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Economic and financial valuation of the marble industry in Egypt

Farah Ahmed Haggag

The American University in Cairo

School of Business

ECONOMIC AND FINANICAL VALUATION OF THE MARBLE INDSUTRY IN EGYPT

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By Farah Ahmed Fouad Abdel Meguid Haggag

Under the supervision of Dr. Tarek Selim

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The American University in Cairo
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Abstract

This study is mainly to evaluate economically and financially the whole marble industry in Egypt. An industrial analysis on the marble industry is done which includes: summary on the international market of marble, sector and enterprises' structure, nature of competition, pricing, and differentiated marble and granite products in the local market. Also, a cluster analysis on the marble cluster is done that comprise: the marble cluster map, the marble cluster diamond, the five forces that shape industry competition, and competitive analysis. A financial valuation is conducted on the marble supply chain divided to the extraction and processing using an investment appraisal approach. The financial valuation includes: revenue cost analysis, estimation of capital investments, cash flow analysis, net present value, CAPM model, and profitability ratios. Afterwards, an economic valuation is done for the marble extraction and processing that incorporates economic cost and benefit analysis, economic investment requirements, industrial positive and negative externalities, natural resource depletion and sustainability using Hotelling's rent, net economic present value, and economic contributions. Based on the results, the main recommendations are: imposition of a Pigouvian tax of 36% on the marble quarries, removal of export duty on marble raw materials, and linking between marble extraction and processing rather than focusing on exporting extraction.

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List of Abbreviations

AET	Absolute Efficiency Test
BEP	Breakeven Point
BMEC	Building Materials Export Council
CAPM	Capital Asset Pricing Model
CASE30	Cairo and Alexandria Stock Exchange Index 30
CBM	Chamber of Buildings Materials
DPBP	Discounted Payback Period
EB	Economic Benefit
EBIT	Earnings Before Interests and Taxes
EBITDA	Earnings Before Interests, Taxes, and Amortization
EBT	Earnings Before Taxes
EC	Economic Cost
EDF	Export Development Fund
EGP	Egyptian Pound
EGSMA	Egyptian General Survey of Mining Authority
EMGTIC	Egyptian Marble and Granite Technology and Innovation Center
EPV	Economic Present Value
ERR	Economic Rate of Return
FOB	Free on Board
GOP	Gross Operating Profit
IMC	Industrial Modernization Center
IMM	Internazionale Marmo e Macchine Carrara
IRR	Internal Rate of Return
ITC	Industrial Training Center
MIFT	Ministry of Industry and Foreign Trade
NCF	Net Cash Flow
NEPV	Net Economic Present Value
NPV	Net Present Value
NPVVA	Net Present Value of Value Added
NRC	National Research Center
PBP	Payback Period
PV	Present Value
R&D	Research and Development
RET	Relative Efficiency Test
ROA	Return on Assets
ROE	Return on Equity
ROI	Return on Investment
SDR	Social Discount Rate
SER	Shadow Exchange Rate
UAE	United Arab Emirates
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USD	United States Dollars
WACC	Weighted Average Cost of Capital

Chapter One: Introductory Chapter

I. INTRODUCTION

The natural resources differ in types, deposits, features, and qualities from one country to the other as these resources have been geologically formed over decades in different conditions. Natural resource economics is very important in studying the scarcity and efficient allocation of natural resources. In addition, it develops the best methods and models for extracting, producing, and consuming the natural resources in ways that take into consideration the importance of sustainability of the natural resources for the future generations.

Dealing with natural resources in economics is completely different than dealing with any kind of unnatural inputs. This is because the natural resources whether water, energy, mineral, or natural stone resources are finite. Therefore, the natural resources should be dealt with in the most efficient way possible in order to reduce their wastes which are generated during their extraction as well as production; and most critically to work on sustaining their available deposits.

The consumption of natural resources have been rising day after day due to the increasing demand for their uses; most importantly the energy resources such as the natural gas or crude oil which have critical economic uses in enormous sectors. Referring to the "Depletion and the Long Run Availability of Mineral Commodities", Tilton (2001) stated that "human kind has consumed more aluminum, copper, iron and steel, phosphate rock, diamonds, sulfur, coal, oil, natural gas, and even sand and gravel over the past century than over all earlier centuries put together, and the pace continues to accelerate, so that today the world annually produces and consumes nearly all mineral commodities at record rates." Thus, this shows the huge increase in the level of consumption of various types of natural resources overtime.

Several measures should be considered for sustaining and expanding the available deposits of natural resources. Encouraging innovation in developing new methods of exploration and extraction of natural resources to increase the available resources is one of the important strategies that needs to be implemented to meet the increasing demand for natural resources. Also, awareness campaigns should be done to raise knowledge of using the natural resources efficiently in order to reduce their wastes. Furthermore, recycling

techniques of natural resources should be developed to make beneficial uses of the wastes of the natural resources.

The Egyptian land is rich in natural stone resources which are available in various colors, types, and qualities. Marble, limestone, alabaster, slate, basalt, and granite are found in Egypt having diverse features and qualities. The marble and granite deposits are extracted from quarries which are located in various areas: the Red Sea coasts (38%), Suez (14%), Sinai (11%), Upper Egypt (9%), and the Nile Valley (2%). (El Garf, 2011) Figure one presents the geographical location of the natural stone quarries; besides, providing the areas of the marble production plants.

Figure 1: Geographical Distribution of the Natural Stone Resources and Plants

Symbol	Description
□	Marble and Marbleized Limestone
△	Marble and Granite Factories
○	Alabaster

Source: Current Mining Development, Samih Afia, 1998.

The estimated number of quarries located all over Egypt is 500 quarries which include registered as well as unregistered ones. The number of the quarries is almost

geographically distributed as follows: 300 marble and marbleized limestone quarries in South Galala, 100 granite quarries in Aswan and Red Sea, 50 marble and granite quarries in Sinai, and 50 marble and marbleized limestone quarries in North Galala. According to the Egyptian Marble and Granite Technology and Innovation Center (EMGTIC), the quarries capacity is high in which they extract output which is equal to 5 million ton per year. The quarries are owned by the government and extraction is done by the marble manufacturing companies that rent the quarries from the state by paying fees which is on average 40,000 EGP annually according to the quarry size, capacity, and type of marble. The license is given to the marble companies for the duration of a year and can be renewed on yearly basis. Marble factories can operate several quarries together as long as they can run the rented quarries efficiently and commit to the payment of the rent fees.

The natural stone resources are different than other mineral resources due to the availability of different types and colors that can be present in the same area. In Egypt, there are the True Marble, Crystalline Limestone, Egyptian Granite, and other Ornamental Stone. First is the True Marble which is found within the basement rocks. The True Marble is crystalline limestone that is characterized with diverse proportions of dolomite. This kind of marble is available mainly in two places. The first place is Wadi Al Miyah which is located in the Eastern Desert between Edfu and Marsa Alam. In this place, True Marble has different color variation mainly white, black, or grey. The second place is Wadi Al Alaqi that is in southeast of Aswan. (Haggag, 2011)

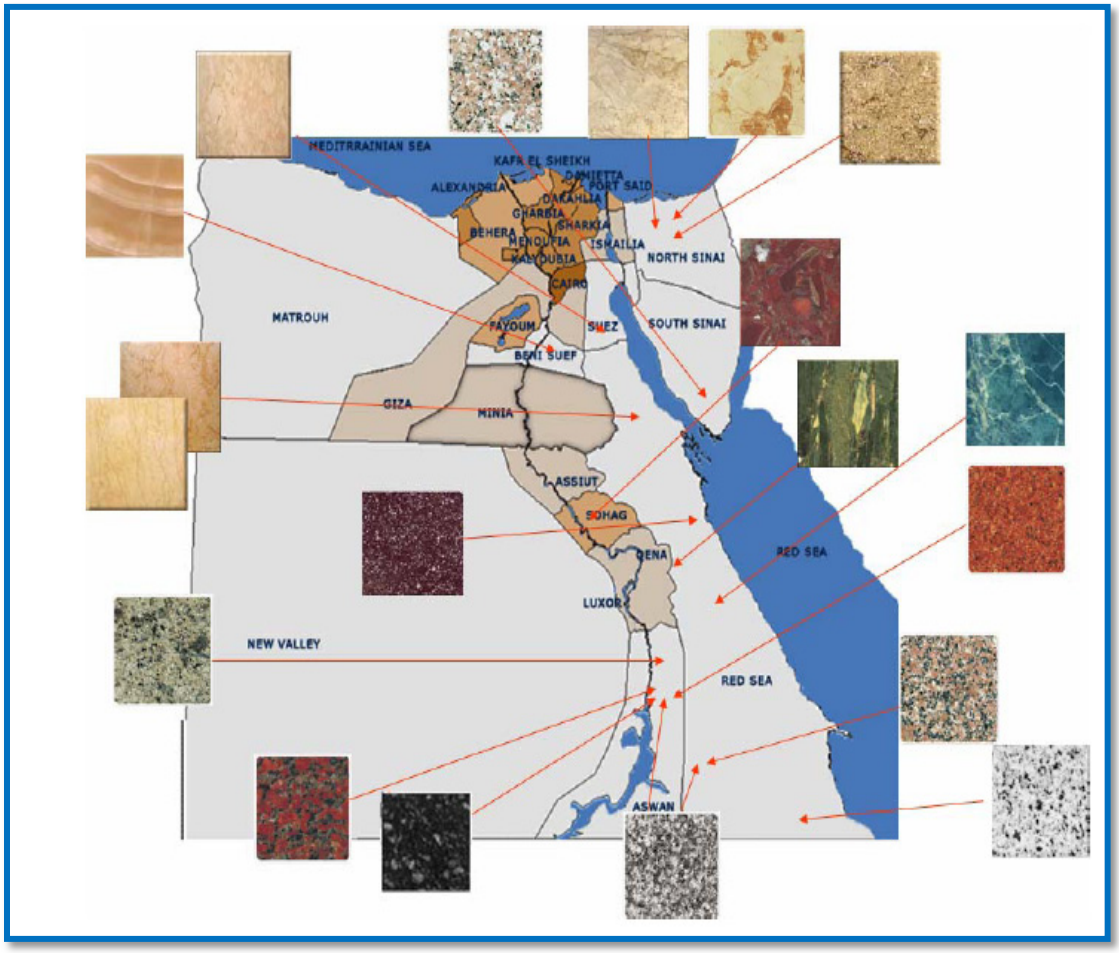
Second is the Crystalline Limestone that is hard limestone; it is found within the sedimentary rocks in the shape of lenses of different dimensions. In Egypt, there are several types of the Crystalline Limestone. The color of the Crystalline Limestone stone is shaped by the Iron Oxide and the Carbonaceous. The Crystalline Limestone can be found in many areas including: Al Menya, Assuit, Zaafarana, Al Hassana, and Khashm El Raqaba.

The Egyptian Granite is the third type of natural stone which is found in various colors in Egypt including pink, white, grey, and dark red. The granite is composed of feldspar and quartz with minor maffics crystals (4 cm in diameter). For example, some famous granite types are Red Aswan, Ghazal Dark, and Nero Aswan. Most of the quarries of the granite are located in Upper Egypt. (El Garf, 2011)

Fourth is the Egyptian Alabaster which is composed of semi crystalline calcium carbonate. The Egyptian Alabaster is considered a very unique type of stone. Its color is basically yellow or white lined. It is extracted from Wadi Sannur in Beni Suef.

Fifth, there are other types of Ornamental Stones that are available in Gebal Dokhan, west of Hurghada, such as: Imperial Porphyry. Also, other stones are found in Wadi Hamamt, in the Eastern Desert, like Berrica Verdi Antico. (Strategic Study on the Egyptian Marble and Granite Sector, 2005) After introducing the main types of natural stone in Egypt, figure two will show geographically the quarries of natural stone in Egypt by type and color of marble, granite, and other stones.

Figure 2: Geographical Distribution of the Natural Stone Quarries by Type



Source: Strategic Study on the Egyptian Marble and Granite Sector, Industrial Modernization Center, 2005.

Subsequent to studying the marble deposits locations and types, it is vital to present the marble supply chain starting from extracting the marble from the quarries till packing the final product that will be sold to the consumers to understand the whole production

process. The supply chain provides the two main marble processes which are the marble extraction and marble processing that will be studied in depth throughout the study. Figure three summarizes the marble supply chain in Egypt.

Figure 3: The Marble Supply Chain in Egypt

			
1: The marble quarries are explored either by the GIS or by random exploration.	2: Marble blocks are extracted by different methods such as explosives.	3: After the blocks are extracted, they are lifted and transported to the marble factories.	4: The marble bocks arrive to the factories and are left in the storage yard.
			
5: The marble blocks are cut into slabs.	6: The marble slabs are then polished.	7: The marble slabs are then cut into tiles of different sizes.	8: The slabs are packed and transported to the local market by trucks or exported by shipment.

Source: Author, 2011.

II. THESIS OBJECTIVE AND HYPOTHESES

The thesis title is "Economic and Financial Valuation of the Marble Industry in Egypt". The objective of the thesis is to carry out an economic and financial valuation of the marble industry from a complete supply chain perspective, starting from the extraction till the manufacturing of marble reaching a final good, using an economic and investment appraisal approach. The economic valuation of the marble industry will study the economic benefits as well as costs of the quarrying and processing. The financial valuation will examine the financial feasibility of the marble extraction and processing. This is important in working on developing short and long term plans as well as

recommendations for the industry to increase its economic benefits and reduce the associated economic costs.

Three main thesis hypotheses that will be examined are as follows:

- Are the processes of the marble extraction, or manufacturing, or both financially viable using a financial feasibility approach?
- Are the processes of the marble extraction, or manufacturing, or both financially viable using an economic cost and benefit analysis?
- Which policies should be developed based on the results of the analysis to efficiently utilize the marble deposits and production capacity in Egypt?

III. LITERATURE REVIEW

It is important to discuss the previous methods used to model the natural resources extraction, depletion, and production. Natural resources in the literature of economics can be classified as follows: the renewable class, the indestructible class, and the exhaustible class. First, the renewable resources are the ones that could be replenished or replaced over time like the wind energy, oxygen, or solar energy. Metals such as gold and silver can be considered renewable despite the fact that they can't be replaced but they could be recycled. Indestructible class is defined as "resource stocks, although are not augmentable, which are not permanently depleted due to their productive use." (Robinson, 1989) This class of resources includes atmosphere, oceans, and airwaves. Concerning the exhaustible resources, these are resources which are not augmentable which can deplete and can't be classified as renewable or even indestructible resources. In the book the "Economic Theories of Exhaustible Resources", Robinson stated that "naturally, the most important category of exhaustible resources is minerals and while nineteenth century economists spoke of minerals as being exhaustible, their investigations were more likely to have been described as the economics of mines rather than the economics of exhaustible resources."

The natural stone specifically marble and granite are considered exhaustible resources although there are high amounts of quarries and marble resources all over the world. This is due to the fact that the marble has been geologically formed for decades. The marble is one type of the metamorphic stones which are stones that change in form due to pressure, heat, and temperature resulting in profound chemical as well as physical change.

(Chisholm, 1911) The marble is derived from the limestone which has been exposed to massive amounts of geological heat that resulted in reforming the stone into a joint structure of dolomite crystals, aragonite, as well as mineral calcite. There are several models that were developed over time to study the natural resources' sustainability as well as depletion by Hotelling, Hartwick, Solow, Dasgupta and Heal, and Perman. These models and studies worked on developing methods on how to sustain the exhaustible resources in which they proposed that technical development in the resource extraction and recycling as well as the availability of substitutes are major factors in the resources' sustainability and meeting the increasing demands of the non renewable natural resources. This was further emphasized in Tamon's publication the "Economics and Sustainability: Balancing Trade Offs and Imperatives" in which he mentioned that Hotelling, Dasgupta and Heal, Hartwick, Solow and others have founded that "higher levels of consumption and welfare can be achieved if the degradation of exhaustible resources can be compensated for by technical progress and substitution between the natural resource and capital accumulation."

The "Hotelling Rule" is among the most famous economic theories of exhaustible resources that was developed by Harold Hotelling in the early 1930s. He is considered the founder of exhaustible economic theory. Hotelling's model has shown that non renewable and non augmentable resources will deplete overtime due to the resources' exploitation. He developed the "Hotelling Rent" which is the net economic profit or the marginal net benefit of the exhaustible resource that is equal $(P - MC)$ in which P is the price paid for the exhaustible resource which represents demand and the MC is the marginal cost of the resource extraction. According to Hotelling, the net economic profit will keep increasing on annual basis due to the rising level of the resources' scarcity. To emphasize more, the opportunity cost of consuming a unit of resources today in period 0 will be equal to the Hotelling rent obtained from selling the resource in period 1 which represents the future. The Hotelling rule can be summarized by this equation $\frac{(P_0 - MC)}{(1+r)^0} = \frac{(P_1 - MC)}{(1+r)^1}$ that is the set of allocations in which the discounted marginal net benefit in period 0 and period 1 are equal. The rate at which the net economic profit will be rising at yearly is equivalent to the rate of interest r. (Hotelling, 1931)

Partha Dasgupta and Geoffrey Heal in 1974 developed a model based on several assumptions: no capital depreciation in which capital will grow infinitely, no technical progress, and constant population growth. They considered the non renewable resource to be one of the studied factors of production besides capital and labor, which is constant, in a Cobb Douglas production function that produces an output. The production function they developed is represented by: $Y(t) = F(K(t), L(t), R(t), t)$ in which $Y(t)$ is the aggregate output, $K(t)$ is capital, $L(t)$ is labor, and $R(t)$ is the non renewable resource. They concluded that the marginal productivity of capital MP_K is equivalent to the marginal productivity of the exhaustible resource MP_R. They founded that the exploitation of the exhaustible resource will come to an end if the resource was found to be not vital in the production in which it could be excluded from the production process and has available substitutes. This happens due to introducing a backstop technology, having a random timing of introduction, which will totally act as a substitute for the exhaustible resource in which the marginal product of the resource MP_R will become bounded. (Dasgupta and Heal, 1974)

Moreover, in 1977, John Hartwick developed the "Hartwick's Rule" which mainly identifies the investment amount needed to be done in the produced capital $K(t)$ in order to compensate for the exhaustible resources' capital $R(t)$ that are decreasing overtime. The production function that Hartwick studied was as follows $Y(t) = K(t)^{\alpha} R(t)^{\beta}$; $Y(t)$ is the aggregate output, $K(t)$ is produced capital, and $R(t)$ is the non renewable resource. The production function $Y(t)$ has constant returns to scale in which $\alpha + \beta = 1$. The constant net investment in the produced capital $K(t)$ is necessary as well as sufficient for achieving the intergenerational equity in which the consumption per capita will be constant over generations. In Hatrwick's model, which is somehow similar to the model developed by Dasgupta and Heal, he assumed that the consumption is constant over time and deprecation rate of capital is zero. (Hartwick, 1977) Moreover in 1980, Hammond, Dixit, and Hobel worked on developing the results obtained by Hartwick in which they founded that the "constant net investment is necessary and sufficient for intergenerational equity." (Pezzey and Toman, 2002) In addition, they emphasized that the results founded by Hartwick holds in various economic models.

Robert Solow, the American economist and Nobel Prize winner for Economic Sciences, has contributed to the exhaustible resources works in economics. Solow worked on developing the conditions in which the constant consumption can be possible which were called the Solow criteria. He worked with a Cobb Douglas production function $Y(t) = K(t)^{\alpha} R(t)^{\beta} L(t)^{1-\alpha-\beta}$ where $Y(t)$ is the output of a single commodity, $K(t)$ is the produced capital, and $R(t)$ is the flow of a certain natural resource into production, and $L(t)$ is labor. In the model, the population was assumed to be constant and no technical progress, in which the constant consumption could be sustained. According to Solow, the resource flow should account for less than half of the production value in order to be able to accomplish constant consumption and ensure the intergenerational equity. He required the availability of substitutes between: exhaustible resource and a natural resource saving technology or other production inputs in order to achieve the constant consumption over time. Solow stated that "if it is very easy to substitute other factors for natural resources, then there is, in principle, no problem. The world can, in effect, get along without natural resources." This statement shows the importance of existence of exhaustible resources' substitutes in Solow's analysis. (Solow, 1974)

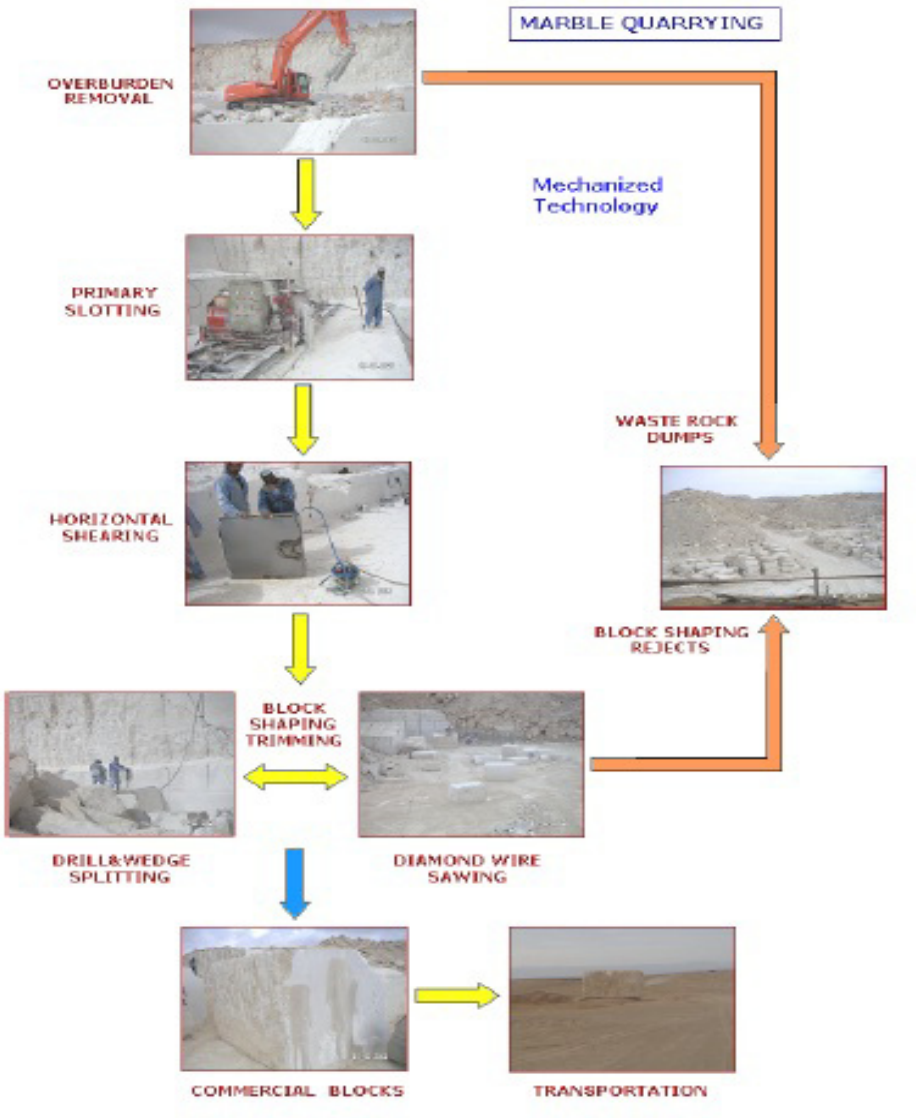
Roger Perman, in his book "Natural Resource and Environmental Economics" that was issued in 2003, contributed to the modeling of exhaustible resources. He focused on studying the issue of sustainability of natural resources differentiating between weak and strong sustainability. The strong and the weak sustainability aim at achieving constant consumption overtime. Concerning the weak sustainability of resources, it assumes that the substitutability conditions of Hartwick are met. The weak sustainability is concerned with the total capital stock which consists of natural capital $R(t)$as well as reproducible capital $K(t)$. The environmental constraints are effective over a specific period of time which he modeled by the inter-temporal constraint. It requires that the sum of reproducible capital $R(t)$and natural capital $K(t)$ to be non declining over time. However, the strong sustainability, according to Perman, assumes substitution is not possible at least in some important aspects. The strong sustainability is concerned with the non declining stock of capital in which the environmental constraints are met at every point in time. (Perman, 2003) Wilfred Beckerman has believed in the substitution of resources like other discussed theorists. However, he rejected the idea of the strong sustainability.

After discussing the different methods of modeling exhaustible resources, it is important to focus on dealing with marble and previous studies carried out on the marble resources' extraction in Egypt. In the study the "Characteristics of the Marble Industry in Egypt", the marble exploration and extraction in Egypt was studied. The process of exploration is carried out pre the quarrying in order to find out the location of the quarries and the types of marble deposited. According to the study, the discovery of the quarries is done on two steps. First, the quarries location is discovered either by the Geographic Information System (GIS) which is applied globally for exploring natural resources, or it is done randomly by exploring the areas that are known to be rich in marble. Second, after determining the quarries locations, a testing of a sample of marble is done by the Egyptian Geological Survey and Mining Authority (EGSMA) in order to identify the marble characteristics including type, color, deposits, and quality. As mentioned previously, the quarries after discovery are rented by businessmen from the government in return of paying annual rent and obtaining a license that can be renewed on yearly basis. The marble extraction in Egypt involves huge amounts of wastes due to the irrational quarrying operations such as the misuse of dynamite and lack of knowledge of the most efficient methods of extraction. The most common extraction method in Egypt was summarized in the study in which the authors stated that "the most critical operations are drilling vertical holes, using a twin-headed rig, and the use of a wire-saw cable for cutting the marble blocs; a flame cutter is used to blast a deep fissure into the quarry face." (Selim and Kandil, 2003) This extraction method results in high level of wastes and damaging the stone quality. In addition, in this study, an investment appraisal was done on a medium sized marble Egyptian firm which was found to have high and positive financial returns i.e. the internal rate of return was found to be 49.16%.

In the "Strategic Study on the Egyptian Marble and Granite Sector", the importance of technology used in the marble extraction in Egypt was highly emphasized. A distinction was made between the level of technology applied in the quarries by large scale companies and the technology used by small and medium marble enterprises. Due to the high level of technology and energy supply needed in the efficient extraction of marble, it is common to find divergence in the level of technology used in the extraction process from one company to the other according to the amount of budget allocated for the

extraction techniques. The technology used in marble extraction in Egypt is mostly imported from Italy, Spain, China, and the United States which are continually updated and requires high costs of application which small factories can't afford. For the large companies, "they have started introducing the rock slotter for the vertical cuts according to the low bench method allowing individual blocks to be directly extracted from the row by means of inflating cushion or similar techniques including the swelling agents." Figure four presents the mechanized marble extraction process carried out by the large firms.

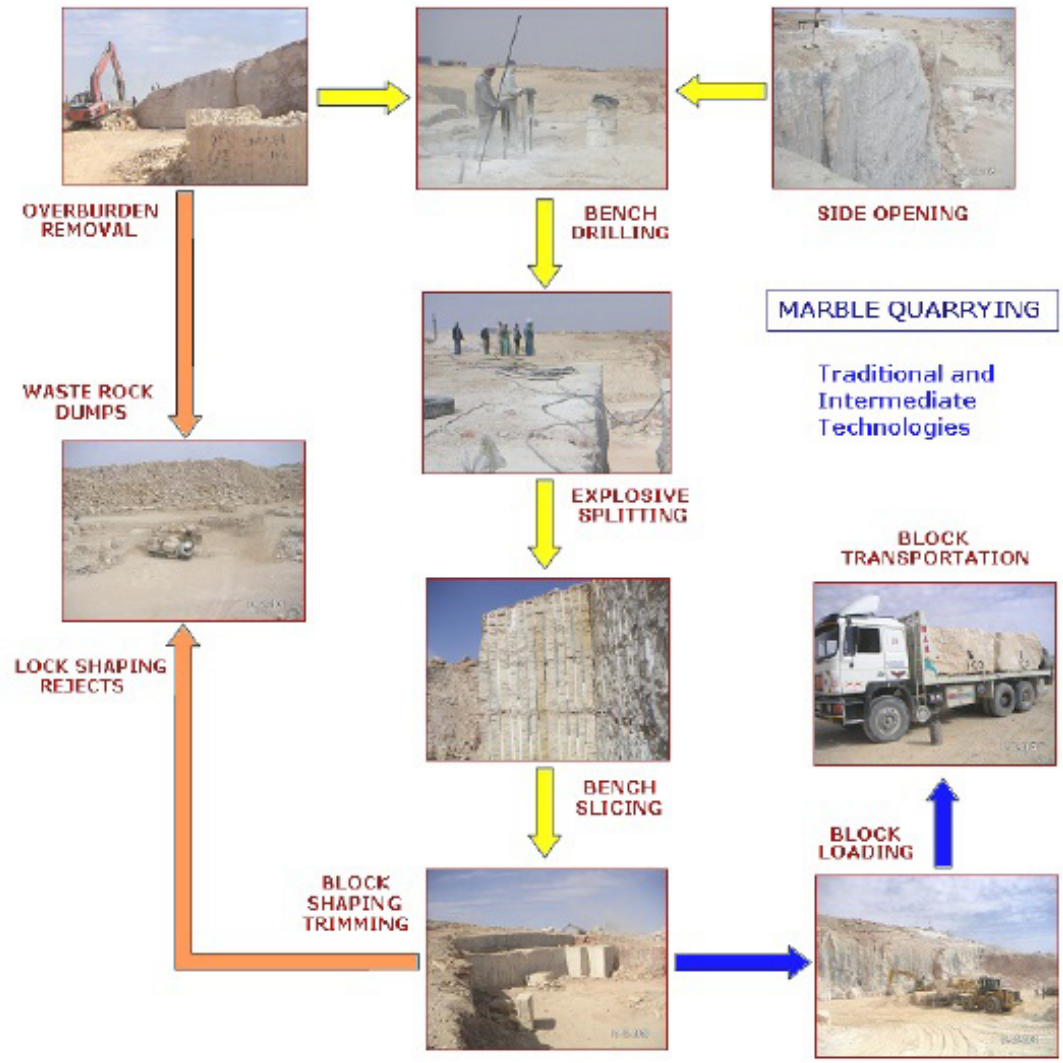
Figure 4: The Mechanized Marble Extraction Process in Egypt



Source: Strategic Study on the Egyptian Marble and Granite Sector, Industrial Modernization Center, 2005.

