhabi. Both public and private sectors should coordinate to develop of a joint growth strategy for the cluster. Such a strategy should mainly address restrictions on foreign investments, and propose new regulations to enhance the local business environment in Abu Dhabi and the UAE. The strategy should also look into capacity building opportunities to boost innovation, and enhance the capacity of national workers. As part of their responsibilities, local energy companies should invest in diversifying the downstream industries, and investigate new sources for feedstock. Regional cooperation with rival companies is favorable to enhance the efficiency of the cluster.

5.2 Recommendations:

Government Level

The Government interventions would mainly focus on applying a reform agenda to enhance the business environment in the UAE. Ease of doing business would attract new local and international companies to the cluster. Reforms would take the shape of new policies and procedures to address the following tactics:

1. Simplify the administrative process of starting business; develop and adopt insolvency, competition, and accounting laws/ standards.
2. Improve the rule of law application in the UAE, with special attention to investors' protections – including minority shareholders.
3. Ease the cluster-specific licensing requirements to promote creation of new recipient industry producers (e.g. piping system, packaging, automotive, wire and cable), and support startup and growth of new SME's. Facilitate creation of new companies would expand the cluster in both vertical and horizontal directions, and aim to increase complexity, and diversify products.
4. Eliminate national ownership requirement, following a gradual process, so as to open local companies for foreign investment in the down stream of the cluster.
5. Support increased privatization of State Owned Enterprises (SOEs), so as to enhance the industrial efficiency and technology transfer. It would be favorable to attract specialized FDIs that could enhance the sophistication of the industry in the productivity, marketing, and innovation fields.
6. Enable concessions to foreign investors in the upstream of the cluster to extract natural gas, which would provide feedstock to the petrochemical industry.
7. Establish Centers of Excellence to develop and apply "best practices" in the petrochemical industry. This would aim to enhance the efficiency and innovation of local companies. Increased cooperation among international organization, local universities and industrial companies is favorable, and could

introduce joint investments in research and development, as well as provision of incentives to new ideas and fresh innovations.

8. Support cooperation between cluster based IFC and local universities; through revising university curriculums to qualify graduates for the growing demands of the industry. Cooperation would also support job orientation and placement of fresh graduates in the petrochemical industry.
9. Create special Fund for small to medium enterprises in the field of the petrochemical downstream companies. Proposed Fund should complement the current Khalifa Fund, by offering larger scale access to finance (i.e. above AED 15 m). This would incentivize expansion of the local demand, and support diversification of the cluster products.

Cluster Level

Both the public and the private sector organizations should cooperate in developing joint strategies for the petrochemical cluster, and as part of the national vision of Abu Dhabi and the UAE. Cooperation should start on the institutional level, and as follows:

1. Develop a cluster-based strategy for the petrochemical industry, and ensure alignment between the Abu Dhabi vision and the actual developments of the industry.
2. Develop cross-cluster coordination by establishing “Abu Dhabi Competitiveness and Innovation Council”, which would be hosted within the Abu Dhabi Department of Economic Development (DED). The Council would coordinate the development process among the various stakeholders, and put forward recommendations to enhance the business/ investment environment in the UAE. The Council should investigate and propose policies for developing and diversifying the downstream industries of the petrochemical cluster, so as to increase the demand in the local market. The high-level political leadership should support the function of the Council, and facilitate implementation of recommendations. The Deputy Chairman of the Abu Dhabi Executive Council would chair the Council,

with membership from DED, Department of Finance, Chamber of Commerce, Abu Dhabi Education Council, Abu Dhabi Technical Committee and others.

3. Facilitate creation of Petrochemical Cluster Board led by Borouge with members representing oil and gas companies providing feedstock, DED, Abu Dhabi Economic Development Council Abu Dhabi Chamber of Commerce, and major petrochemical converter industries to formulate strategies and oversee development of petrochemical cluster.
4. Facilitate creation of Converters Cluster Board led by industry leaders with broad membership from industries and Petrochemical Cluster Board with responsibility to ignite growth of converter industries and increasing demand for petrochemicals.
5. Facilitate the establishment of cluster based IFC for the petrochemical industry to play a role in connecting the resources of a region, and fostering growth-led strategies. Borouge would lead the IFC activities, together with other key stakeholders. The cluster based IFC may include Abu Dhabi Chamber of Commerce, Abu Dhabi Technology Committee, representatives of cluster recipient industries, Petroleum Institute, Local Universities, and other stakeholders.
6. Facilitate collaboration among regional competitors in the Gulf Cooperation Council region, through leveraging the Gulf Chemical and Petrochemical Association. Cooperation should focus on providing new alternative resources for industry inputs, stimulating regional market demand, and supporting the regional development of the cluster. Establish a regional Center of Excellence for the petrochemical cluster to support research and development, so as to boost innovation and positioning of the regional cluster.
7. Launch awareness campaigns to stimulate local and regional demand for petrochemical products, aiming to increase the local per capita consumption. Campaigns would focus on products of the downstream industries of the petrochemical cluster, and would target local contractors, distributors and households.

8. Leverage the logistics cluster in both supply and distribution to better tap into the projected growth of the cluster. This would entail re-engineering port facilities to handle large-scale containerized shipments within fast turnaround times and reasonable costs.

Company Level

The private sector role would focus on enhancing the capacity of the cluster, developing the value chain, developing the supporting industries, and increasing the innovation level of the industry.

Invest in the downstream industries of the petrochemical cluster (e.g. piping system, packaging, automotive, wire and cable), with special attention to increasing the complexity levels and diversifying products. Such approach would expand the local demand for petrochemical products.

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