The mostly applied extraction method by the medium companies in Egypt is based on "the high bench method using explosive splitting as the main technology for the primary cuts and wedge shearing for bench slicing and for the final stages of block shaping." These outdated and inefficient methods in extraction damage the rock and result in huge amounts of wastes. It was mentioned in the study that "current practices indicate irrational exploitation of quarries such as random use of explosives and the obsolete technologies being employed in extracting marble and granite blocks lead to quick depletion of deposits and considerable reduction in the product quality." Figure five explains the extraction process of marble in Egypt used by the medium and small scale companies.

Figure 5: The Traditional Marble Extraction Process in Egypt



Source: Strategic Study on the Egyptian Marble and Granite Sector, Industrial Modernization Center, 2005.

The study also emphasized that the inefficiency in the extraction methods can't only be contributed to the level of technology used in quarrying activities, but also to the lack of energy supply mainly electricity and infrastructure in the quarries that affect the adoption of technology and efficiency of extraction. (Strategic Study on the Egyptian Marble and Granite Sector, 2005)

After examining the previous literature concerning the marble extraction in Egypt, it is vital to illustrate the extraction methods of marble in other developing nations to examine whether developing countries exhibit the same level of technology and challenges like Egypt or not. Thus, the marble extraction techniques in selected developing countries will be discussed such as Afghanistan and Turkey. Afghanistan is rich in natural stone resources which are rare and of high quality among its best natural stone deposits are the onyx and the white marble. In the study "Afghanistan's Marble Industry Competitiveness" that was conducted recently in 2011, the extraction methods held in the Afghanistan quarries were explained in depth. The quarries in Afghanistan don't use advanced technology in extraction due to the low level of investments as well as high financial constraints so they still rely on the method of explosives to extract the marble. It was stated in the study that "quarrying operations are conducted by blasting with dynamite, a process which yields irregularly shaped pieces of stone which are difficult to process and much of which are wasted. Furthermore, blasting causes microfractures throughout the stone, resulting in a lot of breakage during cutting and polishing; blasting not only creates these micro-fractures in the quarried stone, but can also do so in the entire quarry, destroying a great deal of the value of the stone." (Afghanistan's Marble Industry Competitiveness, 2011) The previous statement explains the damages involved in using dynamite to extract the marble in Afghanistan which are very severe and exploit the natural resources of marble available.

Another country case to consider is Turkey; Turkey is extremely rich in marble in which it almost has 33% of the marble deposits of the world. Turkey has created a place in the world market due to its high quarrying capacity and manufacturing base. The marble industry in Turkey is characterized by a huge amount of small and medium enterprises. However, the Turkish manufactures have a common goal of extracting and producing in the best possible quality in order to be able to compete internationally and sustain the

growth of the Turkish marble sector worldwide. In the Industrial Modernization Center study on marble that was conducted in 2005, the Turkish marble industry was studied mentioning that "thanks to focused investment in technology and advanced plants, Turkish stone operators have the technical and organizational resources to supply products with the level of standardization and quality control required by the international markets." It is a fact that still in Turkey irrational quarrying extraction methods is taking place like in Egypt and Afghanistan such using dynamite in extraction. However, the increasing national and foreign investments in the quarrying technology in Turkey have improved their level of technology used applying more updated extraction methods such as: the diamond wire and the chain saws which are considered more advanced relative to the developing nations. In addition, it is important to mention that Turkey has been involved in the production of quarrying and manufacturing machinery of marble to serve the local market and to export to developing nations. Thus, producing the machinery in Turkey has made it easier for the small and medium companies to advance their extraction methods. (Turkish Mining Industry Report, 2010)

IV. METHODOLOGY

As mentioned previously, the thesis will be mainly an economic and financial valuation of the marble industry in Egypt on both: the quarrying level and the manufacturing level. First, a financial feasibility approach will be followed to evaluate marble extraction and processing financially. Second, the cost benefit analysis which is also called economic feasibility will be conducted in order to analyze the economic benefits, costs, as well as externalities of the marble extraction and processing. Both approaches are significant in assessing the importance of an industry in the economy and its economic contributions. The time frame of the study is from 2007 to 2016. The study is based on current market prices of raw material and processed marble per ton.

The financial and economic valuation approach that will be done is based on the "UNIDO Manual for Evaluation of Industrial Projects" that was published in 1986 and is designed for the developing nations specifically. In addition to the UNIDO manual, several other methods of valuation were based on handbooks for cost benefit analysis and investment appraisal including:"Asian Development Bank Guidelines for the Economic

Analysis of Projects", "World Bank Handbook on Economic Analysis of Investment Operations", and "Project Appraisal Manual by Asian Development Bank", 2009.

The financial valuation will be done first on the 500 marble quarries which extract raw materials in the form of blocks, then on the 500 processing facilities that manufacture the marble blocks into slabs or tiles. First, the industrial gross revenue as well as the cost of operations will be calculated to estimate the gross operating profit. Afterwards, the capital requirements including: tangible fixed capital, intangible fixed capital, and net working capital will be measured based on the prices of 2007. Then, the optimal financial structure will be determined for the marble quarries and production plants. The cash inflows and outflows will be measured and discounted at the weighted average cost of capital (WACC). The net present value (NPV) and internal rate of return (IRR) will be estimated to test the financial viability of the extraction and processing. In addition other financial ratios to analyze both processes financially will be obtained including: the return on investment, return on equity, return on assets, financial leverage ratio, payback period, and others.

The economic valuation will be conducted on the extraction and processing of marble. First, the shadow prices will be derived for the: commodity, capital, labor, foreign exchange, and utilities markets. Then, the financial statements obtained in the financial valuation chapter will be converted to economic statements by accounting for derived shadow prices and removing the market distortions and monetary transactions. Afterwards, indirect benefits and costs of the marble extraction and processing will be quantified and included in the economic benefits and costs. The economic evaluation will be done by estimating the economic benefits and costs in addition to discounting them based on the shadow discount rate (SDR). The net economic present value (NEPV) will be measured and the economic rate of return (ERR) to determine the economic viability. Also, the value added, foreign exchange earnings, and employment effects will be estimated for the extraction as well as processing.

After carrying out the economic and financial valuation, the results will be compared in order to examine to what extent the marble extraction and processing are economically and financially viable. A financial and economic valuation comparison will be done between the marble extraction and processing. In addition, based on the results,

recommendations will be developed for the marble extraction, processing, and the whole industry.

V. DATA SOURCES

In order to economically and financially evaluate the marble industry in Egypt, huge amount of data and information are needed to conduct the cost benefit analysis and investment appraisal. The data required include primary and secondary data and studies.

The primary data will be collected by several ways most importantly conducting personal interviews with diverse marble stakeholders such as factory owners, factory employees, quarrymen, geological as well as economic researchers in the field, and government officials.

The secondary data will be obtained from previous studies on marble in Egypt, international studies on natural stones, and publications on: national production, exports, and foreign exchange earnings. The economic and financial data needed for the financial and economic valuation will be gathered from: the Building Materials Export Council (BMEC), Chamber of Building Materials (CBM), Egyptian Marble and Granite Technology and Innovation Center (EMGTIC), and National Research Center Geology Department.

Chapter Two: The Marble Industry in Egypt

I. SUMMARY

Before conducting the economic and financial valuation on the quarrying and the manufacturing of the Egyptian marble, it is very important to carry out a microeconomic industrial analysis on the Egyptian marble industry in order to understand the industry structure, pricing, inputs' markets, and cluster conditions. The chapter will start with an overview on the marble international market highlighting the most famous international marble products, the main importers, and the major exporters of marble raw materials as well as finished products. Afterwards, the evolution of the domestic industry will be outlined mastering the critical developments in the policies affecting the industry that took place overtime. In addition, the main marble and granite products available in the Egyptian market will be presented emphasizing their main technical and physical characteristics. The pricing and enterprises' structure of the marble industry will be examined as well. Additionally, a cluster analysis will be carried out on the marble cluster comprising the cluster map, the cluster diamond, the five forces that shapes industry competition, and the competitive analysis.

II. OVERVIEW ON THE INTERNATIONAL MARKET OF MARBLE

The marble is imported and exported internationally in the five continents with its diverse types, sizes, qualities, and finishes. As the marble is a natural resource, each country has different availability of its deposits, colors, types, and qualities. Thus, countries tend to import the marble types which are not available locally and export the types or colors that are found domestically with large quantities. For instance, Egypt import marble types like: Marron Emperador from Spain, and Bianco Carrara from Italy; and export Golden Cream, Galala, Sunny, and Hashma as well as others. Table one provides the main marble types by the major marble wealthy nations.

Table 1: The Main Marble Types by Country

Country	Main Marble Types
China	Beige Marble, Portor Gold, Green Jade, Tina Beige, Chen Green, White Vine Black, Leopard Skin Flower, Sea Wave Flower, White Jade, and Jinying Beige.
Egypt	Khatmeya, Golden Sinai, Silvia Dark, Silvia, Sunny, Menya, Red Breccia, Galala, Filetto Hassana, Hashma, Zafarana, Imperial Bronze, and Samah.
France	Breche Notre Dame, Rosso Francia, Var Beige, Noir Saint Laurent, Opera Fantistico, Corton, Elysee, and Frans Beige.
Indonesia	Mitalati, and Citatah Beige.
Italy	Bianco Teseo, Melograno, Giallo del Garda, Bianco Carrara, Portoro, Bianco Perlino, Botticino Classico, Talli WG Green, Talli Blue, and Gorgio Carnico.
Iran	Royal Batticino, Rosa Anarak, Aryan Royal, Bajestan, Simakan, Rosa Tea, Langdok, and Spring Organe.
Jordan	Royal Brown, Royal Black, Royal Mink Dark, and Royal Mink Light.
Philippines	K-Beige Caramella, Teresa Beige, Capistrano, and Capistramo Light.
Portugal	Bianco Botticino, Cream Marfil, Rosa Portugal, Rosa Lagoa, Beige Solar, Crème Champagne, Alpnina, and Azul Monica.
Spain	Marron Emperador, Perlato Svevo, Gris Malorka, Nero Marguina, Amarilla Mares, Marron Imperial, Crema Cenia, Rojo Cehegin, Crema Marfil Zafra, Rosa Zarzi, and Rojo Alicante.
Turkey	Bianco Botticino, Cremare Beige, Blanco Ibiza, Verde Laguna, Cremo Mustard, Salome, Gold Anatolia, Maya Beige, Aprhrodit Light, Fantasy Brown, Aphrodit Dark, and Rosalia.

Source: Author, 2012.

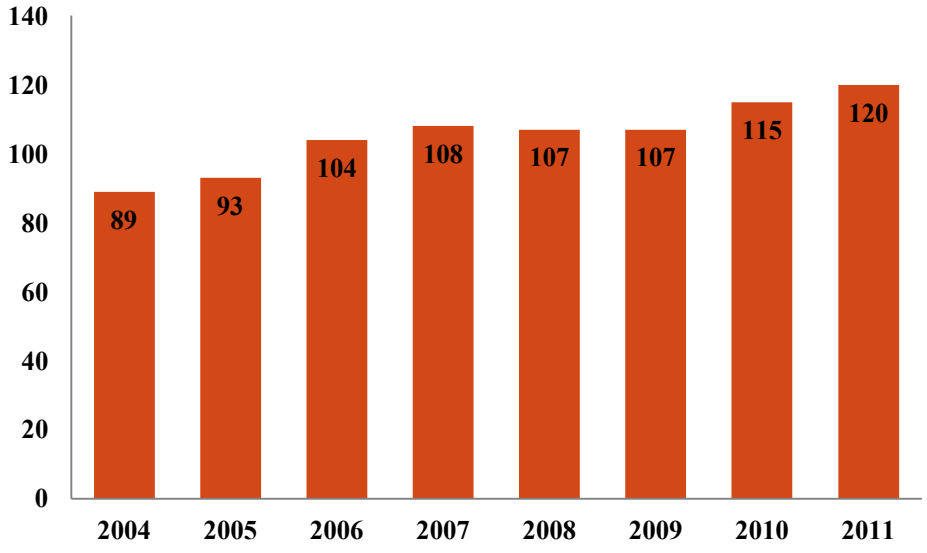
The marble extraction and production have been experiencing a high level of expansion starting the 1990s. This can be contributed to the rapid growth of the construction sector all over the world. Italy, India, Spain, China, Turkey, and Brazil have been outstandingly performing for the past years in terms of the extraction and production of marble accompanied with other nations including Egypt as well as Iran which have been growing and developing new marble products and finishes to gain a larger share in the international market. According to the "Strategic Study of the Egyptian Marble and Granite Sector", the global production capacity of marble and

granite have been rising on average by an 8.8% rate of growth annually starting the year 2000.

It is important to study the main exporters, importers, and producers of marble all over the world in order to understand the structure of the marble international market as well as position Egypt within the leading marble exporting nations. The major marble world suppliers include: Italy, Spain, China, Turkey, Greece, Egypt, and Portugal; while the main importers are the USA, China, Japan, Germany, Italy, and Spain. The most recent export and import data by country available for marble is for the year 2009. In this section, the marble quarry output, imports, and exports by country will emphasized.

The global quarry output of marble has rose by 34% from 2004 till 2011 reaching 120 million metric tons. (IMM, 2011) Egypt is among the top ten natural stone quarry producers in the world besides Italy, Spain, Turkey, Portugal, Brazil, China, Iran, and Greece. It was found while analyzing the marble international market that there is a very strong concentration of the natural stone production within the top ten producing nations which produce 92.6% of the world output. The other producing nations account for 7.4% of the total world quarry output which comprise nations like: Philippines, Jordan, Palestine, and Indonesia. Figure one presents the world quarry stone output from 2004 till 2009 measured in million metric tons.

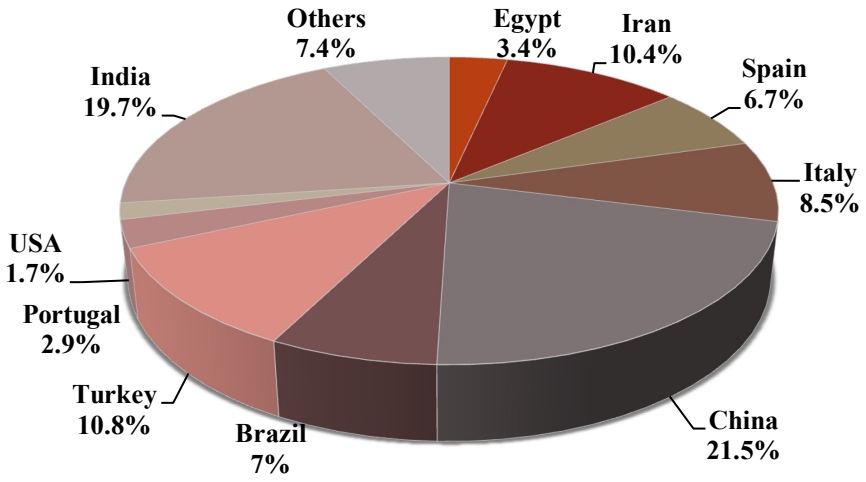
Figure 1: The World Quarry Stone Output (2004-2011)



Source: IMM, 2011.

After presenting the global quarry stone output, it is essential to look at the share of the top ten stone quarry producers in the world. Egypt is among the top ten quarry stone producers in the world having a share of 3.4% of the total worldwide quarry output. Figure two provides the share of each of the top ten global quarry stone producers in 2009.

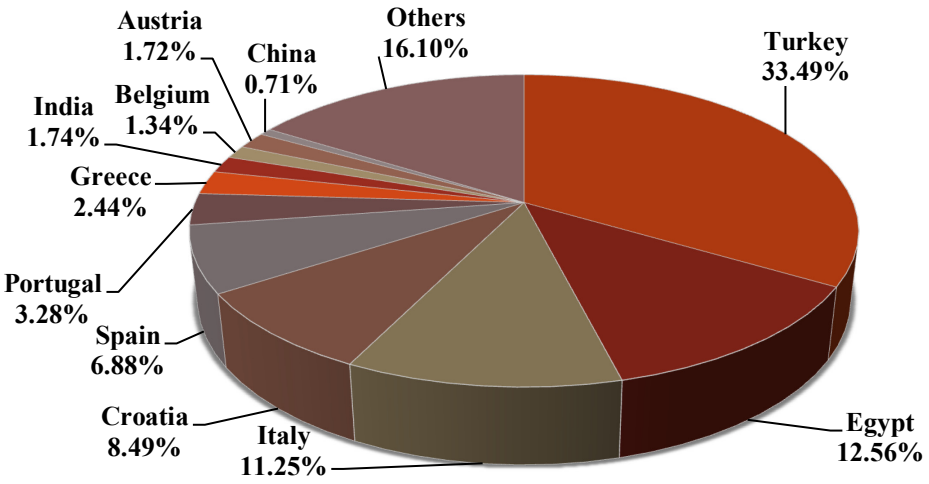
Figure 2: The Top Ten Global Quarry Stone Producers



Source: IMM, 2011.

The trade in marble consists of trade in raw materials in the form of blocks as well as slabs and finished products having the form of tiles. In the global trade of marble raw materials, there is a high level of concentration of certain leading countries. After examining the top global quarry stone producers, the structure of the marble international trade in raw materials will be analyzed. Egypt, Spain, Turkey, Italy, and Croatia are considered the top five exporters of raw material according to the estimates of 2009. These five countries account for 72.7% of the total amount of marble raw materials exported. Figure three provides the share of the main leading countries in the exporting of marble raw materials.

Figure 3: The Main Exporting Countries of Marble Raw Materials



Source: Marble and Beige Marble Industry Report, 2011.

According to the figures of 2009, Turkey is the largest exporter of marble raw materials having the share 33.5% out of the total global raw materials exports of marble. This is mainly due to the fact that Turkey is extremely rich in marble in which it almost has 33% of the marble deposits of the world. (Turkish Mining Industry Report, 2010) Turkey has created a place in the world market due to its high quarrying and manufacturing capacity. Egypt takes the second position after Turkey with the share of 12.6% out of the global raw materials' exporters due to being rich in marble deposits and having a high level of annual quarrying output. According to the EMGTIC, the annual amount of quarrying output is 5 million tons. Not only it is important to examine the share of the top marble exporters of raw materials, but also it is vital to present values of the marble raw material exports by the main leading countries. Table two provides the exports values of the marble raw material in thousands metric tons by country from 2005 to 2009.

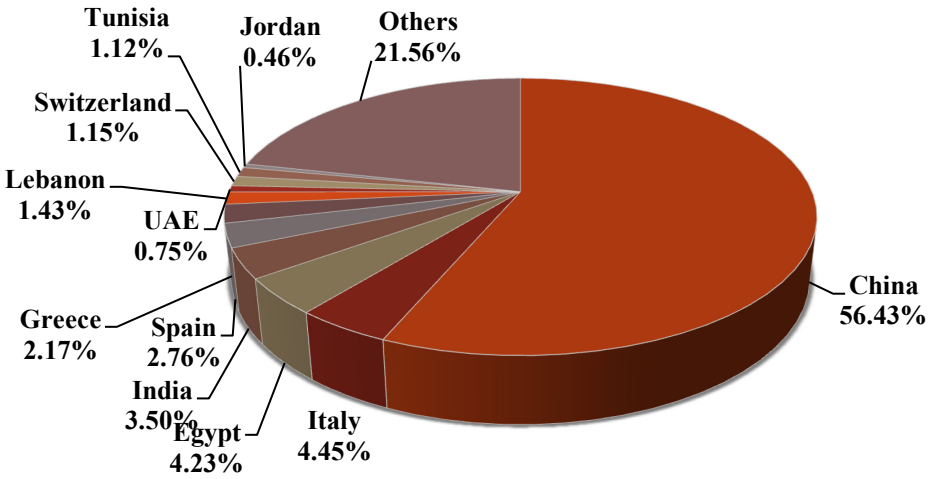
Table 2: Marble Raw Material Exports by Country (2005-2009)

Country	2005	2006	2007	2008	2009
Turkey	1586	2140	2675	3080	3199
Egypt	337	375	439	2102	1200
Italy	789	890	982	1007	1075
Croatia	938	1102	955	1220	811
Spain	1014	813	954	904	657
Portugal	170	250	287	295	313
Greece	231	282	243	240	233
India	161	196	218	203	166
Austria	71	81	108	156	164
Belgium	181	156	248	199	128
China	66	86	96	69	68
Others	1244	1343	961	1419	1538
World Total	6788	7714	8166	10894	9552

Source: Marble and Beige Marble Industry Report, 2011.

After examining the main leading exporters of marble raw materials, the value and breakdown of marble raw material imports by country will be analyzed. The main importer of the marble raw materials is China which imports 56.4% of the global raw materials imports of marble. China imports in huge quantities the raw materials of marble not only to meet the domestic demand but also to process the raw materials and re export it afterwards to markets like Japan, and Korea. Figure four provides the breakdown of the marble raw material imports by country.

Figure 4: The Main Importing Countries of Marble Raw Materials



Source: Marble and Beige Marble Industry Report, 2011.

The values of the raw material imports by country in thousands metric tons from 2005 till 2009 are provided in table three.

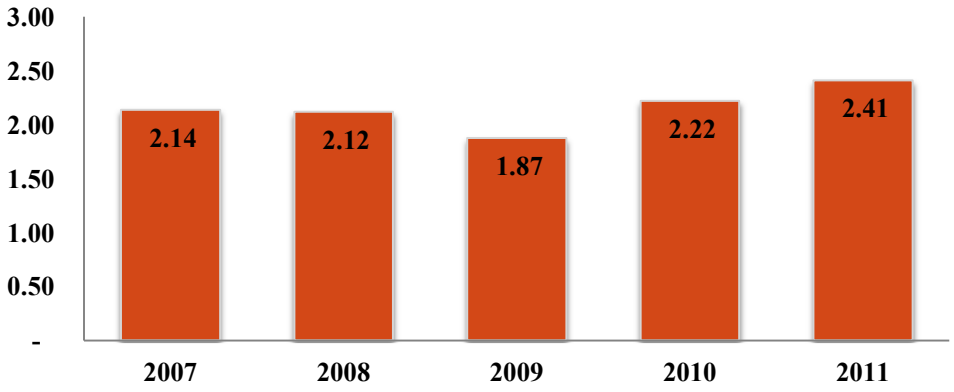
Table 3: Marble Raw Material Imports by Country (2005-2009)

Country	2005	2006	2007	2008	2009
China	2415	3398	4482	5093	5133
Italy	478	604	692	664	405
Egypt	43	20	15	479	385
India	110	155	175	250	318
Spain	226	238	249	314	251
Greece	237	260	308	251	197
Lebanon	95	89	97	115	130
UAE	87	57	95	110	68
Switzerland	119	107	112	104	105
Tunisia	78	71	77	101	102
Jordan	168	162	188	179	42
Others	2039	3638	1929	2594	1961
World Total	6095	8799	8419	10254	9097

Source: Marble and Beige Marble Industry Report, 2011.

After conducting an analysis on the marble international market in terms of exports and imports of marble output, it is important to analyze the amount of the Egyptian marble exports and the shares of its main importing nations over the last five years. Egypt is one of the top ten exporters of marble globally as shown in the previous international market analysis; having the second largest share of exports of raw materials worldwide. The Egyptian marble exports including raw materials and finished products have been rising on average by 4% annually. Figure five shows the export quantity in million tons of the Egyptian marble including raw blocks and finished products from 2007 till 2011.

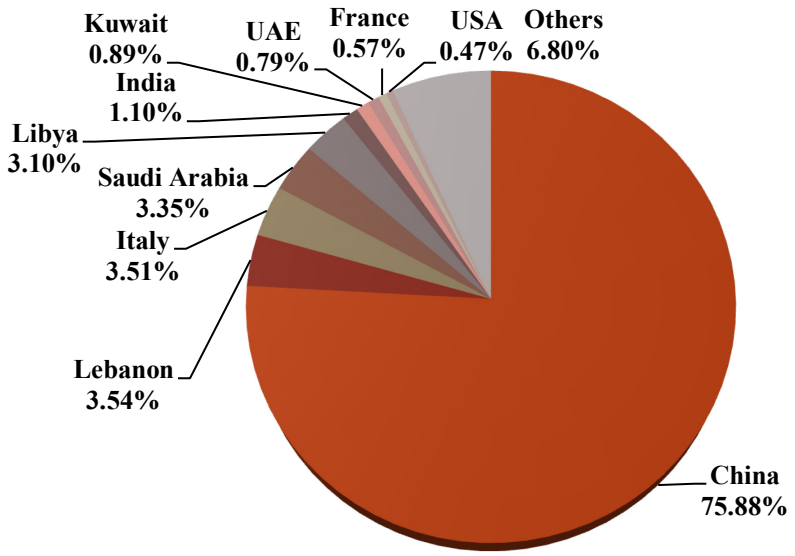
Figure 5: The Egyptian Marble Exports' Quantity in Million Tons (2007-2011)



Source: BMEC, 2012.

According to the Building Materials Exports Council (BMEC), Egypt exports marble in the form of blocks, tiles, or slabs to 130 countries in the five continents. However, the share of the importing countries is highly concentrated in minor nations. Figure six shows the share of the top Egyptian marble importers by country according to the estimates of 2011.

Figure 6: The Main Egyptian Marble Importers (2011)



Source: BMEC, 2012.

Referring to figure six, it is shown that China is the largest importer of the Egyptian marble having the share of 76% of the total Egyptian marble exports. As mentioned previously, China is considered the largest marble importer worldwide. The high share of the Chinese imports of marble is not only directed to meet the local

demand, but also for the purpose of manufacturing the raw materials and exporting them afterwards as final marble products to neighboring nations. It is also shown from the chart that the among the main importers of the Egyptian marble are several Arab countries including Lebanon, Saudi Arabia, UAE, Libya, and Kuwait. This is mainly due to the fact that Egypt is the focal and largest stone supplier in the Arab World. After carrying out an analysis on the marble international market, the evolution of the Egyptian local industry will be illustrated.

III. Evolution of the Local Marble Industry

The Egyptian marble and granite were used historically in Egypt. During the Age of Ancient Egyptians, the granite was extracted from Upper Egypt and used in the construction of buildings as well as temples. In addition, other cultures learnt from the Egyptian methods of extracting and cutting stones like the Ancient Romans in 3rd century B.C. (Selim and Kandil, 2003) Moreover, when the Romans took the knowhow of quarrying from Egypt, they transferred it to other places including Italy. Italy acquired the knowhow from the Romans and concentrated on developing the industry in which currently it is among the most leading suppliers marble in the world.

In Egypt, there were no significant uses of marble and granite after the Age of Ancient Egyptians. However, during the Islamic Civilization, the marble was imported from abroad to be used in the construction of mosques. For instance, Bianco Carrara marble was imported from Italy and used in the construction of El Zaher Bibars mosque in Old Cairo. Afterwards, the production of marble was present locally but on a small scale mainly used in flooring of villas as well as palaces. (Zaki, 2011)

In the early 1950s, there were two companies operating in the market for extraction: Egyptian Company for the Exploitation of Mines and Quarries as well as Egypt's Company for Mines and Quarries. (El Garf, 2011) The marble extraction started to spread locally and several quarries were explored. One of the main projects that marble was used in was the construction of the High Dam in Aswan. By that time, the Egyptian Geological Survey and Mining Authority (EGSMA) was

established to develop the natural resources sector including the marble and granite resources.

By the 1960s and 1970s, the imports of marble started to decline accompanied by the expansion of the marble local industry in which new marble processing firms opened including: Aswan Company for Marble and Granite. (Haggag, 2011) During the 1980s, the local market started to be more specialized and looked for the technicalities of stone production. The factories worked on enlarging the capacity of cutting and processing stone to increase their production capacity. The main production workshops and factories were concentrated in Al Basaten as well as Bab El Khalq in Cairo.

The marble industry started operating largely in the 1990s; several factories and workshops opened in Shaq Al Teban near Maadi district in Cairo. The marble companies were gaining high profits relative to their costs which were low. These companies had a low cost of extraction as they were using low mechanized technology. In addition, the human capital cost was low because labors were unskilled. (Selim and Kandil, 2003) The quantity demanded of marble increased by that time; however, there were supply shortages. The industry became attractive to businessmen who believed in its growth potential. Therefore, new companies were established featuring increases in the supply level of marble as well as the granite.

As soon as the marble industry started to flourish, business owners aimed at improving the technology of production through importing advanced machinery from Italy, Spain, and the United States. The imported machines resulted in increasing the cost of production. In addition, the labor cost rose reflecting the high demand for skilled labor. Therefore, the overall cost of production increased, while the price of finished goods started to decline due to the increase in the marble supply. By that time, Shaq Al Teban became the main and largest industrial cluster of marble production in Egypt.

From the 1990s till now, the industry has been expanding in which the number of factories reached 500 and workshops 2000. Some factories started to expand outside of Shaq Al Teban to other areas like 6th of October to benefit from the better quality

of infrastructure. However, still Shaq Al Teban is considered the largest marble processing cluster in Egypt.

The government was not concerned with the marble and granite cluster except starting 2000 in which there were several policies initiated to support the marble extraction, processing, and sales in the national and the international market. Prior to 2000, there was an environmental law number 4 that applied to the marble extraction and processing which was initiated in 1994. Under this law, the quarries should follow certain environmental standards. The EGSMA is responsible for controlling and monitoring the quarries and factories activities as well as reporting to the Egyptian Ministry of State of Environmental Affairs. Concerning the processing, the law stated that production lines' licenses should not be given to the marble factories except by guaranteeing that they will follow environmental standards in their production and waste disposal.

The Industrial Modernization Centre (IMC) was established in 2000 under the Presidential Decree number 477 as an independent body mainly funded by the European Union as well as the private sector aiming at modernizing the Egyptian industries. The IMC carried out more than 20 programs to support the Egyptian industries and promote exports. The most effective programs to the marble and granite cluster were: the Specialized Industrial Clusters Development Program and the Export Development Program. The Specialized Industrial Clusters Development Program aimed at increasing the value added, productive potential, purchasing power, and competitive advantage of the Egyptian clusters such as: Shaq el Teban of marble, El Roubiki for leather tanning, and Damietta's furniture cluster. The program worked on: developing different packages to each cluster to address their diverse needs, improving efficiency in manufacturing and supplying, supporting the access to finance, and encouraging innovation. Concerning the Export Development Program, it mainly worked on promoting the Egyptian exports abroad in which by 2009; the program offered 2464 services to 1406 exporters of marble, readymade garments, carpets, and leather. The services included: organizing international fairs which reached 79 fairs by 2009 in Europe, COMESA, and the United States, as well as

inviting importers locally to buy from Egypt and learn about the products available. (IMC, 2011)

The Export Development Fund (EDF) was established in 2002 under the Ministry of Industry and Foreign Trade law number 155 for supporting the exporting companies among them the marble exporting firms. The fund focused on providing several services to promote exports including: facilitating the communication between the local exporters and foreign importers, marketing the Egyptian products internationally, supporting cost efficiency to enhance competitiveness of the Egyptian exports aboard, and financing research. The amount of export subsidy provided to the marble sector is 155 million EGP from 2002 till 2011. (Ministry of Industry and Foreign Trade, 2011)

In 2005, the government was very concerned with the marble industry and adopted a vision to work on qualifying the marble and granite market as the "the focal stone market in the Middle East". (El Garf, 2011) Several efforts were directed to the marble industry to improve its conditions and enhance competitiveness. The High Commission of Quarrying worked on amending its regulations to develop the marble business environment. In addition, the government supporting agencies conducted cooperative plans to develop the marble cluster which comprised technological advancement, export promotion, quality upgrading, and cluster development.

Furthermore, the government initiated a framework of the Egyptian Export Support Scheme which started in July 2006 and was planned to have a 1 year period. Its main aim was to encourage suppliers to increase exports especially with quality improvements. "The Export Support Scheme provided suppliers with 8% of the value of export invoices, repaid directly to the exporter as cash money in local currency." (Zaki, 2011) The government extended the scheme for 6 years to end in 2012. About 30 marble companies or more were able to benefit from this framework; and worked a lot to improve the quality of their exports.

Also, in 2006, the Ministry of Industry and Foreign Trade established the Egyptian Marble and Granite Technology and Innovation Center (EMGTIC) under its technology development plan to enhance competitiveness in the marble industry by offering different services such as: trainings to workers, testing labs, infrastructure

development, and cluster advancement. This was the first government specific entity to be concerned with marble and granite technology and cluster development.

In 2009, a very critical law on marble exportation was initiated by the Ministry of Industry and Foreign Trade in which an export duty on the marble blocks was imposed that amounted for 80 EGP/ton. This law aimed at encouraging the marble blocks processing in Egypt to increase the economic value added and the foreign exchange earnings of the marble and granite industry. An amendment in this law was done in 2011 that increased the amount of the export duty on the marble blocks reaching 150 EGP/ton. The marble blocks suppliers were against this law as it increased their cost of exporting raw blocks. However, it is important to mention that this law was economically beneficial. Among its impacts on the cluster was that it resulted in the attraction of 24 Chinese marble firms which bought factories in the Egyptian cluster in order to process the blocks in Egypt and prevent the higher export prices of blocks that was affected by the duty. (Haggag, 2011) Figure seven summaries the evolution of the marble local industry highlighting the main developments and policy changes that took place overtime.

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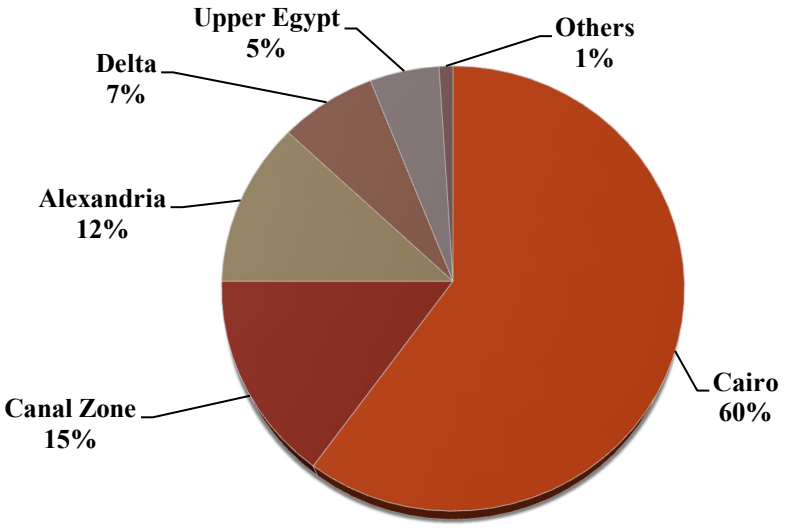
Figure 7: Timeline of the Evolution of the Local Marble Industry

Source: Author, 2012.

IV. STRUCTURE OF THE MARBLE SECTOR AND ENTERPRISES

The marble production areas are dispersed all over Egypt. However, 60% of the natural stone processing plants are located in Cairo. The geographical distributions of the marble production plants in Egypt by city are provided in figure eight.

Figure 8: Distribution of Marble Production Areas in Egypt by City



Source: Author, 2012.

The chart shows that Cairo is the main area for producing marble in Egypt. There are huge numbers of factories and workshops for marble production in Cairo. The marble production areas in Cairo include: Shaq Al Teban, Al Basaten, Al Qatameya, Bab Al Khalq, Al Qalaa, and 6th of October.

Shaq Al Teban is considered the largest marble production area in Egypt. It is the main marble and granite industrial cluster in which most of the factories and workshops are located there. It is located near Maadi and its area is about 1200 acres of land. Dr. Mahmoud El Garf, the former head of EMGTIC claimed that "with over than 1000 Million USD worth of processing lines and facilities, the industrial cluster at Shaq Al Teban is considered as one of the biggest four clusters worldwide."

Small workshops are located in other areas like El Basaten and Bab Al Khalq which used to be the main marble production areas in the 1980s. Both areas are not industrial zones and are highly populated with poor level of infrastructure. Large factories started to move nowadays to areas like 6th of October in which there is a better level of infrastructure than Shaq Al Teban in terms of supply of water and electricity.

According to the EMGTIC, there are 500 quarrying sites, 500 factories, and 2000 workshops in Egypt. After conducting several interviews with factory owners, it was

found out that almost all of the marble and granite production facilities in Egypt are privately owned and totally belong to the private sector with no public investments. The production facilities are mostly partnership in which the investments and risks are shared by the partners. In addition, most of the marble enterprises in Egypt are considered small and medium enterprises in terms of the investments and employment. This is mainly due to the fact that most of the sector enterprises are small workshops. The workshops suffer from several problems including: lack of adequate technology of machinery, low access to infrastructure, production inefficiencies, and unskilled labor. In addition, it was found out that there is a high degree of informality in the marble and granite sector in which several workshops as well as quarries are not officially registered and not involved in the taxation process.

Most of the marble factories in Egypt operate their own several quarries and do the whole production process starting by the extraction of the raw material from the quarries until providing the finished products to the market in the form of tiles. The factories import their extraction and production machinery from leading machineries' exporters like Spain and Italy in order to use the most advanced machines which are considered very expensive for the small marble workshops. However, there are some factories that buy the raw materials from other quarries or factories and only work on the processing of marble in order not to get involved in the extraction process which includes high level of costs for administration, capital, labor, and monitoring. The 500 factories of marble and granite are categorized according to their size in terms of investments, employments, and exports' value. Table four provides the grouping of the marble and granite factories from small to large factories according to a certain criteria.

Table 4: The Structure of the Egyptian Marble Factories

Factory Size	Amount	Investments (Million EGP)	Employment	Exports (Million EGP)
Small	385	From 5 to 15	50 and below	2 and below
Medium	90	From 15 to 30	From 50 to 99	From 2 to 5
Large	25	30 and above	100 and above	5 and above

Source: CBM, 2012.

Referring to table four, it is shown that the small factories have the highest number among the three categories in which they constitute 77% of the 500 factories. However, the large marble processing factories are few in number due to the high level of investments and employment requirements accounting for 5% of the total factories.

V. Available Marble and Granite Products in the Local Market

There are several kinds of natural stone in Egypt including marble, granite, alabaster, slate, crystalline limestone, and other ornamental stones. In this section, the main marble and granite products available in Egypt will be presented.

Most of the marble types in Egypt have the beige color and its light and dark shades. Egypt is known for the beige colored marble all over the world including: Galala, Rosa Cream, Sunny, Imperial Honey, and Silvia. The beige color is one of the most practical colors of marble globally for flooring and cladding indoors as well as outdoors. The beige marble accounts for 15% of the total marble consumption all over the world; the second after the grey marble which represents 45% of the global consumption of marble. (Strategic Study of the Egyptian Marble and Granite Sector, 2005)

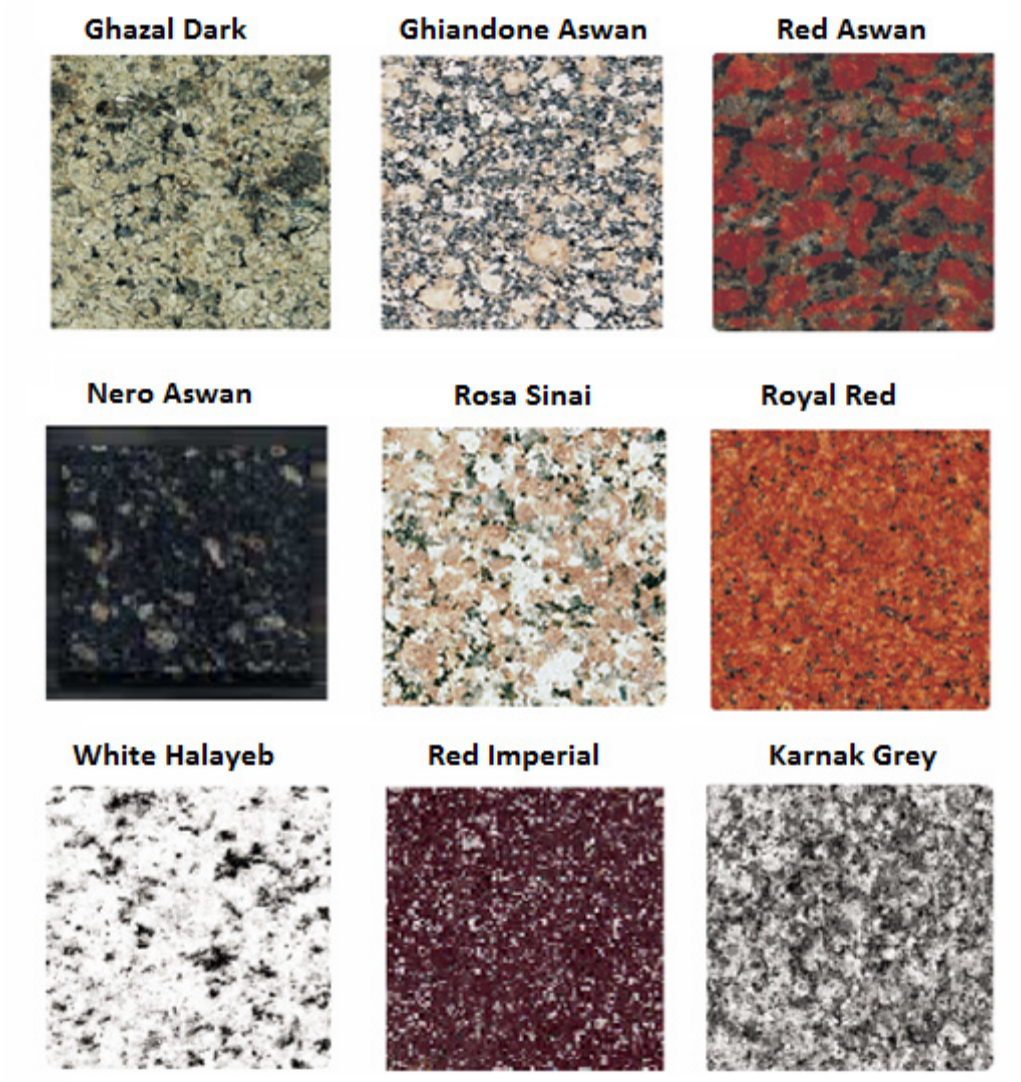
The most famous Egyptian marble products will be presented below in figure nine with their colors and commercial names.

Figure 9: Main Egyptian Marble Types

Source: Author, 2012

Egypt is also famous for some granite products including: Rosa Hoody, Sahara Brown, and Rosa Kali. The demand for granite products differs from marble products as each have different uses. Granite is mainly used in kitchens' surfaces, cladding, and funerary art. Figure ten provides the most famous Egyptian granite in the local with their diverse colors and names.

Figure 10: Main Egyptian Granite Types



Source: Strategic Study on the Egyptian Marble and Granite Sector, 2005.

The demand for the Egyptian marble and granite products differ from one type to the other not only due to the variation in color, but also demand is based on the characteristics of the stone whether physical or mechanical that influence the quality of the stone type. These characteristics include: water absorption, compressive strength, density, and tensile strength. To emphasize more, the higher the water absorption of the marble, the lower is the quality of the stone. In addition, the higher the stone density, the stronger is its quality and durability. Table five provides the mechanical and physical characteristics of some types of Egyptian marble as well as granite.

Table 5: The Technical and Mechanical Characteristics of Egyptian Stones

	Compressive strength kg/cm^2	Tensile strength kg/cm2	Water absorption %	Density kg/m^3
Sylvia	644.0	86.8	1.62	2,478
Sahara beige	824.6	124.0	0.29	2,618
Filetto Hassana	1,035.4	105.0	0,17	2,675
Sunny	824.6	124.0	0.29	2,618
Golden cream	638.6	105.4	1.42	2,581
Golden Sinai	1,252.4	124.0	0.2	2,662
Golden Yellow	1,252.4	124.0	0.26	2,662
Khatmiya	967.2	99.2	1.31	2,567
Galala classic	824.6	111.6	0.12	2,627
Botticino Sakolta	781.2	111.6	0.12	2,581
Cream Samaha	824.6	124.0	0.29	2,618
Giallo Cleopatra	824.6	124.0	0.29	2,618
Cream Beige	1,450.8	148.8	0.24	2,646
Light Beige	824.6	111.6	0.12	2,627
Tropical rose	1,320.6	124.0	0.87	2,56
Limestone Beige	632.4	74.4	7.39	2,156
Sinai Pearl	967.2	99.2	1.31	2,567
Breccia Sinai	1,252.4	124.0	0.26	2,662
Golden Honey	1,399.5	194.9	0.12	2,645
Grey stone	1,320.6	161.2	0.12	2,627
Ghiandone Aswan	1,333.3	142.6	0.09	2,634
Ghazal light	1,481.8	142.6	0.07	2,645
Rosa Elnasr	1,413.6	136.4	0.15	2,639
Red Royal	1,258.6	124.0	0.13	2,621
Red Fersan	1,345.4	142.6	0.08	2,634
Red Aswan	1,227.6	117.8	0.89	2,628
White Safaga	1,320.6	161.2	0.12	2,627
Bianco Halayeb	1,618,2	155.0	0,28	2,659

Source: Strategic Study on the Egyptian Marble and Granite Sector, 2005.

The prices of some of the marble and granite types presented in table five will be provided in the pricing following section. After introducing the main marble and granite types highlighting their technical and mechanical characteristics, the price structure of the marble will be examined.

VI. PRICING

The marble pricing is based on the cost and revenue analysis of the production process starting from the extraction of marble until the product is offered to the market. The cost is divided on two production processes: the extraction process of marble from the quarries, and the processing process of the blocks into tiles of different features. Each process has a different cost structure that affect the pricing of the marble tiles in the market. Based on the data obtained from the interviews with the factories owners, table six provides the price structure of the blocks representing

their extraction costs as well as the finished products' price structure which involves production process costs of tiles. In addition, the average percentage of profit per blocks and finished products are presented in the table.

Table 6: Price Structure of Egyptian Marble Blocks and Finished Products

ITEM	Blocks	Finished Products
Cost of Capital	27%	24.3%
Cost of Manpower, Management, and Administration	1.7%	3%
Cost of Energy, Fuel & Water	6.4%	1 %
Cost of Maintenance	3%	2.7 %
Cost of Consumables	6%	23%
Taxes	11%	9%
Others	1%	1%
Net Profit	44%	36%
Total	**100%**	**100%**

Source: Author, 2012

The provided price structures of blocks and finished products were determined from the data collected from the factory owners of medium and large factories. It is important to note that there are high variations in the technology used from one production facility to the other that can highly influence the price structure. As mentioned previously in chapter one, the different methods used in the marble extraction in Egypt in which there are firms that rely on traditional extraction methods like the use of dynamite in extraction, while other firms use advanced technology in extraction as the chain saw or diamond wires. The same also applies to the marble processing in which the machineries used in each production facility are not necessarily of the same cost or level of technology. Thus, the differences in the costs of capital and maintenance highly create variations in the price structure of marble.

The marble pricing is not only based on the cost and revenue analysis, but also it is greatly affected by the marble characteristics like: the type, quality, cut, polish, and size of the marble tiles which have high influence on the cost of production and price structure. These characteristics are as follows:

- *Marble Type:* the type of marble has a great effect on the price of marble. The more the marble type is scarce and rare, the higher its price in the market. For instance, the Egyptian consumers demand some marble types which are not available in Egypt like the Spanish Marron Emperador and the Italian Botticino Classico. The consumers are willing to pay higher for these products almost triple the price of the marble products available in the domestic market or more.
- *Marble Quality:* the quality of the marble is determined by its technical and mechanical characteristics including density and water absorption that were illustrated in the previous section. The better the quality of marble in terms of its long term durability, the more it is priced in the market.
- *Marble Tiles' Size:* there are standard sizes of marble tiles in terms of surface size and thickness in the market. The standard thickness of the tiles in the marble is 2 cm or 4 cm in which the 4 cm is almost double the price of the 2 cm tiles. The standard surface shapes are mainly the rectangle and square shapes which have various standard sizes. The square standard sizes include: 30cm×30cm, 40cm×40cm, and 60cm×60cm; while the rectangular standard sizes comprise: 30cm×60cm, 40cm×80cm, and 60cm×90cm. However, sometimes project contractors, consumers, or importers demand a specific cut and size of the tiles which require a higher cost of production. Thus, the unique sizes of the tiles increase their market prices.
- *Marble Finish:* there are different finishes of the marble tiles which are based on the uses of the marble whether for flooring or cladding indoors and outdoors. The finishes include the shinny, mat, and antique finishes of the marble tiles. The complicated finishes are more priced like the antique finish which requires complex production process.

After introducing the factors that influence the marble pricing, it is worth mentioning that the marble suppliers don't have a high influence on the increasing the prices of the finished products or blocks due to the intense competition in the local market. In addition, there is high competition in the market from the cheap marble imports. Thus, the suppliers influence over the price is very low reaching maximum

10% increase or decrease which is mainly contributed to the specific marble characteristics which were mentioned formerly.

After explaining the marble pricing structure, it is vital to highlight the market prices of some selected types of marble and granite in the market for blocks as well as finished products. The average prices ranges of marble as well as granite selected types of blocks and slabs as obtained from several suppliers will be provided in table seven

Table 7: Prices of Marble and Granite Selected Types

Marble	Blocks	Slabs (2 cm)
	USD/m^3	USD/ m^3
Sinai Pearl	265 – 300	14 – 18
Silvia or Sunny	250 – 290	13 – 17
Filetto Hassana	270 – 320	15 – 17
Galala Classic	280 – 330	14 – 18

Granite	Blocks	Slabs (2 cm)
	USD/m^3	USD/ m^3
Red Aswan	450 -520	32 – 36
Nero Aswan	700 – 850	40 – 55
Gray Granite	300 – 380	29 – 35
Rosa Aswan	260 – 380	25 – 28
White Halayeb	460 – 500	32 – 36

Source: Strategic Study on the Egyptian Marble and Granite Sector, 2005.

The Egyptian marble prices are considered lower than European and Chinese marble. This is mainly due to the fact that the costs of manpower and utilities are lower in Egypt than in Europe or China. Thus, Egypt benefits from lower prices in the international market which highly influence demand.

VII. NATURE OF COMPETITION

It is very important to analyze the nature of competition in the Egyptian marble and granite sector as competition highly influences the demand and supply for marble. The marble sector is very competitive in which several types of competition exist including: the price competition, quantity competition, product differentiation, and technology competition. In this section, the three types of competition in the marble and granite sector will be illustrated.

The marble sector is highly price competitive. This is mainly due to the high number of suppliers in the market. There are 500 factories and 2000 workshops supplying marble besides the unregistered ones. Therefore, the high number of suppliers in the sector results in a high level of price elasticity. The suppliers are price takers and have very low influence on prices although the costs and marble features highly affect the price structure as emphasized in the pricing section. If the suppliers increase their prices, they will lose sales and their market share. In addition, some small suppliers tend to reduce their prices to gain a higher share in the market. This is based on the cheap technology they use relative to the large suppliers that produce with more expensive machineries. In addition, there are several suppliers of imported cheap marble which make the market more competitive in terms of price. Thus, the high number of suppliers in the market, the sales of cheap marble by small suppliers, and the availability of imported marble in the market create an intense price competition.

The quantity competition is also present in the marble and granite sector. Marble is an important building material and is used in the construction of large and medium scale projects for different applications including flooring, interior cladding, exterior cladding, and stairs. It is important to first introduce the main types of consumers of the marble in order to be able to illustrate the factors influencing the quantity competition in the market of marble and granite. Figure eleven explains the different types of marble consumers and their demand characteristics of marble.

Figure 11: The Main Marble Consumers and Their Demand Characteristics

<table>
<tr><td colspan="2">Marble Factories</td></tr>
<tr><td colspan="2">Deal directly with</td></tr>
<tr><td>Contractors
Middleman between factory and big end user</td><td>Workshops
Middleman between factory and small end user</td></tr>
<tr><td>Characteristics of demand:
• Big quantities demanded for one transaction.
• Finished product with specifications supplied from factory.</td><td>Characteristics of demand:
• Regular demand.
• Varying quantities according to market requirements.
• Semi finished product, further processed by workshop.</td></tr>
<tr><td>Beneficiary/client is a big entity:
• Hotel and mall.</td><td>Beneficiary/client is a small entity:
• Household, small shops, etc.</td></tr>
</table>

Source: The Characteristics of the Marble Industry in Egypt, 2003.

The main consumers of marble are the contractors and workshops. The local or international contractors demand regularly large quantities for the construction projects while the workshops or the end consumers demand varying quantities. The suppliers which are able to supply any type of the consumers with the quantity demanded are more competitive in the market. Therefore, firms work hard on their efficiency as well as capacity of production to be able to compete in the market especially that the marble is used in large scale projects which require huge amounts of marble with specific characteristics. In addition, the contractors have high influence on the price determination of the marble as they demand large quantities; they tend to get the best offers and discounts from the suppliers.

In the marble sector, competition is not only based on price and quantity, but also highly influenced by product differentiation. As noted previously, the marble has diverse characteristics including: type, size, quality, polish, and finish. These features make the marble very differentiated and firms compete in order to develop their products in a creative and unique way. For instance, firms currently develop new finishes of the marble to be more differentiated locally and globally. There is a vertical differentiation of marble based on quality which is influenced by the technical and mechanical characteristics of marble and horizontal differentiation of marble by color and type. The marble suppliers tend to explore different quarries and search for more marble colors and types to be more horizontally differentiated in the market.

Competition in the marble industry is also influenced by the level of technology used in the quarries and processing facilities. There are diverse types of machineries for the marble extraction and processing worldwide with different levels of technology which are developing every now and then. The higher the level of technology used by the factories, the more is the degree of efficiency as well as the productivity of the factors of production allowing the firms to produce in higher quantities. The efficiency of the production and extraction processes also reduces the unit cost of production of the marble suppliers influencing their competitiveness level in terms of pricing. In addition, the advanced technologies like the chain saw or the diamond wire have proven to reduce the level of waste associated with the marble

extraction and processing. Thus, the more advanced the technology used by the marble factories and quarries, the more the level of competitiveness of the marble producers in terms in cost efficiency, production capacity, and product differentiation.

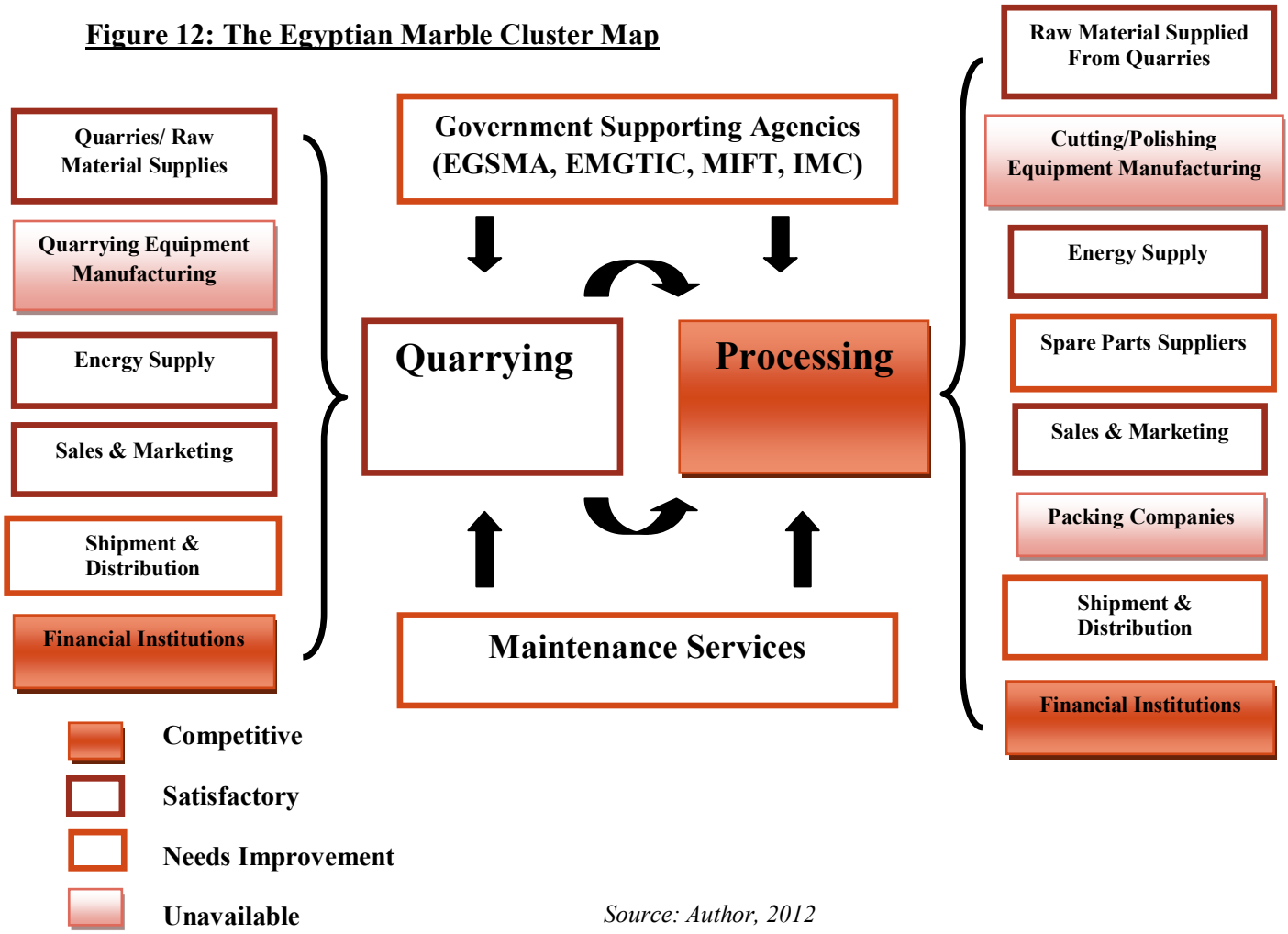
VIII. MARBLE CLUSTER ANALYSIS

In this section, the cluster analysis of the marble and granite cluster will be carried out apply Michel Porter's approach. The marble cluster map, marble cluster diamond, the five forces that shape industry competition, and the competitive analysis are illustrated in this section.

A. Marble Cluster Map

The cluster map is very important as its presents the related and supporting industries to the marble and granite cluster. In addition, it highlights the status of each of the involved industries in the marble and granite quarrying and processing between being competitive, satisfactory, needs improvement, weak, or unavailable in order to show the overall conditions of the cluster and related industries. Figure twelve presents the cluster map of the marble and granite cluster in Egypt providing the status of each industry on the quarrying as well as manufacturing level based on the interviews conducted with quarrymen and marble producers in addition to the previous studies on marble industry in Egypt.

Figure 12: The Egyptian Marble Cluster Map



Source: Author, 2012

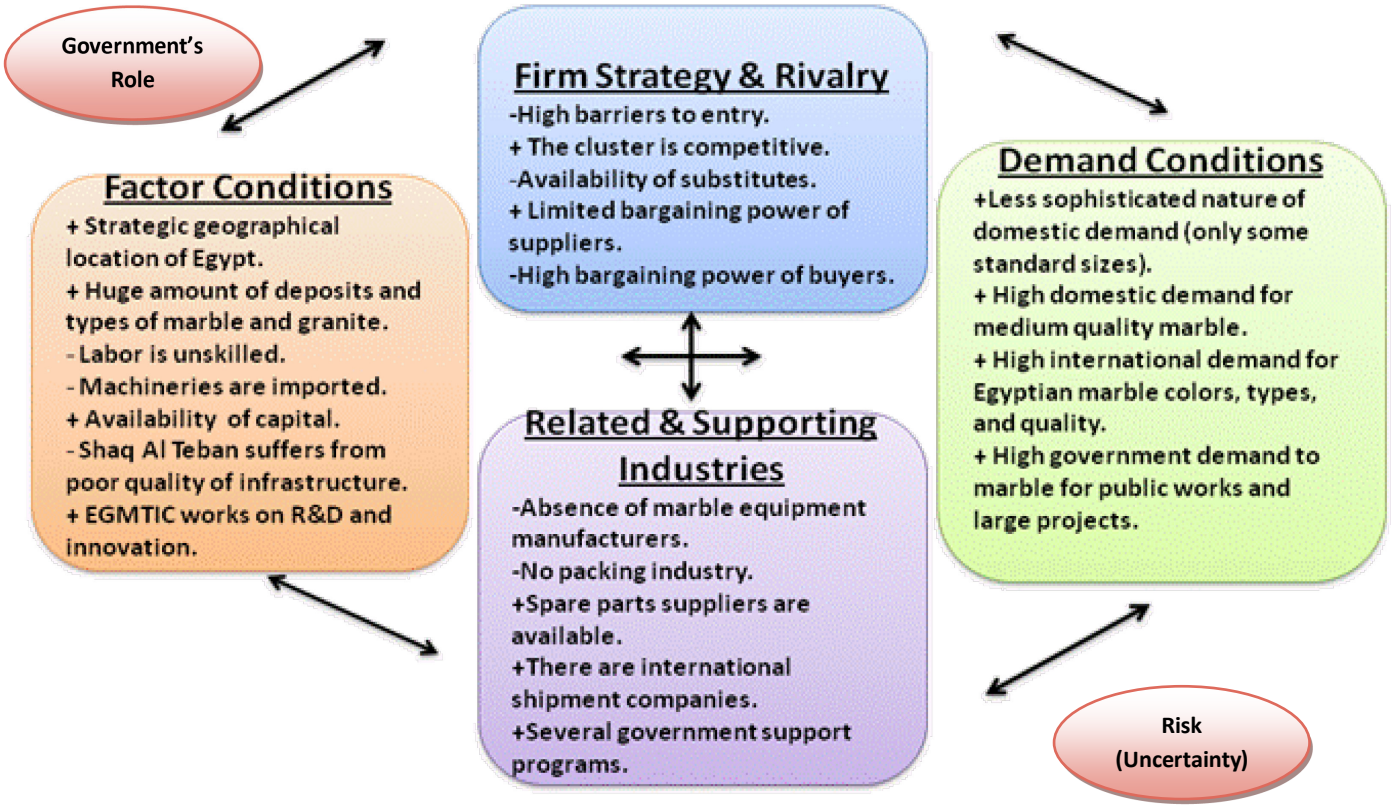
Referring to the cluster map, it is shown that the main unavailable industries are the equipment manufacturing ones which include the quarrying equipments needed in the quarries as well as the cutting and polishing machineries that are used in the processing plants. These machineries are mainly imported from Europe, United States, and Asia. They require high level of technology and costs so the Egyptian marble and granite suppliers import them to use in extraction and production. There are no available industries for the marble manufacturing equipments in Egypt. There are no producers of machinery, abrasives, resins, or diamond tools. In addition, the packing companies are unavailable too. The packing process of the marble takes place in the marble factories in which the packing materials are bought and the marble gets packed in the factories. Some carpenters work for packing in the plants in which they produce wooden boxes that the marble tiles are packed in. The quarries supplies, energy supply, sales and marketing, and the quality of raw material supplied

from the quarries are satisfactory and could be developed further. For instance, the sales and marketing departments have to work on developing a strong consumer relationship management system with the marble importers in order to sustain their relationship with them and increase their market share. The maintenance services, the government supporting agencies, and the shipment and distribution need improvements.

B. Marble Cluster Diamond

After discussing the marble and granite cluster map, the cluster diamond will be constructed based on Michael Porters' approach evaluating the marble cluster' factors conditions, related and supporting industries, demand conditions, government role, risk, and context for firm strategy and rivalry. Figure thirteen is the cluster diamond of the marble and granite cluster providing the summarized aspects of the six studied pillars.

Figure 13: The Egyptian Marble Cluster Diamond



Source: Author, 2012.

i. Factor Conditions

- *Natural Endowments:*

The marble and granite resources are highly available in Egypt in which the amount of discovered quarries is 500 quarries in addition to the unregistered ones. According to the EMGTIC, the quarries capacity is high in which they produce output equals to 5 million ton per year. Not only the marble and granite have huge deposits in Egypt, but also there are various colors, types, and qualities of marble and granite available. Granite types include: Royal Red, Nero Aswan, Gazal Dark, Rosa Sinai, and Karnak Grey while marble types comprise: Khatemya, Imperial Bronze, Golden Sinai, Golden Cream, Silvia, Sunny, Galala, and Felito Hassana and others which were presented in the available marble and granite products' section. Also, the strategic geographical location of Egypt encourages the ease of marble and granite exportation to all the five continents. Egypt is located in a very strategic location in Africa which lies on the Mediterranean Sea from the north as well as the Red Sea from the east. The coastal cities easily connect Egypt to the other continents. In addition, the Suez Canal which joins between the two seas is used by ships from all over the world coming from Europe and other areas to go to the Gulf Area or Africa through Egypt.

- *Human Resources:*

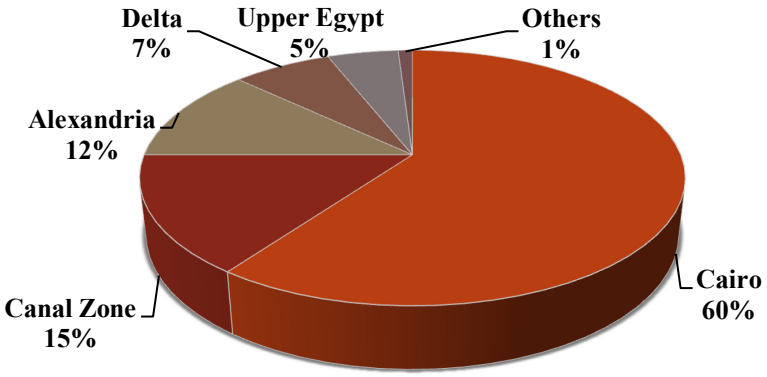
The labor is very important in the marble and granite quarrying and production. Although the machinery is vital in the marble quarrying and processing, the labors are critical too in running, monitoring, and working with the machines. According to the EMGTIC, the registered number of employees in the marble and granite quarries and production facilities is 284,964 employees related directly and indirectly to the cluster. Table eight provides the amount of the direct and indirect employment generated by the marble and granite cluster by activity.

Table 8: Employment Generated by the Marble Cluster by Activity (2011)

Subsector Activity	Number of Workers
Quarrying	36,603
Processing	52,342
Installation	35,138
Indirect (shipment, transportation, spare parts)	162,881
Total	**286,964**

Most of the employment of the marble and granite processing facilities is concentrated in Cairo accounting for 60% of the total employment. This is mainly due to the fact that the production of marble and granite is mainly in Cairo in several areas most importantly Shaq el Teban. The other labors work mainly in the quarries which are located outside Cairo. Figure fourteen presents the labor geographical distribution all over Egypt.

Figure 14: Geographical Distribution of the Marble Cluster Employment



Source: Author, 2012.

The marble industry suffers from the availability of the unskilled and untrained labor in the market who don't have the technical skills and knowledge needed for working in the marble quarries or plants. The productivity of labor in the marble and granite cluster is not fully utilized because the labors are not well trained to maintain the most efficient use of the inputs. The main source for labor to be skilled is through working in the plants to acquire the skills. This process is inefficient as it consumes time and resources. The workers must acquire more skills to be able to achieve higher level of productivity and efficiency. According to the EMGTIC, it is estimated that the marble and granite industry need not less than new 30,000 trained personnel over the next 5 years in order to stabilize the labor market and to provide for higher productivity. The Industrial Training Center (ITC), which is under the Ministry of Industry and Foreign Trade, has provided trainings and workshops to improve the marble labors' skills which were effective and beneficial for them. However, the ITC efforts were not enough to improve the overall problem of unskilled labor in the marble cluster.

- *Capital Availability:*

Capital and investments are available in the marble cluster. Although the cluster is dominated by small and medium scale factories, investments are high and new factories are opening overtime believing in the growth potential and competitive advantage of the marble and granite. The number of factories and workshops reached 500 and 2000 respectively. However, the costs of capital and energy needed in the quarrying and processing of marble are high especially that machineries are imported from abroad as mentioned previously in the cluster map section. The costs of capital in the quarries and the processing plants are important to be illustrated in order to have a full picture of the high costs involved in the marble supply chain. The capital costs are divided into the extraction equipment and the processing ones. Table nine explains the costs associated with the extraction machines and table ten presents the breakdown of the costs of capital in the manufacturing facilities.

Table 9: Extraction Process Costs of Capital

Equipment	Cost Per Unit (USD)
Chain Saw Machine	220,000
Integrated Wire Saw Machine	90,000
Continuous Drilling Machine	60,000
Excavator	350,000
Loader	350,000
Derrick Crane	200,000
Compressor	40,000
Generator	50,000
Truck	100,000
Heavy Truck	200,000
1/2 Truck	30,000
4x4 Car	60,000
Mobile Water Tanker	50,000
Housing, Storage & Special Tools	120,000

Table 10: Manufacturing Process Costs of Capital

Equipment	Cost Per Unit (USD)
Gang Saw Machine	300,000
Integrated Slabs Line	900,000
Block Cutter	150,000
Integrated Tiles Line	750,000
Multi Cross-Cutting Machine	250,000
Bridge Cutting Machine	48,000
Edge Tumbling Machine	58,500
Surface Burning Machine	65,000
Mobile Gantry Crane	145,000
Overhead Crane	46,000
Forklift	25,000
Water Treatment Unit (400 M3)	175,000
Profiling & Special Tools	56,000

Source: Author, 2012.

The previous two tables emphasize the costs of capital of marble extraction and manufacturing.

- *Physical Infrastructure:*

Although Shaq Al Teban is the largest zone of marble production and facilities in Egypt and among the top in the world, it still suffers from problems in physical infrastructure regardless of the investments that have been done to develop its infrastructure. It suffers from the quality of: roads, sewage system, power plants, and internet access. Shaq Al Teban needs investments in the infrastructure in order to reduce the problems generated from poor infrastructural quality. New factories started to concentrate in other areas with better quality of infrastructure in terms of roads and energy supply like 6th of October. Not only the infrastructure problem exists in the processing areas of marble, but also there is a huge problem in infrastructure of roads and facilities in the quarrying areas. The marble producers face problems of infrastructure while they are trying to reach and explore the quarries which are in remote areas mostly in the desert that lacks roads and facilities to reach them.

- *Administration and Information Infrastructure:*

The lack of transparency in the marble and granite cluster within the government entities and firms has resulted in a weak horizontal integration within the industry.

Most of the firms tend to work in isolation of the cluster and don't share their methods used in exploration, extraction, and processing. For instance, firms work hard to explore new marble and granite quarries and obtain their licenses from the government without any kind of awareness in the cluster with the new marble materials that were found. Also, large firms travel to Europe and Asia to find the best machines in the market in terms of technology, features, and cost to import for their quarries and factories and they don't share the information of obtaining the best machines with other firms. The lack of coordination and transparency within the cluster have led to an inadequate benefit of technological, managerial, financial, technical, economies of scale, and specialization within the industry.

- *Scientific and Technological Infrastructure:*

There are several entities that work on technology upgrading, research and development, innovation for the marble and granite cluster. The main agency supporting the scientific and technological infrastructure is the EMGTIC which works on the technological development of the marble production and quarrying. In addition, it offers services such as product testing, quarry planning, quarrying profiling, trainings for flooring as well as quarrying. Other supporting agencies in terms of innovation and technology development is the IMC which provided several programs to the marble cluster most importantly the Specialized Industrial Clusters Development Program that included the provision of technical services to Shaq Al Teban. On the firm level, the technology is mainly imported from abroad. The large scale factory owners travel abroad to visit exhibitions of the marble quarrying and processing machineries in order to adopt the latest technologies available worldwide.

ii. Related and Supporting Industries

Referring to the cluster map, figure ten presented the main related and supporting industries that the Egyptian marble and granite cluster is dependent on with their status. In this section, the main related and supporting industries to the marble cluster will be examined.

- *Equipments' Manufacturing and Spare Parts Industries:*

As mentioned previously, there are no manufacturers of the equipments needed in the marble and granite quarrying like the chain sows and diamond wires as well as the

processing equipments which include polishing and cutting machines. All the machineries are imported from other countries including Italy, Spain, United States, Turkey, and China. This is mainly contributed to the high cost and technology needed to start up equipment manufacturing plants. However, there are spare parts suppliers who provide the marble clusters with the needed spare parts of the equipments. The majority of the simple spare parts of the machines are locally produced, while others are imported that need complex technology in production.

- *Shipment and Distribution:*

The marble is exported by ships due to its huge sizes. There are several leading multinational companies of shipment and freight operating in Egypt like Maersk and Challenger. The marble exporters deal with diverse shipment companies on temporary or permanent basis. Concerning the marble local distribution, trucks are used to move the blocks from the quarries to the factories and also from the factories to the showrooms or construction sites. The trucks are either owned by the firms or rented on temporary basis. The trucks are also used in moving the packed marble tiles to the ports for exportation.

- *Packing Industry:*

There is no packing industry of marble products in Egypt. Thus, packing takes place inside the marble plants in which the firms buy and manufacture the packing supplies like wood and plastic sheets. There are certain labors employed in the factories of marble and granite in order to work on packing the marble products.

- *Financial Institutions:*

There is a strong base of commercial banks in Egypt which have several significant roles in the marble and granite cluster. First, the banks provide the documents needed for the exportation of marble including the letter of credit and insurance documents which are necessary in the process of trade. Second, the marble firms often borrow loans from the banks in order to upgrade and buy their machineries from aboard due to their high costs. In addition, loans are sometimes borrowed for the sake of expanding the factories or opening new ones. The financial institutions are competitive and there are various national and international banks available in the market.

iii. Government's Role

As mentioned previously, the government started to support the marble and granite cluster starting the 1990s in which several agencies were established that provide different services and programs to develop the cluster. These agencies include the: IMC, EGMSA, EMGTIC, CBM, NRC and MIFT. In table eleven, the summarized role of the main marble and granite cluster supporting entities will be provided.

Table 11: Main Government Supporting Agencies for the Marble Industry

Government Agency	*Main efforts to support the marble cluster*
Egyptian Marble and Granite Technology and Innovation Center (EMGTIC)	• The main center concerned with the technology development by offering different services like: agreements with leading technology center of the marble cluster aboard, quarry profiling and exploration, technology upgrading, training for labors, and material testing. • It is also working on the marble and granite cluster development.
Industrial Modernization Center (IMC)	• The IMC offers diverse effective programs for industrial development of marble and granite clusters locally and internationally including: Specialized Industrial Clusters Development Program, Export Development Program, and Inclusive Market Development Program. • Among its most important services offered to the cluster is the preparation of local and international exhibitions for the cluster to be internationally marketed in the five continents with coordination with leading exhibits' organizers like Expolink.
Chamber of Building Materials (CBM)	• The CBM provides several works for the marble and granite cluster including: promotion of the application of the most updated methods in stone production as well as stone elements in building, technological development of the sector, and cluster technological development.
Egypt General Survey and Mining Authority (EGSMA)	• The EGSMA is the main body responsible for the geological works related to the cluster including: exploration of marble and granite deposits, preparation of geological maps of marble deposits, provision of quarries licenses, and promotion of the efficient use of natural stone resources.
National Research Center (NRC)	• The NRC has several geological departments which work on resource exploration and testing as well as conducting research on the natural resources reserves, deposits, and uses including marble and granite.

Table eleven provided the main roles and programs of the supporting government agencies to the marble and granite cluster showing the overall government role in relation to the cluster.

iv. Demand Conditions:

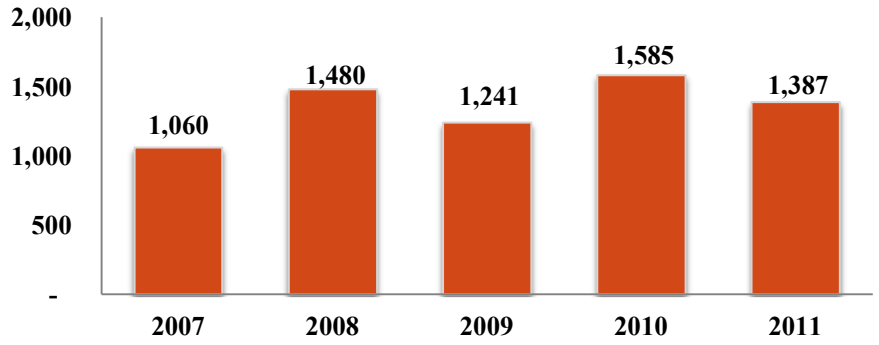
The Egyptian marble and granite are highly demanded locally and internationally due to their enormous uses including: flooring, internal cladding, and external cladding.

- *Local and International Demand for the Egyptian Marble and Granite:*

The Egyptian market of the marble and granite products is a medium low market in which average consumers demand standard sizes, colors, and quality mainly for flooring not being differentiated than ceramics or wooden floors. The consumers demand medium to low quality marble at low prices; they don't consume the medium to high quality ones. "Egypt is ranked 146 on the scale of "Stone Culture"; measured as the average total consumption of natural stone products per 1000 inhabitants." (El Garf, 2011) Concerning the local upper class or class A consumers, they have a high demand for the Egyptian marble basically for flooring indoors and outdoors. Their demand is of the high quality and high priced marble. In addition, a high demand for local marble is by the government which consumes about 40% or more of the total local consumption to be used them in constructing buildings. The quantity of local consumption of marble and granite is equivalent to 1.08 Million tons worth in 2011.

The Egyptian marble and granite is highly demanded internationally due to the various types and colors available in the market as well as their prices which are considered cheaper than the European marble and granite. Most of the Egyptian marble varies between off white, beige, and light brown. These colors are demanded due to their practically and ease of being matched with other colors as well as being used indoors and outdoors. The Egyptian marble is exported to China and East Asia (70%), Europe (10%), the Arab countries (13%) and USA (7%). The value of marble exports has been increasing over the years by an average rate of 10% reflecting the rise in the Egyptian demand. The graph below shows the value of marble exports in billion EGP from 2007 till 2011.

Figure 15: The Exports Value of the Egyptian Marble (2007-2011)



Source: CBM, 2012.

- *Strict Quality:*

Due to the high level of demand of the Egyptian marble and granite in the international market, the marble producers are committed to offer their products in the highest possible quality in order to sustain their market share as well as reputation. The quality control is one of the most important departments in the marble processing plants that work on guaranteeing that the products are offered in the highest quality to meet the international standards. The quality standards include: the quality of the marble material, the conciseness of cutting the marble in the accurate sizes ordered, the quality of the tiles' polish, and the quality of packing the tiles which is very important in making sure that the tiles will reach the destination safely.

v. Risk (Uncertainty)

The current unstable political and economic conditions are among the risk faced by the marble industry. The marble cluster is currently facing challenges due to the political and economic instability such as inflation, currency devaluation, higher interest rates, and lower foreign investments. In addition, as the marble industry is mainly an exporting industry; the clients are foreigners and tend to do regular visits in Egypt to follow up with their orders. It is important to mention that several marble firms, according to the interviews conducted, faced severe losses due to the fear of foreigners to come to Egypt the high period of economic unrest.

In addition, to the economic and political instability, the international intense competition in marble requires the marble producers to continually invest in quality standards. The strict quality is very important to meet by producers due to preventing

the risk of slipping the Egyptian marble share in the international market by international competitors such as Turkey.

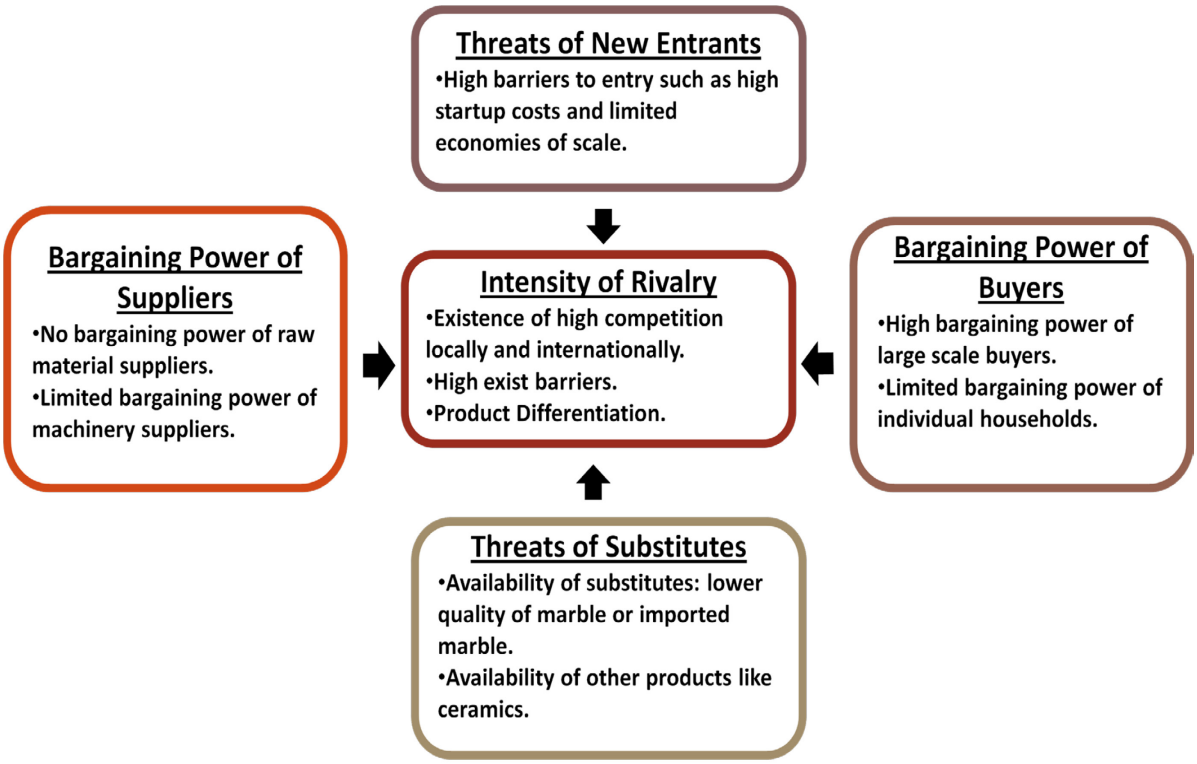
vi. Context for Firm Strategy, Structure, and Rivalry

The context of firm strategy, structure, and rivalry of the marble and granite cluster will be explained by conducting Michael Porter's analysis of the five forces of competition.

C. Five Forces that Shapes the Marble Cluster Competition

The five forces that shape the competition according to Michael Porter are: threats of new entrants, bargaining power of suppliers, bargaining power of buyers, threats of substitutes, and rivalry among existing competitors. Figure sixteen summarize the five forces for the Egyptian marble and granite cluster. Afterwards, each force that shapes competition of the marble cluster will be illustrated.

Figure 16: The Five Forces that Shapes the Marble Industry Competition



Source: Author, 2012.

- *Threats of New Entrants*:

There are low threats of new entrants for the marble and granite cluster due to the existence of the high barriers of entry including: high startup costs, limited economies of scale, cost disadvantages, access to distribution channels, and product differentiation. The startup costs of marble quarrying and processing are high for new entrants. The marble quarrying requires high renting fees in addition to expensive extraction imported technologies like the diamond wires and chain saws. Also, the processing plants install several cutting and polishing machineries which are imported and very expensive in which sometimes the firms are required to borrow loans to finance them. In addition, in order for the new entrants to compete in the market, they need to start up with a large scale to make use of economies of scale and reduce their unit cost of production which includes: cost of energy, maintenance, spare parts, consumables, manpower, management, and administration. The access to distribution channel is another barrier to entry because in order for the marble and granite suppliers to sell their products locally, they need to build their own showrooms or rent them. Also, to be able to export the products, the suppliers offer their products in international marble fairs in Italy, Spain, Turkey, China, and other nations which require high travel costs as well as exhibits' costs. (Zaki, 2011) Thus, the barriers of entry are considered high in the marble industry resulting in reducing the threats of new entrants.

- *Bargaining Power of Suppliers*:

There are two kinds of suppliers in the marble cluster: the primary suppliers which are the raw material suppliers and the secondary suppliers that include companies which provide spare parts, machineries, and lubrications to both the quarries as well as the processing plants. Concerning the primary suppliers, most of the marble processing plants operate their own quarries, so they don't face any braining power in the supply of marble and granite blocks as they supply and extract the marble themselves. However, some difficulties might appear in the process of renting the quarries from the government. As for the secondary suppliers, the marble firms are highly dependent on the imports of machines for quarries and factories. There was a high bargaining power of the leading machinery suppliers like Italian and

Chinese machinery producers. However, several countries started to work in the production of marble equipments like Turkey so the competition became higher causing the braining power to be lower.

- *Bargaining Power of Buyers:*

The marble cluster is competitive and there is high number of suppliers of marble products. The influence of buyers depends on their demanded quantity of marble. For instance, end consumers of marble, who demand marble for the flooring and cladding of apartments, don't have a high bargaining power. However, as marble is used as a dimension stone for the construction purposes of large and medium scale projects, contractors and consumers who demand high quantity have a high bargaining power so the firms work on meeting their needs in terms of prices and quantities.

- *Threats of Substitutes Products*:

There are a number of substitutes available in the market not only the lower quality stones, but also other products like ceramics. The households have a variety of products to choose from for the flooring like wooden floors or ceramics. Concerning the large scale consumer, they can still have the chance to substitute the marble they need with either a lower local marble quality, imported marble, or other products like ceramics.

- *Rivalry Among Existing Competitors*:

The rivalry among existing competitors depends on different factors: number of competitors, exist barriers, and product differentiation. There are high amount of competitors in the market locally and internationally. Thus, rivalry is not so complicated in the cluster. Concerning the exit barriers, exiting the cluster is difficult due to the high startup capital requirements and machinery costs which are huge. Thus, to exit from the business is very difficult as the sales of the machineries are hard as they are highly specialized in the marble production. Therefore, firms have no incentives to exist the market so they tend to operate and compete. However, as mentioned previously, there is vertical and horizontal product differentiation of marble. This can result in reducing rivalry within the marble industry.

D. Competitive Analysis

The competitive analysis of the marble and granite cluster will be carried out emphasizing the strengths, weaknesses, opportunities, and threats; in addition to the extended SWOT analysis that include competitive position, outlook, potential, and risk position. Table twelve provides the SWOT analysis of the cluster.

Table 12: The Marble and Granite Cluster SWOT Analysis

Strengths	***Weaknesses***
• Egypt is very rich in marble and granite deposits in; there are 500 quarries in Egypt with yearly output of 5 million tons. This is very important for the sustainability of the industry. • There is an effective industrial base in which there are 500 quarries, 500 factories, and 2000 workshops which shows the existence of a well operating industry. • The cost of labor and energy is low in comparison to other marble clusters abroad. The low cost is important in increasing efficiency as well as influencing investments in the sector. • Egypt has a strategic location in terms of trade. The coastal cities and the Suez Canal are important in easing the exporting process of marble through shipment.	• The absence of accredit testing laboratories which are important in materials testing result in increasing wastes in the natural stone raw materials. • The irrational extraction operations like the misuse of dynamites in extraction that are used in most of the Egyptian quarries is very dangerous and result in wasting marble deposits and damaging the stone quality. • The cost of machinery is very high because of being imported from aboard and is also subject to high tariffs and fluctuations in exchange rates. • The availability of unskilled labor results in decreasing productivity as well as efficiency.
Opportunities	***Threats***
• There is an increasing demand of the Egyptian stone in the international market due to its variety of colors, prices, and textures. This indicates the growth potential and sustainability of the cluster. • The Egyptian marble brands have good reputation internationally. This will highly motive the local suppliers to continually improve their quality as well as product variations. • The local stone industry is also an attractive incentive for the increase in FDI which will highly affect the Egyptian economic growth positively.	• The slipping of the market share of Egyptian marble exports due to the intensified international competition from several countries most importantly Turkey which is exporting cheap marble and has similar characteristics of the Egyptian stone. • The need of the marble producers to be cost efficient and more creative as well as innovative continuously in order to sustain their share in the international market of marble. • The depreciation of the Egyptian currency that decreases the foreign reserves obtained from exporting marble.

After conducting the SWOT analysis, table thirteen presents the extended SWOT highlighting the competitive position, outlook, potential, and risk position.

Table 13: Egyptian Marble and Granite Cluster Extended SWOT Analysis

S+W = Competitive Position	***O+T = Outlook***
Despite the competitive position of Egypt in the international market as one of the top ten marble exporters worldwide, still there are key policies and reforms that need to be done to increase its share internationally, utilize the marble resources, and explore more marble quarries.	The remarkable opportunities of the Egyptian marble industry such as: the strong industrial base, low cost of labor and energy, and high deposits of marble are highly restricted by the inefficiency in the quarrying and processing operations of marble.
S+O = Potential	***W+T = Risk Position***
The industry has a very strong potential for future growth in terms of the increasing demand for the Egyptian marble globally as well as available opportunities that can further enhance the industry's competitiveness level and productivity.	The main risk for the marble industry is the intense competition in the international market that pressures the Egyptian marble suppliers to improve and develop their products to sustain their share in the market.

The extended SWOT outlines the competitive position, potential, outlook, and risk position of the Egyptian marble industries. Egypt has a great competitive position and potential in the international as well as local market. However, significant efforts have to be done by the marble stakeholders in order to enhance and maintain the competitive position of the Egyptian marble and granite industry.

Chapter Three: Financial Valuation of the Marble Extraction and Processing

I. SUMMARY

This chapter is an overall financial valuation of the marble supply chain which will be divided into: the financial valuation of the marble extraction in Egypt, and the financial valuation of the marble processing in Egypt due to their different financial structures. For the extraction and processing, the pro forma income statement will be constructed and analyzed first. Then, an overall calculation of the investment cost will be done of the extraction and processing. In addition, the optimum financial structure will be determined. Afterwards, the financial evaluation will be carried on in which the present value of the cash inflows discounted at the WACC is to be compared with the present value of the cash outflows to test the viability of the marble industry. Other financial calculations will be done to further analyze the finances of both the extraction and processing such as the IRR, the payback period, the breakeven analysis, and the profitability ratios. The methodology used for financial feasibility is based on the "Manual for Evaluation of Industrial Projects" by UNIDO. In addition to referring to other manuals: "Project Appraisal Manual" by the Asian Development Bank and the "Handbook on Economic Analysis of Investment Operations" by the World Bank.

II. FINANCIAL VALUATION OF THE MARBLE EXTRACTION IN EGYPT

A. Pro Forma Income Statement

The pro forma income statement for the extraction is constructed for the 500 quarries in Egypt which are divided into 400 medium quarries and 100 large quarries based on their level of investments and employment. The income statement includes the revenue, costs, and profit analysis of the marble quarries in Egypt. The period of analysis start from 2007 to 2011 based on annual current market prices which were gathered from the CBM and BMEC.

i. Gross Revenue

The final products of the quarries are raw blocks of marble which are either sold domestically to other factories for processing to tiles or slabs, or exported as raw blocks abroad. Thus, the two sources of revenue for the quarries are the domestic

revenue and the exports' revenue. The data for the quantities sold domestically were obtained from the CBM, and the quantities of exported blocks were from the BMEC. Based on yearly current market prices, the gross revenue was calculated as the sum of the domestic and exported revenue.

Table 1: The Gross Revenue of the Marble Quarries (2007-2011)

Gross Revenue					
	2007	**2008**	**2009**	**2010**	**2011**
Current Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	455	559	541	563	450
Domestic Current Prices (EGP/Ton)	300	332	375	400	420
Quantities (Tons)					
Exported Quantity (Tons)	2,050,296	2,028,947	1,742,938	1,935,151	2,029,352
Domestic Quantity (Tons)	135,919	119,866	262,540	330,173	108,925
Gross Revenue (EGP)					
Export Revenue	933,000,000	1,134,000,000	943,000,000	1,090,000,000	913,000,000
Domestic Revenue	40,775,730	39,795,578	98,452,313	132,069,360	45,748,332
Gross Revenue	**973,775,730**	**1,173,795,578**	**1,041,452,313**	**1,222,069,360**	**958,748,332**

ii. Cost of Operations

The cost of operations of the marble quarries is composed of several items. First, the salaries and wages, cost of electricity, fuel, and water, cost of consumables, cost of maintenance, cost of management, marketing, administration, miscellaneous, and government fees that were calculated based on the cost structure received from the EMGTIC for quarries in which the cost items' weights are 22%, 30%, 22%, 11%, 7%, 4%, and 4% respectively. In addition to these costs, the quarries have to pay annual license fees in return for renting the quarries to the governorates where the quarries are located. The renting fees varied from 45,000 to 65,000 EGP from 2007 to 2011. Also, another cost that the quarries pay on the exported amount of blocks is the export duty which was imposed in 2009 amounting for 80 EGP/ton and rose in 2011 to 150 EGP/Ton. These costs are the items of the cost of operations of the Egyptian marble quarries.

Table 2: The Cost of Operations of the Marble Quarries (2007-2011)

Cost of Operations					
	2007	2008	2009	2010	2011
Salaries and Wages	53,813,323	64,525,196	58,897,745	69,383,448	53,514,273
Cost of Energy, Fuel, and Water	76,876,176	92,178,851	84,139,636	99,119,212	76,448,961
Cost of Consumables	57,657,132	69,134,138	63,104,727	74,339,409	57,336,721
Cost of Maintenance	28,828,566	34,567,069	31,552,364	37,169,704	28,668,360
Cost of Management, Marketing, and Administration	13,453,331	13,223,170	12,341,124	13,940,146	13,158,331
Miscellaneous	9,609,522	11,522,356	10,517,455	12,389,901	9,556,120
Government Fees	19,219,044	23,044,713	21,034,909	24,779,803	19,447,055
License Fees	22,500,000	25,000,000	27,500,000	30,000,000	32,500,000
Export Duty	-	-	139,435,040	154,812,080	304,402,800
Total Cost of Operations	**281,957,095**	**333,195,494**	**448,523,000**	**515,933,705**	**595,032,621**

iii. Gross Operating Profit

The gross operating profit (GOP) is calculated by subtracting the cost of operations from gross revenues. Table three gives the GOP of the marble quarries.

Table 3: The Gross Operating Profit of the Marble Quarries (2007-2011)

Gross Operating Profit					
	2007	2008	2009	2010	2011
Gross Operating Profit	**691,818,635**	**840,600,084**	**592,929,312**	**706,135,655**	**363,715,711**

iv. Pro Forma Income Statement (2012-2016)

Due to the rapid growth of the extracted marble output and exports, it is important to expand the financial analysis to more than five years in terms of gross revenue, costs or operations, and gross operating profit. In order to obtain the market prices of the additional five years included in the analysis, the average rate of growth of the market prices of blocks exported and sold domestically were calculated. These growth rates will be applied to obtain the current prices from 2012 to 2016 in which the average exports price growth rate is 1% and 9% for the domestically sold blocks. The historical market prices per ton of blocks were gathered from Egyptian factory owners to test the change in prices over the past years. The average percentage change was found to be on average 3% for the exports and 11% for the raw materials which are more or less the same as the calculated average growth rate of prices from 2007 to 2011. Thus, the growth rate applied to forecast the prices was 1% for the

exported blocks and 9% for the raw materials sold in Egypt to the marble factories to be conservative about expectations in prices. Concerning the quantity of domestically sold as well as exported blocks, it will be forecasted from 2012 to 2016 to extend the financial analysis for ten years from 2007 to 2016. According to the CBM, the forecasted growth rate of quarrying output is 25% annually mainly due to the increasing level of demand of the Egyptian marble raw materials in the international market. Thus, by applying the 25% increase on annual output, the gross revenue, cost of operations, and gross operating profits are calculated accordingly. Table four presents the pro forma income statement from 2012 to 2016 in order to carry out the financial analysis of marble extraction in Egypt for ten consecutive years.

Table 4: Pro Forma Income Statement of the Marble Quarries (2012-2016)

	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)					
Export Current Price (EGP/Ton)	454	459	464	468	473
Domestic Current Price (EGP/Ton)	458	499	544	593	646
Quantities (Tons)					
Exported Quantity (Tons)	2,562,870	3,203,588	4,004,484	5,005,605	6,257,007
Domestic Quantity (Tons)	169,899	212,374	328,174	410,218	136,156
Gross Revenue (Billion EGP)					
Export Revenue	1,164,558,595	1,470,255,226	1,856,197,222	2,343,448,993	2,958,604,354
Domestic Revenue	77,779,705	105,974,848	178,498,040	243,203,579	87,986,849
Gross Revenue	**1,242,338,300**	**1,576,230,074**	**2,034,695,262**	**2,586,652,572**	**3,046,591,203**
Cost of Operations (EGP)					
Salaries and Wages	53,514,273	69,590,649	88,558,789	114,415,996	145,769,883
Cost of Energy, Fuel, and Water	76,448,961	99,415,214	126,512,556	163,451,423	208,242,690
Cost of Consumables	57,336,721	74,561,410	94,884,417	122,588,567	156,182,017
Cost of Maintenance	28,668,360	37,280,705	47,442,209	61,294,283	78,091,009
Cost of Management, Marketing, and Administration	13,158,331	16,816,664	21,020,829	26,661,920	33,327,400
Miscellaneous	12,426,902	15,814,070	20,431,428	26,030,336	31,338,269
Government Fees	24,853,803	31,628,139	40,862,856	52,060,672	62,676,538
License Fees	35,000,000	37,500,000	40,000,000	42,500,000	45,000,000
Export Duty	384,430,500	480,538,125	600,672,656	750,840,820	938,551,025
Total Cost of Operations	**186,449,351**	**236,399,441**	**305,170,329**	**387,801,848**	**453,533,279**
Gross Operating Profit (EGP)					
Gross Operating Profits	487,962,453	632,330,939	844,316,134	1,093,607,745	1,221,438,833
Taxes (20%)	97,592,491	126,466,188	168,863,227	218,721,549	244,287,767
Net Profit After Taxes	**390,369,962**	**505,864,751**	**675,452,907**	**874,886,196**	**977,151,067**

The pro forma income statement from the ten years from 2007 to 2016 is provided in appendix 1. After calculating the gross revenue, costs of operations, and net profit after taxes from 2007 to 2016, the capital requirements of the marble extraction in Egypt will be determined.

B. Capital Requirements

The capital requirements are mainly the initial investment cost of the marble quarries. In this section, the investment cost evaluated at 2007, the first year of the analysis, will be calculated in order to carry out the financial feasibility of the marble extraction in Egypt. The capital requirements include the fixed assets and the net working capital.

i. Fixed Capital

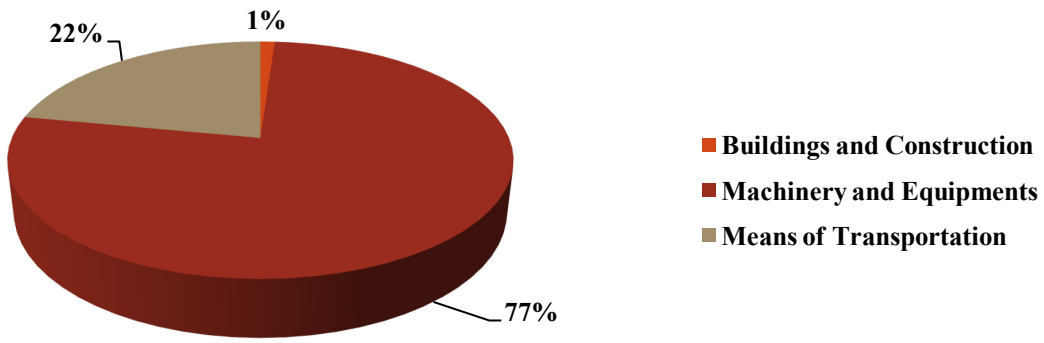
The fixed capital consists of the total tangible assets and the total intangible assets of the marble quarries. The tangible assets include machinery and equipments, buildings and construction, and means of transportation. The machinery and equipments are the main assets in the quarries as the extraction process is mainly done by machines such as: chain saw machines, integrated wire machines, continuous drilling, excavators, generators, and loaders. Thus, the machinery and equipments account for 70% of the value of the total tangible assets; while the rest 30% is distributed on the buildings and construction, furniture and fixtures, and means of transportation. (CBM, 2012) Concerning the intangible assets of the quarries, it consists of the exploration process which is done for discovering new quarries or the existing quarries internally to search for the location of the best materials in terms of type and quality. The tangible and intangible assets are added together to get the fixed capital. Afterwards, a 10% contingency is applied to account for the fluctuations that might happen in prices during the period under investigation.

Table 5: Fixed Capital of the Marble Quarries (2007)

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Machinery and Equipments	1,960,000,000
Buildings and Construction	28,000,000
Means of Transportation	560,000,000
Total Tangible Fixed Assets	**2,548,000,000**
Intangible Fixed Assets	
Exploration Fees	252,000,000
Total Intangible Fixed Assets	**252,000,000**
Total Fixed Capital Requirement	**2,800,000,000**
10% Contingency	280,000,000
Total Fixed Capital after Contingency	**3,080,000,000**

The shares of each capital requirement including tangible and intangible fixed assets is provided in the below chart.

Figure 1: Fixed Capital Requirements of the Marble Extraction Base (2007)



In addition to the fixed assets evaluated at 2007, more investments are needed in the extraction field by 2013 in order to buy new machineries to cope with the increasing quantity extracted based on the current labor to capital ratio. The machineries needed were estimated to be 20,000,000 EGP.

Table 6: Fixed Capital of the Marble Quarries (2013)

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	20,000,000
Total Tangible Fixed Assets	**20,000,000**

ii. Working Capital

The working capital is mainly the amount of capital required for financing the financial gaps that the industries encounter during their operations. The gaps are the accounts receivable, inventory of final products, inventory of raw material, and accounts payable. The accounts receivable is the time lag between selling the blocks and collecting cash which is estimated to be four months. The inventory of final products in the case of extraction is considered the inventory of marble blocks which are the final products of the quarries; it is the lag between extracting and selling the blocks which is on average six months. Concerning the inventory of raw material, it doesn't exist on the quarries level because there are no raw materials required in the extraction process of marble. The accounts receivable, inventory of final product, and inventory of raw material are the components of the gross working capital. The forth financial gap is the accounts payable which is the gap between buying the raw materials and paying for them. As mentioned previously, the quarries don't purchase raw material, so the forth gap doesn't apply for the quarries. In order to obtain the net working capital, the accounts payable is deducted from the gross working capital. The equations of calculating the financial gaps are provided in the appendix.

Table 7: The Working Capital of the Marble Quarries (2007)

Working Capital	
Year	**2007**
Accounts Receivable	70,489,274
Inventory of Final Product	46,992,849
Inventory of Raw Material	-
Gross Working Capital	**117,482,123**
Accounts Payable	-
Net Working Capital	**117,482,123**

The change in the annual working capital is provided in appendix A.

iii. Total Investment Cost

The initial investment cost evaluated at 2007 for the marble extraction in Egypt is the fixed capital added to the net working capital.

Table 8: The Investment Cost of the Marble Quarries (2007)

Investment Cost	
Year	**2007**
Total Fixed Capital after Contingency	**3,080,000,000**
Net Working Capital	**117,482,123**
Total Investment Cost	**3,197,482,123**

C. Optimum Financial Structure

The optimum financial structure determines the most efficient debt to equity amount for financing the industry. The debt is considered to have lower level of cost and risk relative to the equity. Thus, the optimum financial structure is vital in determining the total amount of loan needed by the quarries to minimize their cost of financing and secure the level of liquidity which should be enough to cover the debt repayments. The optimum loan is derived based on the relationship between repayment, profit, interest on loans, and installments. The optimum loan is repayments multiplied by the installments. The optimum loan detailed calculations are provided in appendix A.

Table 9: Optimum Loan for the Marble Extraction Base (2007)

Optimum Loan	
Year	**2007**
Optimum Loan	**1,869,780,094**

D. Financial Evaluation

In order to financially evaluate the marble extraction in Egypt, the present value of the cash inflows discounted at the WACC should be obtained in order to compare it with present value of the cash outflows and determine the feasibility of the marble extraction. In addition, other financial indicators will be calculated and analyzed including the internal rate of return, the payback period, and breakeven quantity to further explain the financial performance of the Egyptian marble quarries.

i. Weighted Average Cost of Capital

The WACC mainly measures the average cost of capital accounting for the two main sources of financing: debt and equity. The debt to equity ratio as for the marble extraction is 60% to 40%. This ratio is almost constant within the industry and over the years studied. Some quarries or processing plants have exceptional agreements with the lenders in which they can reach a debt to equity ratio of 70% to 30% due to their size of investments and employment. However, this case isn't common in the marble industry. Thus, the debt to equity ratio used to measure the WACC is 60% to 40%. The WACC equation and formula is presented in the appendix. The nominal WACC was found 12.5%.

Table 10: The WACC for the Marble Extraction Base (2007-2016)

WACC	
Years	**2007**
Deposit Interest Rate (I_d)	9%
International Risk (R)	6%
Country Risk (α)	1.3
Equity Ratio $\left(\frac{E}{I}\right)$	40%
Lending Interest Rate (I_b)	12%
Taxes(T)	20%
Debt Ratio $\left(\frac{L}{I}\right)$	60%
WACC $=\left((I_d + R\alpha) * \frac{E}{I}\right) + \left(I_b * (1 - T) * \frac{L}{I}\right)$	**12.5%**
Real WACC	**4.5%**

ii. Net Present Value of The Marble Extraction Base

The net present value (NPV) is the difference between the present value (PV) of the cash inflows of the marble quarries discounted at the WACC, which is the current value of the investment, and the PV of the cash outflows discounted at the WACC. The cash inflows mainly include the annual revenue which is the main source of inflows for the marble quarries. On the other hand, the cash outflows comprise: the initial investment cost, annual change in working capital, costs of operations, any required re-investments in fixed assets, and profit taxes. After calculating the annual cash inflows and outflows, the PV of both will be obtained using the discounted cash flow method. The annual calculations of the PV of the cash inflows and outflows are

provided in the appendix. The difference between the PV of cash inflows and cash outflows is the NPV. It is the main indicator towards assessing the financial viability of the marble extraction. If the net present value is positive meaning that the PV of cash inflows is higher than the PV of cash outflows, then the Egyptian marble extraction base is financially viable. After calculating the PV for the ten studied years of cash inflows and outflows of the marble extraction base and comparing them together, it was found to be financially viable. Figure two provides the discounted cash inflows and outflows of the marble extraction from 2007 to 2016.

Figure 2: Annual Discounted Cash Inflows and Outflows of the Marble Extraction Base (2007-2016)

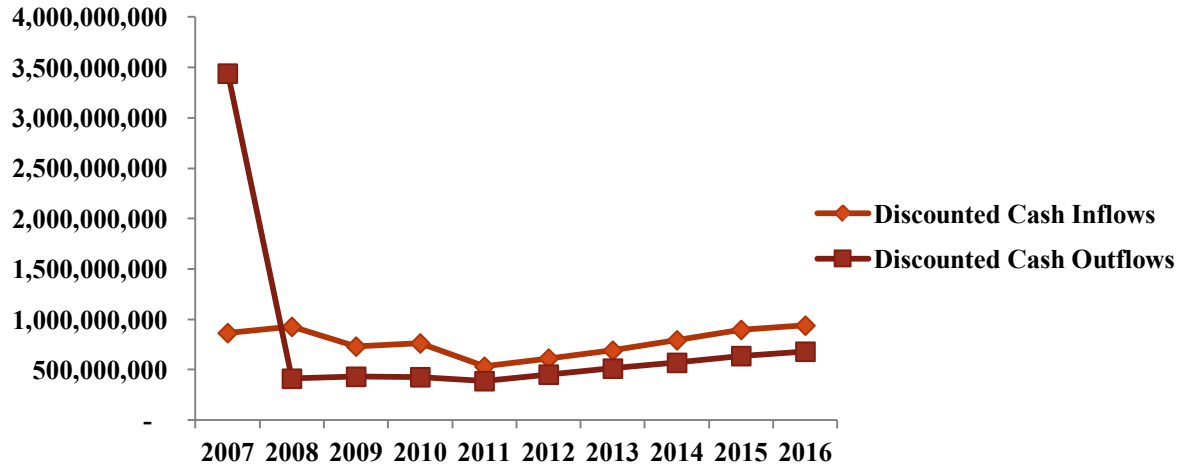


Table eleven presents the values of the PV of cash inflows, outflows, and NPV.

Table 11: Financial Viability of the Marble Extraction Base

Financial Viability	
PV of Cash Inflows	14,453,633,711
PV of Cash Outflows	12,251,957,161
NPV	2,201,676,550
Viability	Viable

iii. Internal Rate of Return and Return on Investment

The IRR is another important financial indicator as it measures the rate of return on the investment incurred. It could be also interpreted as the net cash flow as a percentage of invested capital. The IRR is considered helpful for future investors to know the rate of return for investing in the marble extraction. The IRR is the rate that

will almost equate the PV of cash inflows of the marble quarries from 2007 till 2016 to PV of cash outflows. It is calculated through the trial and error method by replacing it instead of the WACC in the discounted cash flow formula of the cash inflows and outflows. The IRR for the marble quarries was found to be 20%. Since the IRR is higher the WACC which is 12.5%, then this ensures the financial viability of the marble extraction base.

Table 12: The IRR of the Marble Extraction Base

IRR	
IRR	**0.20129**
PV of Cash Inflows	**7,510,294,728**
PV of Cash Outflows	**7,510,294,728**
NPV	**0**
Viability	**Viable**

Another ratio to compare it with the WACC to ensure the viability of the marble extraction base in Egypt is the return on investment (ROI) which is a performance measure of the investment's efficiency. The ROI is given by dividing the GOP by the initial investment cost and calculated at a certain point in time. For the marble extraction base the ROI is 22% according to year 2010. The ROI is also greater than the WACC. Thus, the marble extraction base is financially viable.

iv. Payback Period

The payback period (PBP) is mainly the amount of years in which the investor will retain back the initial incurred investment. The PBP of the marble extraction base was found to be 4.9 years which means that the investors return their initial capital investments in 5 years. The discounted payback period (DPBP) is important to estimate too as it accounts for the time value of money. For the marble extraction base, the DPBP was found to be 2.7 years on average for the ten studied years.

v. Breakeven Point

The breakeven point (BEP) is mainly the level of output produced at which the total revenue and cost are equivalent. It is the number of blocks produced by the total quarries that will equate the total revenue earned to the total cost incurred in a certain year. It is important to determine the BEP in order for the quarries to ensure to extract a quantity of blocks higher than the breakeven quantity to be able to gain profit. In

order to calculate the BEP, the variable and fixed costs of the quarries should be distinguished.

Table 13: The Variable and Fixed Costs of the Marble Quarries

Variable and Fixed Costs	
Variable Costs	**Fixed Costs**
• Marketing and Sales Expenses • Wages • Consumables • Government Fees	• Salaries • Utilities • Administration • License fees • Maintenance • Miscellaneous

After distinguishing between the variable and fixed costs incurred by the quarries, the breakeven quantity was found to be 399,568 units in 2010. Corresponding to the breakeven quantity, the breakeven sales were estimated to be 215,553,951 EGP. The detailed steps of the BEP calculations are in the appendix.

E. Capital Asset Pricing Model

The capital asset pricing model (CAPM) is an important financial model which explains the risk and expected return relationship. It includes the risk free rate denoted by R_f, market return R_m, and the sensitivity of the expected excess returns to the expected excess returns of the market denoted by β. The CAPM model is applied on a static basis for the year 2012 to derive the risk of the marble extraction β. The risk free rate R_f is taken as the current rate deposit interest rate according to the Central Bank of Egypt which is 9.25% .The market return rate R_m is calculated as the return on the CASE30 index of the Egyptian stock exchange in 2012 that was found to be 31.4%. According to the CAPM model, the β was found to be 0.27 based on the return on investment of the marble extraction base in 2012 which is 15.3%. In addition, the adjusted β was found to be 0.51 which converge to the market risk that is considered 1.

F. Profitability Ratios and Dupont Analysis

The profitability ratios are mainly: the profit margin ratio, return on assets (ROA), and return on equity (ROE). The Dupont analysis is an important financial tool that

provides more information and insights regarding the return on assets as well as return on equity.

i. Return on Assets

The ROA is a ratio which is used to evaluate the effectiveness of using the assets and how much the capital invested in the assets generate profit. The ROA is calculated as the net profit divided by the total assets. According to the Dupont analysis, the ROA can be broke down to measure the combined effects of the profit margins as well as the asset turnover. Applying the ROA to the marble extraction base, the ratio was found to be 3.2% based on the year 2010. Table fourteen provides the breakdown of the ROA to the profit margins and asset turnover ratio as well as their financial interpretations.

Table 14: The ROA of the Marble Extraction Base (2010)

ROA		
ROA	**Profit Margin**	**Asset Turnover**
3.2%	**6.6%**	**48%**
For every pound invested in assets, it generates 0.032 piaster profit.	**For every pound obtained from sales, 0.066 piaster of profit is generated.**	**For every pound invested in assets, 0.48 piaster of sales is generated.**

ii. Return on Equity

Concerning the ROE, it is calculated as the net profit divided by the equity. The ROE for the marble extraction base is 8%. The ROE can be decomposed to explain financial ratios: profit margin, asset turnover, and financial leverage ratio.

Table 15: The ROE of the Marble Extraction Base (2010)

ROE			
ROE	**Profit Margin**	**Asset Turnover**	**Financial Leverage**
8%	**6.6%**	**48%**	**250%**
For every pound invested in equity, 0.08 piaster is the return on equity in terms of profit.	**For every pound obtained from sales, 0.066 piaster of profit is generated.**	**For every pound invested in assets, 0.48 piaster of sales is generated.**	**It mainly explains the equity ratio to the assets; the assets are 250% the equity.**

Referring to the Dupont analysis, the ROE can be further decomposed to account for five ratios being called the Dupont system. The 8% ROE is equal to the following financial ratios: tax burden, interest burden, return on sales, asset turnover, and

financial leverage ratio. Table sixteen provides the calculated ratios of the Dupont system.

Table 16: The Dupont System of the Marble Extraction Base (2010)

ROE					
ROE	**Tax Burden**	**Interest Burden**	**Return on Sales**	**Asset Turnover**	**Financial Leverage**
8%	**35.9%**	**49.5%**	**37.1%**	**48%**	**250%**
For every pound invested in equity, 0.08 piaster is the return on equity in terms of profit.	**For every pound of profit generated, 0.359 piaster is a tax burden.**	**For every pound of profit generated, 0.495 piaster is an interest burden.**	**For every pound of sales obtained, 0.371 piaster is earnings on sales.**	**For every pound invested in assets, 0.48 piaster of sales is generated.**	**It mainly explains the equity ratio to the assets; the assets are 250% the equity.**

The detailed calculations and formulas of the ROA, ROE, and Dupont system are explained in the appendix.

III. Financial Valuation of the Marble Processing in Egypt

After studying the financial viability and other financial performance indicators for the marble extraction base, the same approach and steps will be applied on the marble processing facilities in order to test its financial feasibility and returns based on a different financial structure.

A. Pro Forma Income Statement

The pro forma income statement for the marble processing facilities reflects the performance of 500 marble processing plants in which 90 are small factories, 385 are medium, and 25 are large ones. In this section, the gross revenue, cost of operations, and profit for the marble manufacturing base will be measured. The analysis is based on annual current market prices of exports and domestic sales obtained from CBM and BMEC. It is mainly done from 2007 to 2011 and a five years forecast will be done to extend the study till 2016.

i. Gross Revenue

The marble supplied from the factories is different than the final product of the quarries. The marble is processed from being raw blocks supplied from the quarries to tiles of different sizes, thicknesses, qualities, and finishes. The marble facilities supply to the domestic market as well as export the processed marble abroad. However, in comparison to the quarries' domestic to export sales ratio, the processing

plants have a higher ratio of selling domestically and a lower exporting level relative to the quarries. This is mainly due to the fact that the marble raw material is more demanded internationally and the manufacturing process takes place outside Egypt. The quantities sold domestically from 2007 to 2011 were obtained from the CBM, and the quantities of exports of manufactured marble were from the BMEC. In addition to the domestic and exporting revenue, the marble facilities are granted an export subsidy from the EDF under the MIFT for promoting their exports and quality of processed marble. The export subsidy for all the processing plants amounts for 31 million EGP yearly.

Table 17: The Gross Revenue of the Marble Processing (2007-2011)

Gross Revenue					
	2007	**2008**	**2009**	**2010**	**2011**
Current Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	1,389	3,875	2,272	1,727	1,242
Domestic Current Prices (EGP/Ton)	1,000	1,270	1,444	1,332	1,400
Quantities (Tons)					
Exported Quantity (Tons)	90,013	88,006	131,189	285,968	380,846
Domestic Quantity (Tons)	1,223,272	1,078,796	2,362,856	2,971,561	980,321
Gross Revenue (EGP)					
Export Revenue	125,000,000	341,000,000	298,000,000	494,000,000	473,000,000
Domestic Revenue	1,223,271,900	1,370,070,666	3,411,963,342	3,958,118,719	1,372,449,960
Export Subsidy	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000
Gross Revenue	**1,379,271,900**	**1,742,070,666**	**3,740,963,342**	**4,483,118,719**	**1,876,449,960**

ii. Cost of Operations

The marble processing plants have a cost structure different than the marble quarries. The cost components of the marble factories are: cost of raw materials, salaries and wages, cost of consumables, cost of energy, fuel, and water, cost of management, marketing, and administration, and miscellaneous. The cost of operations was measured based on the cost structure of the marble plants obtained from the EMGTIC. The cost of consumables is the highest cost incurred for the marble manufacturers which amounts for 36% of the total cost of operations due to the high consumption of the production machines; followed by the raw materials' cost which is 31%. The raw materials' cost is mainly the cost of buying and delivering the

blocks from the quarries to the factories. Although several factories operate their own quarries, the cost of raw materials' is financially recorded separately in order to be able to calculate the profit accurately. The cost of operations is calculated from 2007 to 2011 and forecasted based on the same cost structure for further five years.

Table 18: The Cost of Operations of the Marble Processing (2007-2011)

Cost of Operations					
	2007	**2008**	**2009**	**2010**	**2011**
Cost of Consumables	313,796,072	410,724,646	875,791,792	1,027,606,024	433,348,538
Cost of Raw Materials	272,866,150	357,151,866	761,558,080	893,570,456	376,824,816
Salaries and Wages	87,862,900	78,062,719	166,859,440	217,938,933	91,066,390
Cost of Maintenance	36,836,930	48,215,502	102,810,341	120,632,012	50,871,350
Cost of Management, Marketing, and Administration	19,100,630	25,000,631	53,309,066	62,549,932	26,377,737
Cost of Energy, Fuel, and Water	17,736,300	23,214,871	49,501,275	58,082,080	24,493,613
Miscellaneous	13,643,307	17,857,593	38,077,904	44,678,523	18,841,241
Total Cost of Operations	**761,842,289**	**960,227,828**	**2,047,907,897**	**2,425,057,959**	**1,021,823,686**

iii. Gross Operating Profit

To obtain the GOP of the marble processing plants, the cost of operations will be subtracted from the gross revenue.

Table 19: The Gross Operating Profit of the Marble Processing (2007-2011)

Gross Operating Profit					
	2007	**2008**	**2009**	**2010**	**2011**
Gross Operating Profits	**617,429,611**	**781,842,838**	**1,693,055,445**	**2,058,060,760**	**854,626,274**

iv. Pro Forma Income Statement (2012-2016)

As mentioned previously, the financial analysis of the marble extraction and production will be extended to further five years to be from 2012 to 2016 to account for the industrial growth rate and expected returns. The market prices from 2012 to 2016 of exports and domestic ton of marble are obtained based on the calculation of the average yearly growth rate of the prices from 2007 to 2011. The average annual growth rate of exported manufactured marble ton is 21%, while for the manufactured ton price of marble sold domestically is 10%. In order to test the historical price variations of the processed marble in tons, the growth rate of the market prices was calculated for previous fifteen years. It was found be on average 23% for the exported

marble reflecting rise in international demand and 11% for the domestically sold marble due to the tough competition in the Egyptian market. The rates used for forecasting the processed marble tons price internationally and in Egypt were 21% and 10% which are based on prices from 2007 to 2011 as the growth rates almost didn't vary in comparison to the average percentage change of the prices in the previous historical years. The forecasts of the quantities of exports and domestically sold marble are forecasted based on the expected growth rate of the industrial output of 25% yearly. (CBM, 2012) The gross revenue, cost, and profit for the five forecasted years are presented in table twenty.

Table 20: Pro Forma Income Statement for the Marble Processing (2012-2016)

	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)					
Export Current Price (EGP/Ton)	1,508	1,830	2,222	2,697	3,275
Domestic Current Price (EGP/Ton)	1,533	1,679	1,839	2,014	2,205
Quantities (Tons)					
Exported Quantity (Tons)	476,058	595,072	743,840	929,800	1,162,250
Domestic Quantity (Tons)	3,714,451	4,643,063	5,803,829	7,254,787	9,068,483
Gross Revenue (EGP)					
Export Revenue	717,762,039	1,089,180,434	1,652,795,707	2,508,063,462	3,805,904,325
Domestic Revenue	5,694,898,606	7,795,776,241	10,671,678,532	14,608,516,096	19,997,673,458
Export Subsidy	31,000,000	31,000,000	0	0	0
Gross Revenue	**6,443,660,646**	**8,915,956,675**	**12,324,474,240**	**17,116,579,558**	**23,803,577,782**
Cost of Operations (EGP)					
Cost of Consumables	1,307,521,346	1,808,830,476	2,504,912,973	3,472,722,857	4,820,246,404
Cost of Raw Materials	1,136,975,084	1,572,896,066	2,178,185,194	3,019,759,006	4,191,518,612
Salaries and Wages	216,094,318	270,117,897	337,647,372	422,059,215	527,574,018
Cost of Maintenance	153,491,636	212,340,969	294,055,001	407,667,466	565,855,013
Cost of Management, Marketing, and Administration	79,588,256	110,102,725	152,472,964	211,383,130	293,406,303
Cost of Energy, Fuel, and Water	73,903,380	102,238,244	141,582,038	196,284,335	272,448,710
Miscellaneous	56,848,754	78,644,803	108,909,260	150,987,950	209,575,931
Total Cost of Operations	**3,024,422,775**	**4,155,171,180**	**5,717,764,802**	**7,880,863,960**	**10,880,624,990**
Gross Operating Profit (EGP)					
Gross Operating Profits	3,419,237,870	4,760,785,495	6,606,709,438	9,235,715,599	12,922,952,793
Taxes (20%)	683,847,574	952,157,099	1,321,341,888	1,847,143,120	2,584,590,559
Net Profit After Taxes	**2,735,390,296**	**3,808,628,396**	**5,285,367,550**	**7,388,572,479**	**10,338,362,234**

The pro forma income statement from the ten years from 2007 to 2016 is provided in appendix B in details.

B. Capital Requirements

The capital requirements for the marble processing facilities are evaluated at 2007 which is the first year of the analysis. The investment cost consists of the fixed capital as well as net working capital.

i. Fixed Capital

The fixed capital is the total tangible assets of the production facilities of marble and the total intangible assets. For the marble processing facilities, the tangible assets are: the land, machinery and equipments, buildings and construction, and means of transportation. The land value was calculated to be 2,887,500,000 EGP based on the amount of meter per factory size multiplied by the number of factories and the average price per meter which is 700 EGP/meter; the detailed calculation of the land's value is illustrated in appendix B. The value of the other tangible assets were measured based on weights obtained from the CBM out of the fixed assets. The highest value of fixed assets is for the machinery and equipments which accounts for 44% of the total investments of the marble manufacturing plants. This is mainly due to the capital intensity of the production process which include enormous equipments like: the gang saw machines, integrated slabs lines, block cutters, integrated tiles lines, multi cross cutting machines, bridge cutting machines, and edge tumbling machines. The percentages of the other tangible assets out of total fixed assets are as follows: buildings and construction 13%, means of transportation 9%, and furniture and fixtures 1%. There are no intangible assets for the marble processing facilities and a 10% contingency is added to account fluctuations in assets' prices. Figure three shows the share of each investment requirement out of the total fixed capital requirements of the marble plants.

Figure 3: Fixed Capital Requirements of the Marble Processing (2007)

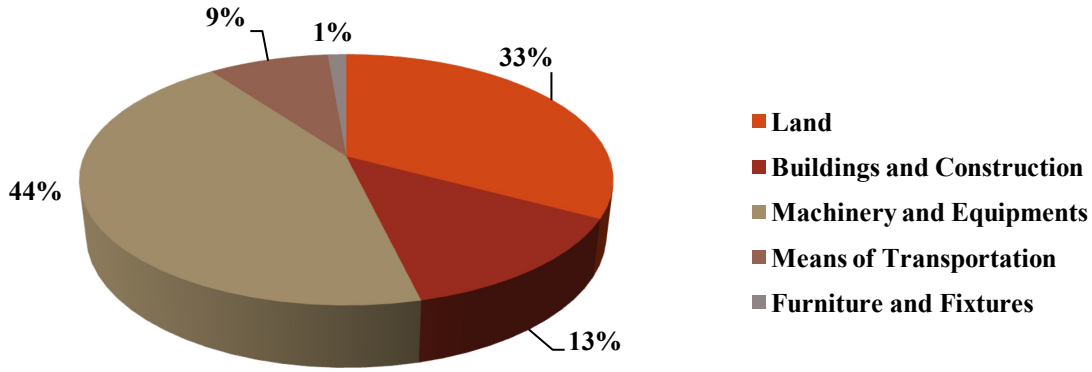


Table twenty one provide the values of the fixed capital requirements of the marble processing plants

Table 21: Fixed Capital of the Marble Production Plants (2007)

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Land	2,887,500,000
Machinery and Equipments	3,843,125,000
Buildings and Construction	1,182,500,000
Means of Transportation	768,625,000
Furniture and Fixtures	118,250,000
Total Fixed Capital Requirement	**8,800,000,000**
10% Contingency	880,000,000
Total Fixed Capital after Contingency	**9,680,000,000**

In addition to the initial investments of fixed assets, investments in machineries are required in the marble manufacturing to match the increase in the annual quantity produced till 2016. The additional investments needed for the machineries amount for 50,000,000 EGP assuming constant labor to capital ratio.

Table 22: Fixed Capital of the Marble Production Plants (2013)

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	50,000,000
Total Tangible Fixed Assets	**50,000,000**

ii. Working Capital

The working capital includes the main four financial gaps that are incurred by the factories. The gaps include: accounts receivable, inventory of final products, inventory of raw materials, and accounts payable. First, the accounts receivable is the gap between the final products' sales and cash collection. In the case of marble factories, it is on average six months that account for cash settlements and transfers from the importers of marble. Second, the inventory of final products is the lag between producing the tiles and slabs and selling them. The marble production is based on orders of diverse specifications from domestic or international consumers; its time lag is five months. Third, the inventory of raw material that is the lag that starts when the blocks arrive to the processing plants until the production process takes place. This process takes about six months. The previous three lags are added together to obtain the gross working capital. The account payable, the forth gap, is mainly the time lag between buying the blocks from the quarries and paying for them that is on average ten months. The annual change in working capital is provided in appendix B.

Table 23: The Working Capital of the Marble Production Plants (2007)

Working Capital	
Year	**2007**
Accounts Receivable	126,973,715
Inventory of Final Product	152,368,458
Inventory of Raw Material	45,477,692
Gross Working Capital	**324,819,864**
Accounts Payable	27,286,615
Net Working Capital	**297,533,249**

iii. Total Investment Cost

The initial investment cost evaluated at 2007 for the marble extraction in Egypt consist of the fixed capital in addition to the net working capital.

Table 24: The Investment Cost of the Marble Quarries (2007)

Initial Investment Cost	
Year	2007
Total Fixed Capital after Contingency	8,800,000,000
Net Working Capital	437,263,902
Investment Cost	10,117,263,902

C. Optimum Financial Structure

The debt to equity ratio for the marble processing plants is 60% to 40% like the extraction ratio as both lie under the same financing options. The optimum loan per year calculation is based on several factors: profit, repayment amount, installments, and lending interest rate. It is the repayments multiplied by the installments amount; the derivation of the optimum loan is provided in the appendix.

Table 25: Optimum Loan for the Marble Processing Plants (2007)

Optimum Loan	
Year	2007
Optimum Loan	1,668,728,677

D. Financial Evaluation

To financially assess the Egyptian marble processing facilities, the same steps of evaluating the marble extraction will be followed in which the NPV, WACC, IRR, ROI, PBP, and BEP will be measured and analyzed.

i. Weighted Average Cost of Capital

The WACC is calculated based on several factors to obtain the average cost of financing for the marble production plants of equity and debt. The common debt to equity ratio of the marble factories is 60% to 40% which almost applies to all the factories other than some exceptional factories that are offered 70% to 30%. The nominal WACC was found to be 12.5%.

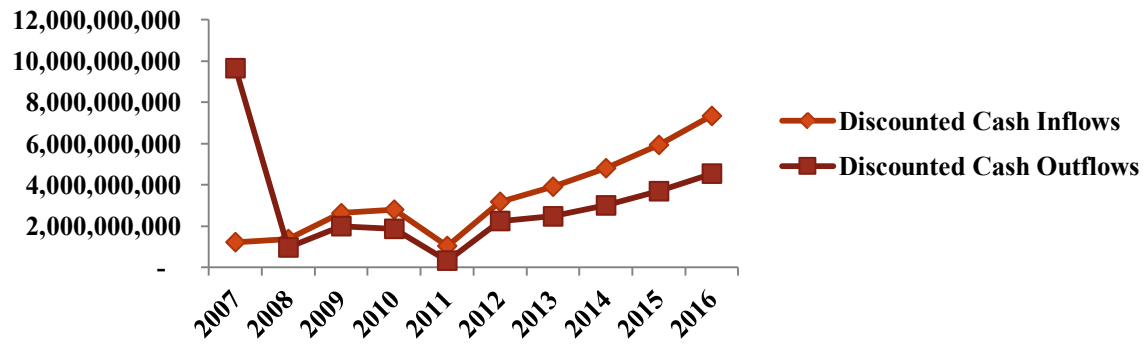
Table 26: The WACC for the Marble Production Plants (2007-2016)

WACC	
Years	**(2007-2016)**
Deposit Interest Rate (I_d)	9%
International Risk (R)	6%
Country Risk (α)	1.3
Equity Ratio $\left(\frac{E}{I}\right)$	40%
Lending Interest Rate (I_b)	12%
Taxes(T)	20%
Debt Ratio $\left(\frac{L}{I}\right)$	60%
WACC $=\left((I_d + R\alpha) * \frac{E}{I}\right) + \left(I_b * (1-T) * \frac{L}{I}\right)$	**12.5%**
Real WACC	**4.5%**

ii. Net Present Value of The Marble Processing Facilities

To measure the NPV, the PV of the cash inflows is conducted for the ten studied years discounted at the estimated WACC accounting for the residual value in the eleventh years. The cash inflows for the marble manufacturing facilities include the total revenue as well as export subsidy. The detailed calculations of the PV are explained in the appendix. In order to measure the marble production facilities' financial feasibility, the PV of cash inflows will be compared to the PV of cash outflows based on the discounted cash flow method to obtain the NPV. The cash outflows of the marble production plants consist of: the initial investment requirements, annual change in net working capital, cost of operations, tax payments, as well as additional re-investments in fixed assets. Figure four provides the discounted cash inflows and outflows from 2007 to 2016.

Figure 4: Discounted Cash Inflows and Outflows of the Marble Processing (2007-2016)



It is important to note that in 2008 there was the global financial crisis and in 2011 the January 25th revolution which highly affected the production level and revenues of the marble processing plants in terms of domestic sales and exports. The NPV was found to be positive meaning that the marble processing facilities are financially viable according to the estimated figures provided in table twenty seven.

Table 27: Financial Viability of the Marble Processing Plants

Financial Viability	
PV of Cash Inflows	86,575,620,379
PV of Cash Outflows	62,108,182,079
NPV	24,467,438,299
Viability	Viable

iii. Internal Rate of Return and Return on Investment

The IRR is calculated through the trial and error method by replacing random rates instead of the WACC in the PV formula until reaching the rate at which the PV of cash inflows will be equal to the PV of cash outflows. The IRR of the marble production facilities from 2007 till 2016 is 27%. The IRR is higher than the 12.5% WACC which ensures the financial viability of the marble processing facilities in Egypt. Although the IRR of the production is lower than the extraction IRR, both are positive and almost twice the WACC.

Table 28: The IRR of the Marble Processing Plants

IRR	
IRR	0.27253
PV of Cash Inflows	21,465,013,403
PV of Cash Outflows	21,465,013,403
NPV	0
Viability	Viable

After calculating the IRR, it is also vital to measure the ROI of the marble production facilities in Egypt. Measuring the ROI for year 2010, it was found to be 21% which is higher than the WACC. Therefore, the marble manufacturing base is financially viable.

iv. Payback Period

The PBP is an important indicator for the investors as it measures for how many years the investment cost will be retained to the investor. Measuring the PBP for the

marble production plants, it was found to be 3.6 years. The DPBP on average for the ten studied years is 2 years as it accounts for the time value of money.

v. Breakeven Point

In order to calculate the BEP for the marble processing facilities, the cost should be divided into the variable and fixed costs.

Table 29: The Variable and Fixed Costs of the Marble Production Plants

Variable and Fixed Costs	
Variable Costs	**Fixed Costs**
• Marketing and Sales Expenses • Wages • Consumables • Cost of Raw Materials	• Salaries • Utilities • Administration • Maintenance • Miscellaneous

The variable and fixed costs are used to estimate the BEP which is the total amount of output produced that will equate the revenue to the cost. The BEP quantity is 1,099,922 units and the breakeven sales is 1,503,282,315 EGP for 2010. The marble producers should manufacture more than BEP quantity to guarantee a range of profit.

G. CAPM Model

The CAPM Model identifies the relationship between the risk and return. The static CAPM based on the year 2012 was measured to derive the marble processing risk the β .The risk free rate R_f is the deposit interest rate which is 9.25%. The market return rate R_M is the return on CASE30 index in 2012. The β was calculated to be 1.128 based on the expected return on investment in 2012 of the marble production base which is 34.3%. In addition, the adjusted β was found to be 1.08 which converges to the market risk after the adjustments.

H. Profitability Ratios and Dupont Analysis

In this section, the profitability ratios: profit margin, ROA, and the ROE will be measured and analyzed for the marble processing base applying the Dupont analysis.

i. Return on Assets

To obtain the ROA, the net profit is divided by the total assets. For the marble production in Egypt, the ROA was estimated to be 6.6% according to the financials of

2010. To further analyze the ROA ratio, we calculate the profit margin and asset turnover. Multiplying the profit margin with the asset turnover gives the ROA ratio.

Table 30: The ROA of the Marble Production Plants (2010)

ROA		
ROA	**Profit Margin**	**Asset Turnover**
6.6%	10.8%	61.3%
For every pound invested in assets, 0.066 piaster is the return on assets in terms of profit.	For every pound obtained from sales, 0.108 piaster of profit is generated.	For every pound invested in assets, 0.613 piaster of sales is generated.

ii. Return on Equity

Estimating the ROE ratio which is the net profit divided by the owner's equity. The marble production plants' ROE is 16.5%. The 16.5% can be divided to several ratios which are the profit margin, asset turnover, and leverage ratio.

Table 31: The ROE of the Marble Production Plants (2010)

ROE			
ROE	**Profit Margin**	**Asset Turnover**	**Financial Leverage**
16.5%	10.8%	61.3%	250%
For every pound invested in equity, 0.165 piaster is the return on assets in terms of profit.	For every pound obtained from sales, 0.108 piaster of profit is generated.	For every pound invested in assets, 0.613 piaster of sales is generated.	It is mainly explains the equity ratio to the assets; the assets are 250% the equity.

Referring to the Dupont analysis, the 15.6% ROE can be decomposed further five financial ratios: tax burden, interest burden, return on sales, asset turnover, and financial leverage ratio. The five ratios are named the Dupont and provide more information regarding the industry's financial performance.

Table 32: The Dupont System of the Marble Production Plants (2010)

ROE					
ROE	**Tax Burden**	**Interest Burden**	**Return on Sales**	**Asset Turnover**	**Financial Leverage**
16.5%	54%	57.3%	34.8%	61.3%	250%
For every pound invested in equity, 0.165 piaster is the return on assets in terms of profit.	For every pound of profit generated, 0.54 piaster is a tax burden.	For every pound of profit generated, 0574 piaster is an interest burden.	For every pound of sales obtained, 0.348 piaster is earnings on sales.	For every pound invested in assets, 0.613 piaster of sales is generated.	It is mainly explains the equity ratio to the assets; the assets are 250% the equity.

The detailed calculations and formulas used in estimating the ROA, ROE, and Dupont system are explained in appendix B.

IV. Financial Valuation Comparison between the Marble Extraction and Processing

After conducting the financial valuation of the marble extraction as well as processing, it is important to compare the financial results and indicators of both obtained from the previous financial analysis. The marble quarries as well as processing facilities were both found to be financially viable in which the NPVs were positive and the IRRs were higher than the WACC. Table thirty three provides a summary of the financial indicators of the marble extraction and processing.

Table 33: Financial Valuation Comparison of the Marble Extraction and Processing

Indicators	Year	Marble Extraction	Marble Processing
Initial Investment Requirements	2007	3,080,000,000	10,117,263,902
Optimum Loan	2007	1,869,780,094	1,668,728,677
Reinvestments in Fixed Capital	2013	20,000,000	50,000,000
WACC	2007	12.5%	12.5%
Present Value of Cash Inflows	(2007-2016)	14,453,633,711	86,575,620,379
Present Value of Cash Outflows	(2007-2016)	8,519,202,532	62,108,182,079
Net Present Value	(2007-2016)	5,934,431,179	24,467,438,299
IRR	(2007-2016)	20%	27.2%
Payback Period	(2007-2016)	4.9	3.6
Discounted Payback Period	(2007-2016)	2.7	2.03
Breakeven Quantity	2010	399,568	1,099,922
Breakeven Sales	2010	215,553,951	1,503,282,315
ROI	2010	22%	21%
β	2012	0.27	1.12
ROA	2010	3.2%	6.65%
ROE	2010	8%	16.5%
Profit Margin	2010	6.6%	10.8%
Asset Turnover	2010	48%	61.3%
Financial Leverage Ratio	2010	250%	250%
Return on Sales	2010	37.1%	34.8%
Tax Burden	2010	35.9%	54.3%
Interest Burden	2010	49.5%	57.3%

The marble extractions as well as processing were found to be financially viable. The marble extraction has a lower level of cash inflows, cash outflows, and investments as compared to the marble production although the quantity of raw material extracted and sold is higher than the quantity of processed annual output per year. This is mainly due to the fact that the processed marble is sold on a much higher level of prices than the raw material sales' prices due to being manufactured using several production levels associated with higher costs. In addition, the production facilities are larger entities than the quarries as they have several production processes with higher levels of investments and costs compared to the quarries. A large factory can operate three or more quarries in parallel with the production activities.

However, studying the financials of each one separately, both were found to have sound financial returns and viability. The NPV was high and significant for both as well as the IRR which was found to be 20% for the extraction and 27.2% for the marble production. The payback period is 4.9 for the extraction and 3.6 years for the processing. The breakeven quantity and sales were lower for the extraction base than the manufacturing meaning that a quarry can operate above the breakeven level easier than the factory. Thus, the marble processing was found to be more profitable than the marble extraction.

Concerning the profitability ratios for both activities, the processing had higher level of profitability ratios including the ROE, ROA, and profit margin in comparison to the marble extraction that had positive profitability ratios but lower than that of the marble processing. In addition, the risk of the extraction was found to be lower in comparison to the risk of processing. The taxes and interest burden had lower ratios for the extraction than the processing. This means that the production plants has a higher financial burden which is mainly due to their high investment requirements relative to the extraction.

Chapter Four: Economic Valuation of the Marble Extraction and Processing

I. SUMMARY

This chapter is mainly an economic valuation of the marble extraction and processing in Egypt; each one is separately evaluated due to their different financial and economic structures. The economic valuation aims at measuring the positive and negative externalities associated with the industry that affect the economy and social welfare. The chapter starts by deriving the shadow prices for the marble industry. The shadow prices derived will be used to transform the financial statements constructed in the previous chapter to economic statements. The indirect benefits as well as costs associated with the marble extraction and manufacturing will be quantified and reflected in the economic statements. Afterwards, the economic evaluation will be done in which the net economic present value will be estimated to test the economic viability of the marble extraction and processing. In addition, the economic contribution in terms of value added, employment, and foreign exchange earnings will be measured for both processes. The methodology used for economic valuation is mainly based on the "Manual for Evaluation of Industrial Projects" by UNIDO with reference to other project valuation manuals including: "Project Appraisal Manual" by the Asian Development Bank and the "Handbook on Economic Analysis of Investment Operations" by the World Bank.

II. DERIVING SHADOW PRICES

The economic analysis is based on shadow pricing which are prices that prevail under a market free from distortions in which there is perfect competition and no government intervention. The shadow prices are derived for the five main markets: the commodity market, the labor market, the capital market, the foreign exchange market, and utilities market. For each of the studied markets, the shadow prices of the marble extraction and processing will be derived using different pricing methods.

a. Commodity Market

The commodity shadow prices can be obtained using two methods: the equilibrium price of the product and the international opportunity cost method. The first method is mainly deriving the commodity equilibrium price that will maximize revenue as well

as minimize cost. This price is obtained using the LaGrange method that will minimize the cost as well as maximize the revenue subject to industrial production constraints. The equilibrium price approach is not commonly used due to the high marginal error associated with its application process. Therefore, the international opportunity cost will be applied in order to derive the shadow price of the ton of extracted and processed marble. This approach derives the shadow price based on the opportunity cost of exporting the marble abroad. Concerning the marble raw material obtained from the quarries, it is sold domestically as well as internationally. Thus, the shadow price per ton of marble block is the FOB price of selling the marble internationally which will be applied for the total output of marble blocks per year. The same applies to the processed marble which is either sold domestically or exported. The ton of manufactured marble will be evaluated at the annual FOB price per ton. In addition, as the FOB prices of marble are in USD, the prices will be adjusted to account for the derived shadow exchange rate (SER). The shadow prices of the extracted and processed marble for the period of analysis are presented in the appendix. Figure one and two present the FOB prices and the adjusted FOB prices by the shadow exchange rate of the Egyptian pound for the extracted and processed marble.

Figure 1: Current and Adjusted FOB Prices of Extracted Marble (2007-2016)

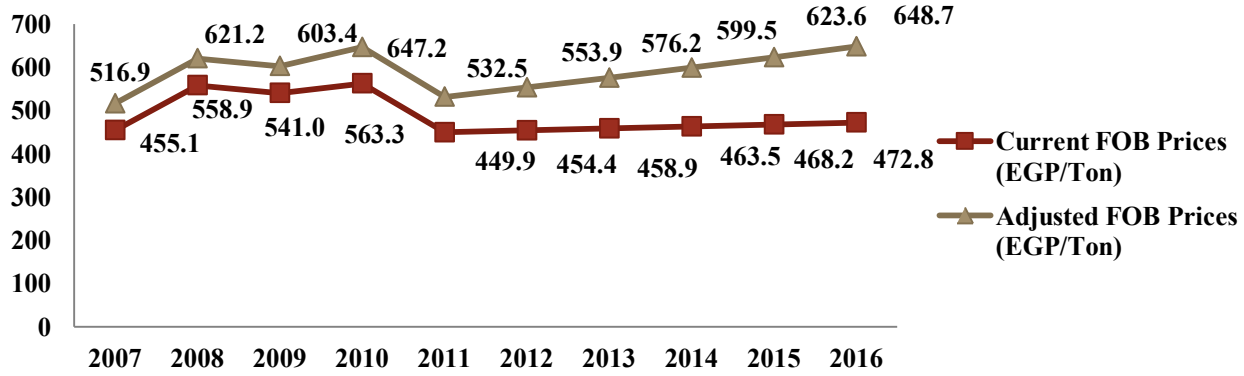
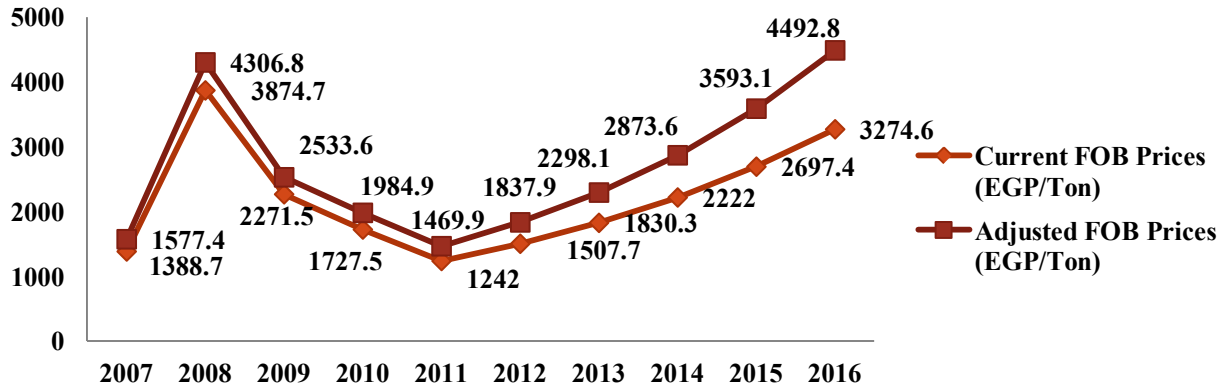


Figure 2: Current and Adjusted FOB Prices of Processed Marble (2007-2016)



b. Labor Market

The labor market includes skilled as well as unskilled labor. Concerning the skilled labor, their wages are based on supply and demand. The skilled labors are employed according to their productivity and skills in which the producers will employ the labor when his/her marginal productivity is higher than the offered wage rate. On the other hand, the labor will accept to work if the job matches his/her market price.

However, the distortion always prevails in the unskilled labor market. There are two kinds of unskilled labor in the marble industry in Egypt. First, the very unskilled workers are the ones that have a very low level of skills and educational background. They include the office boys, securities, servants, and cleaners in the administration and production lines. The shadow wages rate for the very unskilled labor is estimated by measuring the value of the forgone marginal product. It is usually estimated as the forgone value of the marginal product of labor in the agricultural sector. In Egypt, the value of the marginal product of labor in agriculture was found to be 4,800 EGP annually meaning that the shadow wage rate for the very unskilled labor is 400 EGP monthly; the formula applied is presented in the appendix. The shadow wage rate of the very unskilled labor is lower than the average current monthly wage rate offered in the marble extraction and processing which is 700 EGP.

Second, the unskilled workers are the ones that have basic level of technical skills and knowledge concerning the production or extraction process. These workers are more skilled than the very unskilled labor. The shadow wage rate for the unskilled labor is estimated to be the marginal productivity value of the unskilled labor in the

economy which is the efficient wage rate. This is evaluated at the minimum wage rate in the economy which is 700 EGP monthly. The average monthly wage rate in the marble quarries is 1200 EGP and 900 EGP in the factories which are above the efficient wage rate.

c. The Capital Market

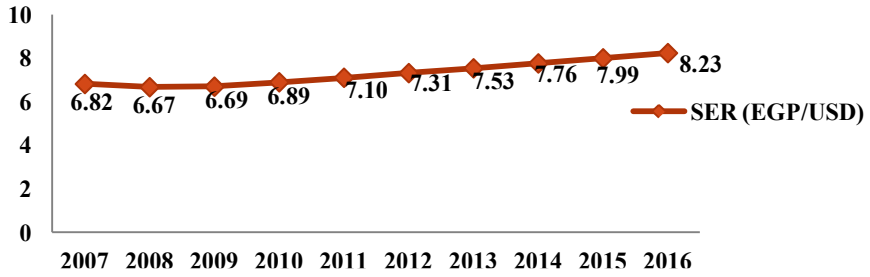
For the capital market, the social discount rate (SDR) will be derived. The SDR accounts for the cost of capital in the economic analysis. The SDR is the international cost of capital which is the rate of borrowing from abroad at the case of deficit or lending aboard in the case of surplus. The SDR is estimated based on the lending or borrowing rate in addition to a risk factor which presents any kind of risks associated with the country. For Egypt, the SDR was estimated to be 10% in which the international borrowing rate is 7% and the risk factor is 3% which is the currency risk of devaluation per year. The SDR will be further used in the economic present value estimation.

d. Foreign Exchange Market

The exchange rate for each nation is determined according to the foreign exchange system adopted by the country which can be free floating exchange rate, pegged exchange rate, or fixed exchange rate. The free floating exchange rate is an undistorted system of exchange rate determination as it based on supply and demand forces. Egypt has managed floating exchange rate regime which has a degree of government intervention in order to maintain a certain range of the Egyptian pound's value. This system is mainly adopted due to the high dependency of Egyptian economy on the imports. Therefore, the Egyptian currency is overvalued in order to maintain a lower level of imports' cost for the economy. Thus, the shadow exchange rate (SER) should be derived for Egypt to use it in the analysis. The SER reflects the real value of the Egyptian currency in terms of others based on market supply and demand. There are three approaches commonly used to derive the SER: the UNIDO approach, the World Bank approach, and the supply and demand approach. The supply and demand approach is used to estimate the SER as it accounts for goods, services, as well as capital flow unlike the other two approaches. The SER for Egypt was estimated from 2007 to 2010 using the supply and demand approach which is

based on the ratio between capital and goods inflows and outflows. In addition, from 2011 to 2016, the SER was calculated based on annual value of currency devaluation of 3%. Figure three provides the estimated SER of the Egyptian pound in terms of dollars for the ten years studied.

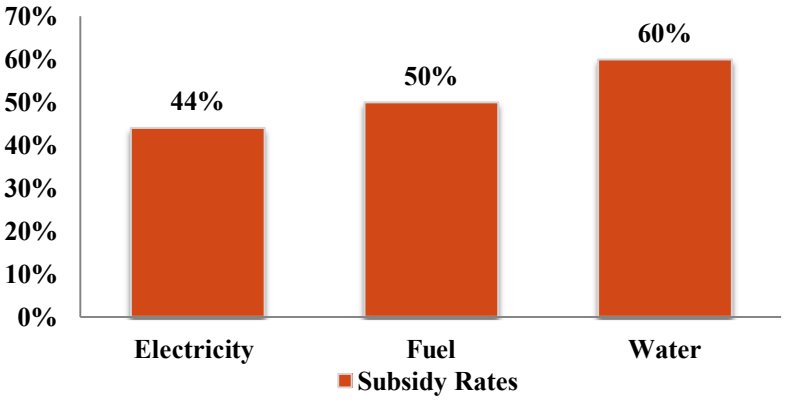
Figure 3: The Shadow Exchange Rate of EGP per USD (2007-2016)



e. Utilities Market

In Egypt, the utilities mainly the electricity, fuel, and water are highly subsidized. In the economic valuation, the energy prices should reflect their real cost to exclude the subsidy value which creates distortions in the market. According to the African Development Bank report "Reforming Energy Subsidies in Egypt" that was published in March 2012, the subsidy rate for industrial fuel and electricity are 50% and 44% estimated based on the price gap methodology of determining the rate of subsidy. In addition, the subsidy rate of water according to the Holding Company of Water and Wastewater is 60%. These subsidy rates will be used in adjusting the cost of utilities for the marble extraction and processing based on the consumption level of each process.

Figure 4: Subsidy Rates of Electricity, Fuel, and Water in Egypt



III. ECONOMIC VALUATION OF THE MARBLE EXTRACTION (2007-2016)

A. Transforming the Financial Statements to Economic Statements

After deriving the shadow prices in the commodity, labor, capital, foreign exchange, and utilities markets, these prices will be used to transform the constructed financial statements of chapter three into economic statements. The economic statements are based on shadow prices and exclude all money transactions that can create distortions in the economy such as subsidies, interests, or taxes. In this section, the pro forma income statement from 2007-2016 will be adjusted to account for the shadow prices and government intervention.

i. Shadow Pricing of Gross Revenue

The financial gross revenue will be adjusted to account for the shadow prices derived in the previous section. For the marble extraction, the shadow price for the ton of marble blocks was obtained using the international opportunity cost method in which the FOB price will be used. Thus, the gross revenue will be calculated as the yearly quantity of tons sold multiplied by the annual FOB market prices per marble ton. It is also important to adjust the FOB prices to the derived annual shadow exchange rate for the Egyptian currency to totally remove the distortion. The adjustments will result in having a higher level of revenue than the amount of revenue estimated in the financial analysis. Table one presents the gross revenue for the marble extraction after adjusting the shadow prices.

Table 1: Economic Gross Revenue for the Marble Quarries (2007-2016)

Gross Revenue					
	2007	**2008**	**2009**	**2010**	**2011**
Current FOB Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	517	621	603	647	532
Domestic Current Prices (EGP/Ton)	517	621	603	647	532
Quantities (Tons)					
Exported Quantity (Tons)	2,050,296	2,028,947	1,742,938	1,935,151	2,029,352
Domestic Quantity (Tons)	135,919	119,866	262,540	330,173	108,925
Gross Revenue (EGP)					
Export Revenue	1,059,784,484	1,260,447,516	1,051,774,712	1,252,444,449	1,080,537,831
Domestic Revenue	70,255,687	74,464,761	158,429,277	213,690,736	57,997,406
Gross Revenue	**1,130,040,170**	**1,334,912,277**	**1,210,203,989**	**1,466,135,185**	**1,138,535,236**
	2012	**2013**	**2014**	**2015**	**2016**
Current FOB Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	554	576	599	624	649
Domestic Current Prices (EGP/Ton)	554	576	599	624	649
Quantities (Tons)					
Exported Quantity (Tons)	2,562,870	3,203,588	4,004,484	5,005,605	6,257,007
Domestic Quantity (Tons)	169,899	212,374	328,174	410,218	136,156
Gross Revenue (EGP)					
Export Revenue	1,419,605,811	1,846,019,907	2,400,518,137	3,121,573,772	4,059,216,494
Domestic Revenue	94,109,116	122,377,142	196,726,586	255,818,334	88,330,680
Gross Revenue	**1,513,714,928**	**1,968,397,049**	**2,597,244,723**	**3,377,392,106**	**4,147,547,173**

ii. Shadow Pricing of Cost of Operations

There are several items in the extraction cost of operations that need to be adjusted to transform the cost of operations to economic costs that are based on shadow prices and don't include monetary transactions or market distortions.

First, the cost of salaries and wages will be adjusted to account for the shadow wages derived for the unskilled and very unskilled workers. The cost of skilled labors account for 20% of the total labor cost of the quarries; while the very unskilled workers account for 30% and the unskilled workers for 50%. The skilled labor wages are not distorted. However, the unskilled labor wages will be transformed to the derived shadow wage rates which were estimated to be 400 EGP for the very unskilled labor, and 700 EGP for the unskilled workers. Both derived shadow wages

are lower than the current wages in the marble which are 700 for the very unskilled workers and 1200 EGP for the unskilled labor. Thus, the adjustments in the cost of salaries and wages to shadow wages will result in decreasing the cost of salaries and wages.

Second, 60% of the consumables of the marble quarries are mostly imported from abroad and the rest are bought from the domestic market. Thus, the cost of imported consumables should be adjusted to the SER derived for each year. In addition, the tariffs should be removed from the imported amount of consumables to remove the distortions. According to the MIFT, the average tariff rate on consumables is 5%.

Third, the cost of fuel, electricity, and water is distorted due to the fact that the energy in Egypt is highly subsidized. In the quarries, the fuel is very important in the extraction process and running the machineries in which it amounts for 80% of the total cost of utilities. In addition to the fuel consumed by quarries, the water and electricity account for the rest 20% of the utilities cost in the quarries. The subsidy per fuel, electricity, and water should be added to the cost to reflect their real cost. Thus, the cost of fuel, water, and energy will be adjusted to account for the energy subsidies.

Forth, the government fees paid upon the blocks extraction as well as the export duty on exported blocks will be removed from the extraction costs of operations. The government fees are paid for the extracted marble blocks to the governorates where the quarries are located. In addition, the exports' duty is imposed on the blocks exported mainly to encourage the marble producers to manufacture the marble blocks domestically and then export the marble in the form of slabs or tiles.

The detailed adjustments' calculations per cost items are provided in the appendix. Table two will present the cost of operations after adjusting the cost elements to shadow pricing and removing the distortions.

Table 2: Economic Costs of Operations for the Marble Quarries (2007-2016)

Cost of Operations					
	2007	**2008**	**2009**	**2010**	**2011**
Cost of Salaries and Wages	23,398,892	28,247,390	25,520,247	30,010,923	22,626,355
Cost of Electricity, Fuel, and Water	119,700,453	144,503,657	130,552,554	153,525,268	115,748,428
Cost of Consumables	62,620,654	74,592,289	67,533,776	80,890,883	62,123,611
Cost of Maintenance	29,845,525	36,029,835	32,551,335	38,279,239	28,860,147
Cost of Management, Marketing, and Administration	13,453,331	13,223,170	12,341,124	13,940,146	13,158,331
Miscellaneous	9,948,508	12,009,945	10,850,445	12,759,746	9,620,049
Government Fees	-	-	-	-	-
License Fees	22,500,000	25,000,000	27,500,000	30,000,000	32,500,000
Export Duty	-	-	-	-	-
Total Cost of Operations	**281,467,363**	**333,606,286**	**306,849,480**	**359,406,207**	**284,636,920**
	2012	**2013**	**2014**	**2015**	**2016**
Salaries and Wages	29,206,195	36,872,822	47,235,587	59,634,929	71,100,610
Cost of Electricity, Fuel, and Water	149,408,565	188,628,313	241,640,554	305,071,199	363,725,572
Cost of Consumables	81,701,038	105,113,227	137,247,969	176,648,269	214,753,261
Cost of Maintenance	37,252,800	47,031,660	60,249,473	76,064,960	90,689,554
Cost of Management, Marketing, and Administration	16,816,664	21,020,829	26,661,920	33,327,400	39,341,660
Miscellaneous	12,417,600	15,677,220	25,354,987	25,354,987	30,229,851
Government Fees	-	-	-	-	-
License Fees	35,000,000	37,500,000	40,000,000	42,500,000	45,000,000
Export Duty	-	-	-	-	-
Total Cost of Operations	**361,802,862**	**451,844,072**	**578,390,490**	**718,601,743**	**854,840,508**

iii. Shadow Pricing of Gross Operating Profit

The economic gross operating profit (GOP) is estimated after economically adjusting the revenue and costs. The GOP is basically the revenue minus the estimated cost of operations. In addition, there are profit taxes that are deducted from the GOP. The 20% profit taxes for the marble extraction base would be excluded from the analysis in order to remove the monetary transactions.

Table 3: Economic Gross Operating Profit of the Marble Quarries (2007-2016)

Gross Operating Profit					
	2007	**2008**	**2009**	**2010**	**2011**
Gross Operating Profit	**744,469,996**	**699,899,614**	**763,530,841**	**865,757,596**	**248,562,661**
	2012	**2013**	**2014**	**2015**	**2016**
Gross Operating Profit	**287,984,966**	**327,681,616**	**376,877,900**	**460,219,951**	**522,734,290**

iv. Shadow Pricing of Fixed and Working Capital

After deriving the economic value of the gross revenue as well as cost of operations, the fixed and working capital will be adjusted economically to determine the economic initial investment value. The machineries and equipments used in the quarries are imported from abroad mainly from Italy, Spain, Turkey, China, and USA. Therefore, the machineries and equipments will be adjusted to account for the shadow exchange rate for year 2007 which was estimated to be 6.82 EGP per USD. Also, the 5% tariffs imposed on the importation of the machines should be removed from the value of the fixed assets estimated in the financial valuation chapter. In addition to the adjustments for the machines, the means of transportation mainly the trucks are also imported and subject to tariffs. Therefore, the value of the fixed capital investments in the means of transportation should account for the derived SER 6.82 EGP in 2007. Additionally, the 5% tariffs on trucks will be removed for the value of the means of transportation. Other than the machines and means of transportation, the other tangible and intangible capital items including the building and construction, and the exploration fees are not subject to market distortions. The shares of the fixed capital requirements items of the quarries out of the total economic fixed capital are presented in the below figure.

Figure 5: Economic Fixed Capital Requirements of the Marble Quarries (2007)

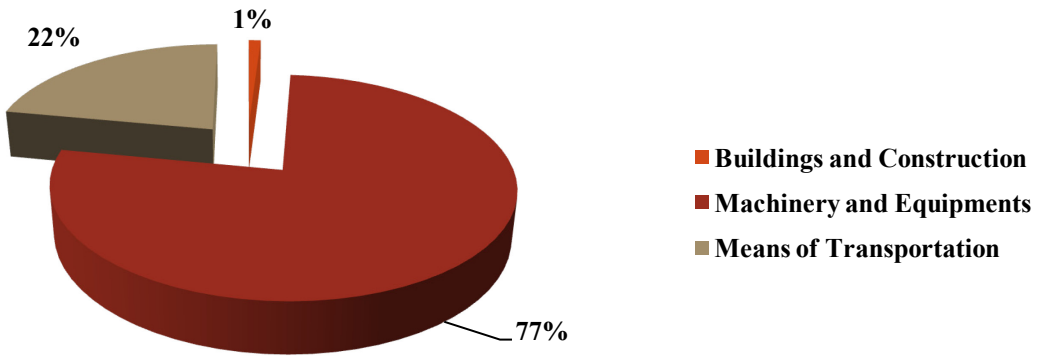


Table four provides the economic value of the extraction fixed capital.

Table 4: Economic Fixed Capital of the Marble Quarries (2007)

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Buildings and Construction	28,000,000
Machinery and Equipments	2,120,326,227
Means of Transportation	605,807,493
Total Tangible Fixed Assets	**2,754,133,720**
Intangible Fixed Assets	
Exploration Fees	252,000,000
Total Intangible Fixed Assets	**252,000,000**
Total Fixed Capital Requirements	**3,006,133,720**

In addition to the fixed capital evaluated at 2007, the required investments for the expansion of the marble extraction base which is needed to be carried out by 2013 should be economically valuated. The investments amount for 20,000,000 EGP which are directed to the purchase of new machines. Thus, the re-investments should exclude the 5% tariff rate of importing machines in order to remove the distortion and account for the shadow exchange rate of year 2013 which was estimated to be 7.53 EGP per USD. Table five provides the economic value of the machineries investments needed in 2013.

Table 5: Economic Fixed Capital Re-investments of the Marble Quarries (2013)

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	**23,915,769**
Total Tangible Fixed Assets	**23,915,769**

Concerning the working capital, it includes the accounts receivable, inventory of raw materials, inventory of final product, and accounts payable. The value of these items are adjusted due to the changes that took place in cost of operations which is used to estimate the accounts receivable as well as the inventory of final products. Table six presents the working capital accounting for the economic adjustments.

Table 6: Economic Working Capital of the Marble Quarries (2007)

Working Capital	
Year	**2007**
Accounts Receivable	83,379,692
Inventory of Final Product	55,586,461
Inventory of Raw Material	-
Gross Working Capital	**138,966,154**
Accounts Payable	-
Net Working Capital	**138,966,154**

Thus, after economically valuating the fixed as well as the working capital, the economic initial investment cost for the marble extraction base is provided in table seven.

Table 7: Economic Initial Investment Cost (2007)

Investment Cost	
Year	**2007**
Total Fixed Capital	**3,006,133,720**
Net Working Capital	**138,966,154**
Total Investment Cost	**3,145,099,874**

B. Accounting For Indirect Costs and Benefits

The economic analysis incorporates the indirect benefits and costs to the economy and social welfare. Both the negative and positive externalities are quantified and included in the analysis in order to test to what extent the extraction facilities affect the economic, social, and environmental welfare. Thus, after transforming the financial measures to economic ones, the costs and benefits associated with the quarries will be measured.

i. Quantifying The Indirect Benefits

The main indirect benefits associated with the marble quarries are mainly: the value added, employment, and foreign exchange earnings. These benefits are considered economic contributions and will be examined below in the economic contribution section.

ii. Quantifying The Indirect Costs

Quantifying the indirect costs in the economic valuation can be done using three methods. First method is measuring the actual impact of the industry's negative

externalities. The second approach is done by estimating the mitigation cost needed for each externality. The mitigation cost is mainly the cost of preventing the damage of the indirect cost either on society, economy, and the environment. The third approach is the opportunity cost approach which estimates the cost of the forgone opportunities. The first approach involves a high degree of error in measuring the actual impact of the costs. Thus, to quantify the indirect extraction costs, the mitigation cost and opportunity cost methods will be adopted.

The indirect costs of the marble extraction are the wasted raw material, depletion of natural stone resources, as well as the safety damages. Each cost will be estimated differently according to its opportunity cost or prevention cost.

According to the extraction process nature, there is a degree of waste associated with the process due to the fact that the marble is extracted from mountains and naturally there are parts of the mountains which are not fit to be extracted because of diverse stone features like size, quality, or color. Thus, the normal waste associated with the extraction process is not regarded as an indirect cost. However, the irrationally wasted marble materials which are wasted due to irrational extraction methods such as the use of dynamite and explosives have to be accounted for as an indirect extraction cost. The irrationally wasted marble in the quarries will be quantified using the opportunity cost method. Almost 70% of the quarries in Egypt use irrational extraction techniques and those quarries waste 25% of the total extracted amount. The wasted material can be sold in the market with a low price to be recycled or used for other purposes such as the mosaic production. According to the data gathered from the conducted interviews with marble factory owners, the estimated price of wasted material is 20% of the price per ton of marble blocks. Table eight presents the total indirect cost per year for the wasted marble raw materials due to irrational extraction techniques; the detailed calculations are provided in the appendix.

Table 8: Opportunity Cost of Wasted Marble Material (2007-2016)

Opportunity Cost of Wasted Marble (EGP)					
Year	2007	2008	2009	2010	2011
Opportunity Cost of Wasted Marble	39,551,406	46,721,930	42,357,140	51,314,731	39,848,733
Year	2012	2013	2014	2015	2016
Opportunity Cost of Wasted Marble	52,980,022	68,893,897	90,903,565	118,208,724	145,164,151

The second indirect cost of extraction is the resource depletion. Marble is considered an exhaustible natural resource and it gets depleting overtime. The resource depletion is considered an environmental cost as the current consumption of the resource affects its sustainability for future generation. The opportunity cost of resource depletion will be quantified using Hotelling's rent. Hotelling's rent is the net economic profit of the exhaustible resource which represents its demand. The opportunity cost is measured by the set of allocations in which the discounted net economic profits at the SDR are equal across the period of analysis. Thus, the opportunity cost of resource depletion applying Hotelling's rent is estimated as the divergence of the discounted net economic profit from 2008 to 2016 from the discounted net economic profit of 2007. The figure below presents the discounted Hotelling's rent in EGP per ton and the divergence from it yearly.

Figure 6: Discounted Hotelling's Rent (2007-2016)

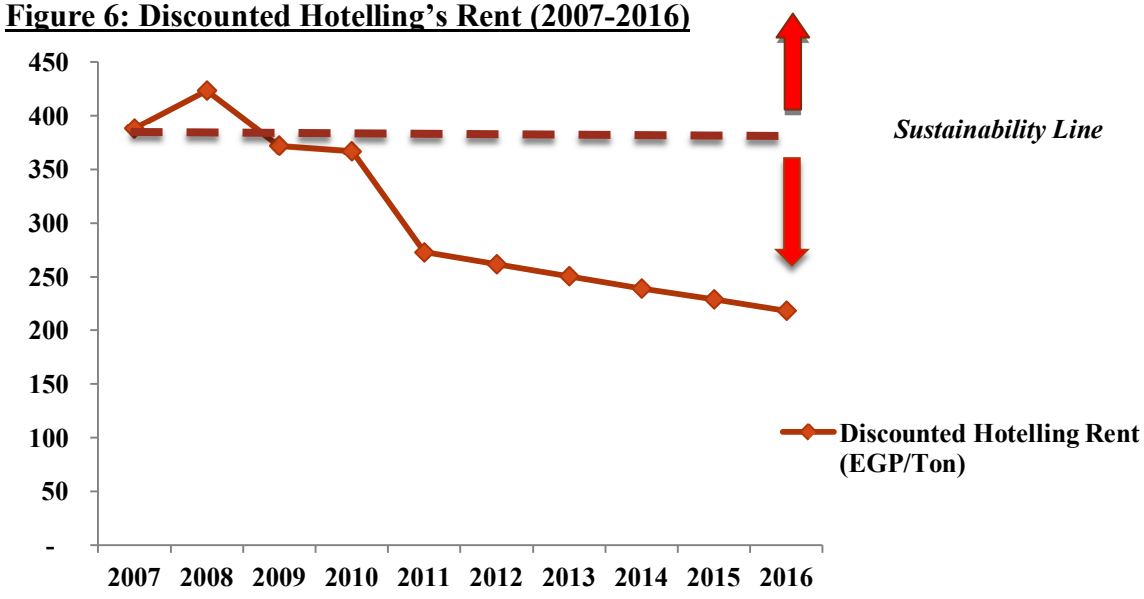


Table 9: Opportunity Cost of Resource Depletion (2007-2016)

Opportunity Cost of Resource Depletion (EGP)					
Year	2007	2008	2009	2010	2011
Opportunity Cost of Resource Depletion	-	76,222,801	31,846,078	47,776,982	246,741,584
Year	2012	2013	2014	2015	2016
Opportunity Cost of Resource Depletion	345,469,245	469,840,392	645,717,007	861,790,231	1,085,057,751

The third indirect cost associated with the marble extraction process is the safety damages. In the extraction process of marble, some workers are subject to physical damages or injuries. As previously mentioned, there are dangerous methods of extraction highly adopted in Egypt like the use of dynamite. In addition, the tough machineries and equipments are used in the extraction process like the chainsaw, diamond wires, and loaders. Therefore, safety measures need to be accounted for by the quarries' directors in order to prevent any human injuries or physical damages. To account for the safety cost, the mitigation cost approach will be implemented to estimate the cost of creating a safe environment for the workers in the quarries. The safety cost includes safety tools for the workers like masks, hamlets, boots, and glasses. The cost of these tools per labor is 400 EGP. In addition to the safety tools, safety awareness sessions should be given to the workers yearly to inform them about the risks associated with the extraction process and equipments. The cost of the safety trainings for labor yearly is estimated to be 100 EGP per worker after consulting the ITC to determine the cost of annual training sessions.

Table 10: Mitigation Cost of Safety (2007-2016)

Mitigation Cost of Safety (EGP)					
Year	2007	2008	2009	2010	2011
Mitigation Cost of Safety	12,500,000	13,750,000	15,125,000	16,637,500	18,301,250
Year	2012	2013	2014	2015	2016
Mitigation Cost of Safety	20,131,375	22,144,513	24,358,964	26,794,860	29,474,346

After quantifying the quarrying indirect costs, the three costs will be added to get a total value of the extraction indirect costs.

Table 11: Total Indirect Costs of the Marble Extraction Base (2007-2016)

Mitigation Cost of Safety (EGP)					
Year	**2007**	**2008**	**2009**	**2010**	**2011**
Opportunity Cost of Wasted Marble	39,551,406	46,721,930	42,357,140	51,314,731	39,848,733
Opportunity Cost of Resource Depletion	-	76,222,801	31,846,078	47,776,982	246,741,584
Mitigation Cost of Safety	12,500,000	13,750,000	15,125,000	16,637,500	18,301,250
Total Indirect Cost	**52,051,406**	**136,694,731**	**89,328,218**	**115,729,214**	**304,891,567**
Year	**2012**	**2013**	**2014**	**2015**	**2016**
Opportunity Cost of Irrationally Wasted Marble	52,980,022	68,893,897	90,903,565	118,208,724	145,164,151
Opportunity Cost of Resource Depletion	345,469,245	469,840,392	645,717,007	861,790,231	1,085,057,751
Mitigation Cost of Safety	20,131,375	22,144,513	24,358,964	26,794,860	29,474,346
Total Indirect Cost	**418,580,643**	**560,878,802**	**760,979,536**	**1,006,793,815**	**1,259,696,248**

iii. Adjusting Economic Statements to The Indirect Benefits and Costs

The estimated indirect costs need to be added to the cost of operations of the marble quarries to account for the negative externalities of the costs in the economic statements. The increase in the cost of operations by the amount of the indirect costs will affect also the economic gross operating profit. Thus, the cost of operations and profit will be adjusted in the following table to include the indirect costs for the ten studied years.

Table 12: Adjusting the Gross Operating Profit to the Indirect Costs (2007-2016)

Gross Operating Profit (2007-2016)					
	2007	**2008**	**2009**	**2010**	**2011**
Gross Revenue					
Gross Revenue	**1,130,040,170**	**1,334,912,277**	**1,210,203,989**	**1,466,135,185**	**1,138,535,236**
Cost of Operations					
Indirect Costs	52,051,406	136,694,731	89,328,218	115,729,214	304,891,567
Costs of Operations	281,467,363	333,606,286	306,849,480	359,406,207	284,636,920
Total Cost of Operations	**333,518,769**	**470,301,017**	**396,177,698**	**475,135,421**	**589,528,487**
Gross Operating Profit					
Gross Operating Profit	**796,521,401**	**864,611,260**	**814,026,291**	**990,999,764**	**549,006,749**

	2012	2013	2014	2015	2016
Gross Revenue					
Gross Revenue	**1,513,714,928**	**1,968,397,049**	**2,597,244,723**	**3,377,392,106**	**4,147,547,173**
Cost of Operations					
Indirect Costs	418,580,643	560,878,802	760,979,536	1,006,793,815	1,259,696,248
Costs of Operations	361,802,862	451,844,072	578,390,490	718,601,743	854,840,508
Total Cost of Operations	**780,383,505**	**1,012,722,873**	**1,339,370,026**	**1,725,395,558**	**2,114,536,756**
Gross Operating Profit					
Gross Operating Profit	**733,331,423**	**955,674,175**	**1,257,874,697**	**1,651,996,548**	**2,033,010,417**

C. Economic Evaluation

After obtaining the economic statements that exclude the market distortions and are based on shadow prices, the economic evaluation will be done. The economic evaluation applies to the same concept of financial valuation but based on economic statements. The main objective of the economic evaluation is to determine the economic feasibility of the marble extraction base.

i. Net Economic Present Value

The net economic present value (NEPV) is the difference between the present value of the economic benefit and the cost estimated for the period of analysis. The PV of the economic benefit (EB) is calculated using the discounted cash flow formula in which the net benefit that is economic cash inflows is discounted at the SDR at 10%. The economic cash inflows include the economic revenue generated by the quarries for the ten studied years accounting for the terminal value in year 11. While the PV of the economic cost (EC) is the economic cash outflows estimated based on the discounted cash flow method discounted at the SDR at 10%. The economic cash outflows comprise the economic cost of operations, investment in fixed capital as well as net working capital. After calculating the PV of the EB and EC, if the NEPV was found to be positive, this means that the marble extraction base is economically viable. Figure seven shows the discounted economic benefit and cost for the ten studied years.

Figure 7: Discounted Economic Benefit and Cost of the Marble Extraction (2007-2016)

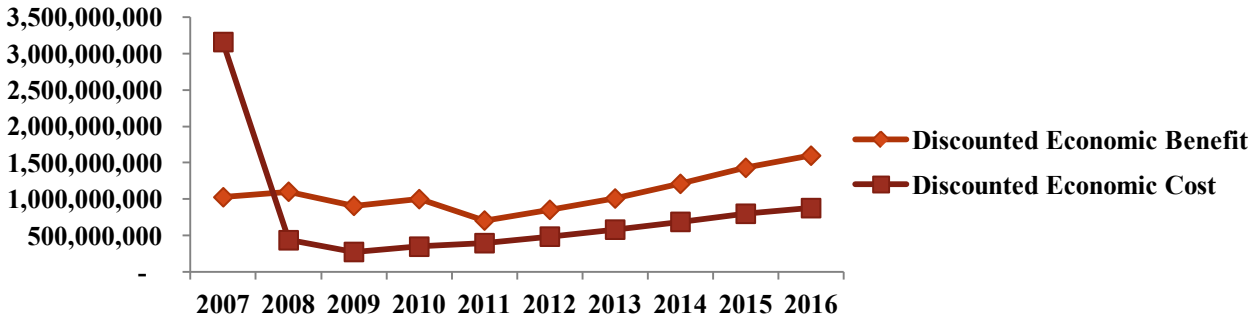


Table 13: Economic Viability of the Marble Extraction Base (2007-2016)

Economic Viability	
PV of Economic Benefit	25,392,605,686
PV of Economic Cost	16,879,461,455
NEPV	8,513,144,231
Viability	Viable

Referring to table thirteen, it is shown that the NEPV is positive and have a significant value. This means that the marble extraction base was found to be economically feasible after incorporating all its associated indirect costs and adjusting for the market distortions.

ii. Economic Rate of Return

The economic rate of return (ERR) is the rate of return of the marble extraction base economically. It is the discount rate that will equate the PV of the EB and EC. The ERR will be obtained using the trial and error method in which diverse discount rate it randomly tried in the NEPV formula until reaching the rate that will equate the PV of the EB and EC. For the marble extraction base, the ERR was found to be 40%.

Table 14: The ERR of the Marble Extraction Base

ERR	
ERR	0.40344
PV of Economic Benefit	3,608,787,643
PV of Economic Cost	3,608,787,643
NEPV	0
Viability	Viable

Comparing the ERR at 40% to the SDR at 10%, it is found that the ERR is higher than the SDR which also ensures the economic viability of the marble extraction base.

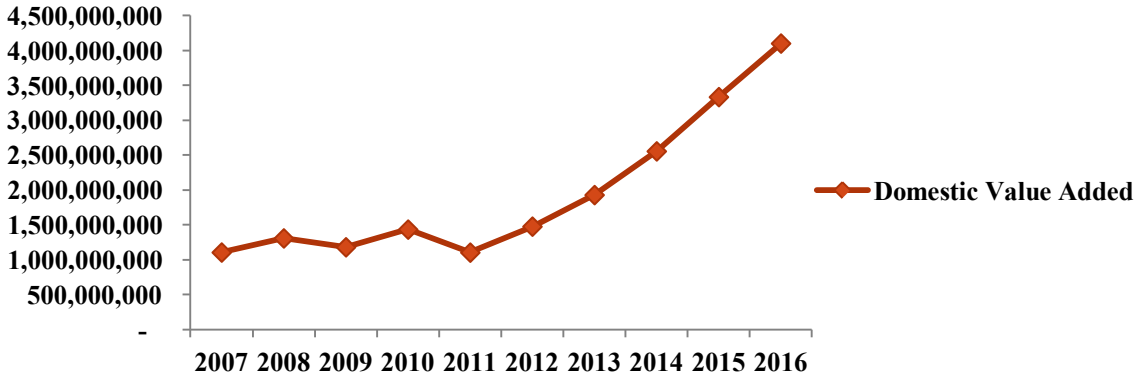
D. Economic Contribution

In this section, the economic contribution of the marble extraction facilities will be measured in terms of value added, employment, and foreign exchange earnings.

i. Value Added

The value added is a major economic indicator which explains to what extent the industry creates value. It is the most important indictor when it comes to measuring the economic contribution of a project, firm, or an industry. The domestic value added is measured as the difference between the gross output and the material inputs. In the case of extraction, there is no cost of material inputs because the blocks are purely extracted from the mountain. However, the quarries license fees are regarded as the material inputs to provide an estimate of the raw materials cost. The value added was measured for the ten studied years. It was found to be positive and significant. The domestic value added is equal to the national value as the transfer abroad is zero. Figure eight provide the annual value added of the marble extraction base.

Figure 8: The Domestic Value Added of the Marble Extraction Base (2007-2016)



After measuring the value added, it is important to test its relationship with the investment incurred in the marble extraction. This could be done by conducting the absolute efficiency test (AET) which is the difference between the PV of the value added discounted at the SDR and the PV of the investment. If the net present value of value added (NPVVA), the difference between the PV of value added and the PV of

the investment, is positive; this means that the marble extraction is valuable from the economic view point. The NPVVA of the marble extraction base was found to be positive as well as significant. Table fifteen provides the results NPVVA of the marble extraction base.

Table 15: NPV of Value Added of the Marble Extraction Base (2007-2016)

NPV of Value Added	
PV of Value Added	10,660,224,750
PV of Investment	3,283,333,507
NPVVA	7,376,891,243

In addition to the AET, the relative efficiency test (RET) is important to conduct. It measures the competitiveness of the extraction base as well as the marginal productivity of the capital invested through relating the PV of value added to the PV of the investment. The RET was found to 3.24 which is a very high ratio indicating that the PV of the value added is three times the PV of the investment. This means that an EGP invested will create a value added of 3.24 EGP.

ii. Employment Effect

The employment effect is another indicator to use in order to measure the contribution of the extraction base in the creation of employment. The employment effect refers to the new employment opportunities created by the marble quarries. It relates the amount of employment created to the PV of the capital invested. It is evaluated at the amount of employment of a normal year related to the PV of capital invested over the period of study. The normal year for the marble extraction was chosen to be 2010. For the marble extraction base, the 3,283,333,507 EGP invested in the marble extraction creates 33,275 employment opportunities. In addition, the cost of creating a job in the quarries is 98,673 EGP. The employment effect was found to be 0.00001013452 which means that for every million EGP invested 10 jobs are created in the quarries.

iii. Foreign Exchange Earnings

The foreign exchange earnings effect is another economic contribution that the marble extraction provides to the economy. It is mainly related to the foreign currency that the marble extraction generates from its sales. The marble extraction base mainly exports the raw material abroad with huge amounts as previously

emphasized and this is translated into foreign earnings of diverse currencies such as dollars, Euros, and others. To test the foreign exchange effect on the economy, the PV of the foreign exchange earnings should be estimated and related to the PV of the investment. The PV of the foreign exchange earnings don't only account for foreign earnings generated by the quarries, but also the earnings spent on the industrial imports are deducted in order to evaluate the net foreign exchange earnings generated by the marble quarries. The marble quarries highly imports from abroad the required machineries and equipments required in the extraction. Thus, the imports value of the extraction base will be deducted from the exports revenue generated. The PV of the foreign exchange earnings for the extraction was found to be 7,588,481,629 EGP. For the marble extraction base, the foreign exchange effect was found to be 2.3 which is high meaning that the extraction generates foreign exchange earnings which are almost two and a half times the investments done.

IV. ECONOMIC VALUATION OF THE MARBLE PROCESSING (2007-2016)

After testing the economic viability and contribution of the marble extraction process, the same method of economic valuation will be applied for the marble processing plants to test its economic feasibility.

A. Transforming the Financial Statements to Economic Statements

Based on the shadow prices derived in the beginning of the chapter for the commodity, labor, capital, foreign exchange, and utilities markets, the financial statements of the marble processing facilities will be transformed in this section to the economic statements that will exclude all the market distortions for the ten studied years.

i. Shadow Pricing of Gross Revenue

The marble production plants export as well as sell the manufactured marble domestically. Using the international opportunity cost approach in determining the marble shadow price, the FOB price will be applied for the total processed marble quantity per year. This adjustment will affect the gross revenue. In addition to FOB adjustments, the FOB prices will account for the annual estimated SER which will highly differ from the FOB prices based on the current Egyptian exchange rate. Also,

the export subsidy offered to the marble processing plants will be excluded from the revenue analysis to remove all market distortions. Table sixteen present the economic gross revenue of the marble factories based on the adjusted FOB prices.

Table 16: Economic Gross Revenue for the Marble Processing (2007-2016)

Gross Revenue					
	2007	**2008**	**2009**	**2010**	**2011**
Current Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	1,577	4,307	2,534	1,985	1,470
Domestic Current Prices (EGP/Ton)	1,577	4,307	2,534	1,985	1,470
Quantities (Tons)					
Exported Quantity (Tons)	90,013	88,006	131,189	285,968	380,846
Domestic Quantity (Tons)	1,223,272	1,078,796	2,362,856	2,971,561	980,321
Gross Revenue (EGP)					
Export Revenue	141,986,131	379,023,459	332,374,193	567,621,613	559,796,707
Domestic Revenue	1,929,584,000	4,646,148,173	5,986,417,996	5,898,289,388	1,440,951,702
Export Subsidy	-	-	-	-	-
Gross Revenue	**2,071,570,131**	**5,025,171,633**	**6,318,792,189**	**6,465,911,001**	**2,000,748,409**
	2012	**2013**	**2014**	**2015**	**2016**
Current Prices (EGP/Ton)					
Export Current Prices (EGP/Ton)	1,838	2,298	2,874	3,593	4,493
Domestic Current Prices (EGP/Ton)	1,838	2,298	2,874	3,593	4,493
Quantities (Tons)					
Exported Quantity (Tons)	476,058	595,072	743,840	929,800	1,162,250
Domestic Quantity (Tons)	3,714,451	4,643,063	5,803,829	7,254,787	9,068,483
Gross Revenue (EGP)					
Export Revenue	874,957,402	1,367,550,836	2,137,470,105	3,340,847,249	5,221,715,295
Domestic Revenue	6,826,877,379	10,670,350,177	16,677,664,848	26,067,045,615	40,742,566,379
Export Subsidy	-	-	-	-	-
Gross Revenue	**7,701,834,781**	**12,037,901,013**	**18,815,134,953**	**29,407,892,864**	**45,964,281,674**

ii. Shadow Pricing of Cost of Operations

For the cost of operations, some adjustments will be made to apply the derived shadow prices and remove the distortions that include taxes, subsidies, or tariffs.

The salaries and wages of the skilled and unskilled workers should account for the shadow wage rates. As the skilled labor market is based on supply and demand; there will be no changes made in the cost of skilled labor which account for 30% of the cost. However, the very unskilled labor shadow wage rate was found to be 400 EGP

which is lower than the average wage rate of the very unskilled labor in the marble factories which is 700 EGP per month. For the unskilled labors, their derived shadow wage rate is 700 EGP and they are currently paid 900 EGP monthly. The unskilled labor cost represents 50% and the very unskilled 20% o of the total cost of salaries and wages. The adjustments in the cost of salaries and wages will result in a decline in the total cost of salaries and wages.

In addition to the shadow wage rates of unskilled labor, the tariffs imposed on the imported consumables should be excluded. An amount of 60% of the cost of consumables is for the imported consumables that the factories buy from abroad. Thus, 60% of the cost of consumables should be reduced by the 5% tariff rate imposed on them. In addition, the cost of buying consumables from abroad will be adjusted to account for the derived annual shadow exchange rate of the EGP in terms of USD.

Concerning the utilities cost, several adjustments will be made for the electricity, fuel, and water. The subsidies rate per each energy item should be added to the cost due to the fact that the energy is highly subsidized and the cost that the plants incur underestimate the actual cost of energy. The marble production process mostly depends on electricity as the primary source of energy accounting for 70% of the cost of utilities. Almost all the machineries are operated using electricity. Afterwards, the water accounts for 25% of the cost of utilities as it used in some machines liking the cutting equipments. The fuel cost is 5% of the total cost of energy as it is not used on large scale mainly for some machines or transportation means. The subsidy rates in Egypt based on the price gap methodology is 44%, 50%, and 60% respectively. The cost of utilities will rise to account for the high subsidy rate.

All the adjustments' calculations are present in the appendix for detailed references and the final cost entries after adjustments are provided in table seventeen.

Table 17: Economic Costs of Operations for the Marble Processing (2007-2016)

Cost of Operations					
	2007	**2008**	**2009**	**2010**	**2011**
Cost of Raw Materials	364,748,675	904,209,744	1,133,060,334	1,125,453,987	364,748,675
Salaries and Wages	83,388,842	206,720,432	259,040,254	257,301,290	77,297,865
Cost of Energy, Fuel, and Water	35,159,949	87,161,298	109,221,351	108,488,137	32,591,758
Cost of Consumables	407,476,377	1,010,131,457	1,265,790,259	1,257,292,882	377,713,050
Cost of Maintenance	49,241,071	122,068,315	152,963,145	151,936,288	45,644,352
Cost of Management, Marketing, and Administration	25,532,407	63,294,682	79,314,223	78,781,779	23,667,442
Miscellaneous	18,237,434	45,210,487	56,653,017	56,272,699	16,905,316
Total Cost of Operations	**1,020,440,224**	**2,514,959,337**	**3,154,386,956**	**3,158,495,542**	**956,641,783**
	2012	**2013**	**2014**	**2015**	**2016**
Cost of Raw Materials	1,120,095,439	1,699,744,829	2,579,362,778	3,914,183,016	5,939,772,727
Salaries and Wages	107,971,600	163,846,903	248,637,675	377,307,672	572,564,392
Cost of Energy, Fuel, and Water	107,971,600	163,846,903	248,637,675	377,307,672	572,564,392
Cost of Consumables	1,251,306,619	1,898,857,795	2,881,516,704	4,372,701,598	6,635,574,675
Cost of Maintenance	151,212,884	229,465,552	348,213,975	528,414,707	801,869,318
Cost of Management, Marketing, and Administration	78,406,681	118,982,138	180,555,394	273,992,811	415,784,091
Miscellaneous	56,004,772	84,987,241	128,968,139	195,709,151	296,988,636
Total Cost of Operations	**3,162,335,311**	**4,840,304,592**	**7,409,966,421**	**11,345,914,631**	**17,375,745,173**

iii. Shadow Pricing of Gross Operating Profit

The gross operating profit will be adjusted according to the implementation of shadow pricing and removal of distortions applied to the revenue and the cost of operations. Table eighteen presents the value of the economic gross operating profit for the ten studied years.

Table 18: Economic Gross Operating Profit of the Marble Processing (2007-2016)

Gross Operating Profit					
	2007	**2008**	**2009**	**2010**	**2011**
Gross Operating Profit	**1,051,129,907**	**2,510,212,295**	**3,164,405,233**	**3,307,415,458**	**1,044,106,626**
	2012	**2013**	**2014**	**2015**	**2016**
Gross Operating Profit	**4,539,499,471**	**7,197,596,420**	**11,405,168,532**	**18,061,978,233**	**28,588,536,501**

iv. Shadow Pricing of Fixed and Working Capital

The fixed and working capital will be adjusted to shadow pricing and removal of distortions in order to obtain the economic investment cost of the marble quarries. First, the land value is not distorted because the land is mainly obtained based on the supply and demand. Second, the values of the machineries and means of transportation should be adjusted to exclude the tariffs as they are imported and subject to a tariff rate of 5%. In addition, as the machineries and means of transportation are imported, their estimates will account for the derived shadow exchange rate of the Egyptian pound in 2007 at 6.82 EGP per USD. The values of the buildings and construction in addition to the furniture and fixtures won't be changed as there is no existence of distortion for these items. The chart below shows the share of each investment requirement in fixed capital of the marble production plants.

Figure 9: Economic Fixed Capital Requirements of the Marble Processing (2007)

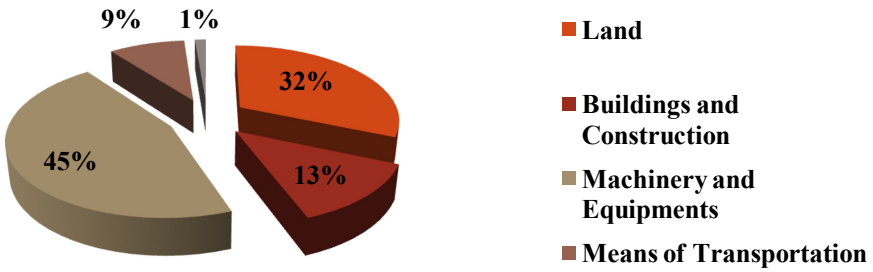


Table nineteen provides the total economic fixed capital requirements for the marble production plants.

Table 19: Economic Fixed Capital of the Marble Production Plants (2007)

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Land	2,887,500,000
Machinery and Equipments	1,182,500,000
Buildings and Construction	4,157,489,148
Means of Transportation	831,497,830
Furniture and Fixtures	118,250,000
Total Tangible Fixed Assets	**9,177,236,978**
Intangible Fixed Assets	
Total Intangible Fixed Assets	-
Total Fixed Capital Requirements	**9,177,236,978**

As the study is conducted on ten years, there is an amount of re investments needed by 2013 for expansion purposes to meet the rise in the production capacity. The new investments will be mainly directed for purchasing of new machines. Thus, these machines should be adjusted to have an economic value to remove the distortion arising from the 5% tariff rate imposed on machines' importation. In addition, the machineries value should account for the shadow exchange rate of the Egyptian pound in 2013 which was estimated to be 7.53 EGP in terms of USD.

Table 20: Economic Fixed Capital Re-investments of the Marble Processing (2013)

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	59,789,422
Total Tangible Fixed Assets	**59,789,422**

The working capital comprises the following entries: accounts receivable, inventory of raw materials, inventory of final product, and accounts payable. The calculations of those items depend mainly on the cost of raw materials and cost of operations which were previously adjusted to exclude distortions and account for shadow prices. Therefore the value of the working capital will change accordingly. In table twenty one, the estimates of the economic working capital are provided.

Table 21: Economic Working Capital of the Marble Production Plants (2007)

Working Capital	
Year	**2007**
Accounts Receivable	271,638,715
Inventory of Final Product	181,092,477
Inventory of Raw Material	30,395,723
Gross Working Capital	**483,126,915**
Accounts Payable	30,395,723
Net Working Capital	**452,731,192**

Thus, after economically valuating the fixed and the working capital, the economic initial investment cost for the marble extraction base is provided in the table below

Table 22: Economic Initial Investment Cost of the Marble Processing (2007)

Investment Cost	
Year	2007
Total Fixed Capital	9,177,236,978
Net Working Capital	452,731,192
Total Investment Cost	9,629,968,170

B. Accounting For Indirect Costs and Benefits

The marble processing facilities' benefits and costs to the economy, society, and the environment will be quantified and incorporated in the economic statements.

i. Quantifying The Indirect Benefits

The marble processing plants have economic benefits such as the value added, employment, and generation of foreign exchange earnings. These benefits will be measured in the economic contribution section.

ii. Quantifying The Indirect Costs

The negative externalities of the marble production process will be quantified using the opportunity cost which measures the forgone opportunities and the mitigation cost approach that measure the cost of preventing the negative externalities. The indirect costs of the marble extraction facilities are the high level of waste associated with the production, the air pollution, and the safety damages.

The waste in the manufacturing facilities is mainly generated from cutting the blocks' surfaces and slabs. In order to standardize the blocks to adequate sizes for entering the production process, waste is generated. An amount of 60% of the quantity manufactured generates wastes and this is due to the nature of the raw material as being a natural stone resource which comes from different quarries. From the 60% of the manufactured output, 20% of the output is wasted. This is an indirect cost to the production plants as they could make use of selling the waste, but instead the waste is just left idle in the factories. The waste highly affects the factories' space which creates a burden on them especially after the accumulation of more waste overtime. The waste can be sold in the market at a low price almost equals to 15% of the processed marble ton. Through applying the opportunity cost method, the annual forgone amount of revenue of the wasted marble is measured per year.

Table 23: Opportunity Cost of Wasted Marble Material (2007-2016)

Opportunity Cost of Wasted Marble (EGP)					
Year	**2007**	**2008**	**2009**	**2010**	**2011**
Opportunity Cost Wasted Marble	**37,288,262**	**90,453,089**	**113,738,259**	**116,386,398**	**36,013,471**
Year	**2012**	**2013**	**2014**	**2015**	**2016**
Opportunity Cost Wasted Marble	**138,633,026**	**216,682,218**	**338,672,429**	**529,342,072**	**827,357,070**

The air pollution is another cost of the marble production process which affects the workers as well as the environment. The air pollution cost will be measured through using two approaches: the mitigation cost to estimate the cost of air pollution on the marble workers, and an estimate of the cost of environmental degradation of air pollution in Egypt to measure the cost of air pollution on the environment. For the cost of air pollution on the workers, the air pollution can be prevented by using facial masks that the workers should wear while during the production activities. The mitigation cost of air pollution is given by the cost of masks multiplied by the number of workers in the industry. Referring to "Cost Assessment of Environmental Degradation" by the World Bank, the effect of air pollution on the environment is measured as 2.1% of GDP. Applying the World Bank's approach, the cost of air pollution the marble production on the external environment is estimated by multiplying 2.1% to the net income of the marble production plants. Table twenty four provides the total cost of air pollution for the workers as well as the environment.

Table 24: Cost of Air Pollution (2007-2016)

Opportunity Cost of Resource Depletion (EGP)					
Year	**2007**	**2008**	**2009**	**2010**	**2011**
Mitigation Cost of Air Pollution	1,072,500	1,179,750	1,297,725	1,427,498	1,570,247
Cost of Air Pollution on External Environmental	4,262,029	13,134,960	28,443,331	34,575,421	14,357,721
Total Cost of Air Pollution	**5,334,529**	**14,314,710**	**29,741,056**	**36,002,918**	**15,927,969**
Year	**2012**	**2013**	**2014**	**2015**	**2016**
Mitigation Cost of Air Pollution	1,727,272	1,899,999	2,089,999	2,298,999	2,528,899
Cost of Air Pollution on External Environmental	57,443,196	79,981,196	110,992,719	155,160,022	217,105,607
Total Cost of Air Pollution	**59,170,468**	**81,881,195**	**113,082,718**	**157,459,021**	**219,634,506**

The safety is the third indirect cost associated with the marble production process. The marble production process has several production lines and equipments like the

cutting machines which can cause injuries to the workers if the workers were not trained or aware with the damages that they might incur. In addition, the safety problem is more common to the small factories which don't regularly do the maintenance needed to the production machines and tools. This also increases the risk of injuries and physical damages to the labor. Thus, to avoid the problem of safety, the workers should be trained and aware with the risks associated with the process. The training cost per labor annually was estimated to be 100 EGP. Also, some tools are needed for safety such as masks, hamlets, boots, and glasses. These tools cost yearly 400 EGP per worker. The mitigation cost of safety is measured as the training cost and safety tools cost per labor in the manufacturing marble facilities.

Table 25: Mitigation Cost of Safety (2007-2016)

Mitigation Cost of Safety (EGP)					
Year	**2007**	**2008**	**2009**	**2010**	**2011**
Mitigation Cost of Safety	**17,875,000**	**19,662,500**	**21,628,750**	**23,791,625**	**26,170,788**
Year	**2012**	**2013**	**2014**	**2015**	**2016**
Mitigation Cost of Safety	**28,787,866**	**31,666,653**	**34,833,318**	**38,316,650**	**42,148,315**

After quantifying the quarrying indirect costs, the three costs will be added to obtain a total value of the processing indirect costs.

Table 26: Total Indirect Costs of the Marble Processing Base (2007-2016)

Mitigation Cost of Safety (EGP)					
Year	**2007**	**2008**	**2009**	**2010**	**2011**
Opportunity Cost of Wasted Marble	37,288,262	90,453,089	113,738,259	116,386,398	36,013,471
Cost of Air Pollution	5,334,529	14,314,710	29,741,056	36,002,918	15,927,969
Mitigation Cost of Safety	17,875,000	19,662,500	21,628,750	23,791,625	26,170,788
Total Indirect Cost	**60,497,791**	**124,430,299**	**165,108,066**	**176,180,941**	**78,112,228**
Year	**2012**	**2013**	**2014**	**2015**	**2016**
Opportunity Cost of Wasted Marble	138,633,026	216,682,218	338,672,429	529,342,072	827,357,070
Cost of Air Pollution	59,170,468	81,881,195	113,082,718	157,459,021	219,634,506
Mitigation Cost of Safety	28,787,866	31,666,653	34,833,318	38,316,650	42,148,315
Total Indirect Cost	**226,591,361**	**330,230,067**	**486,588,465**	**725,117,743**	**1,089,139,891**

iii. Adjusting Economic Statements to The Indirect Benefits and Costs

The total quantified indirect cost will be added to the costs of operations to account for the costs in the economic statements. The economic profit will be adjusted according by the amount of increase in the cost of operations.

Table 27: Adjusting the Gross Operating Profit to the Indirect Costs (2007-2016)

	2007	2008	2009	2010	2011
Gross Revenue					
Gross Revenue	**2,071,570,131**	**5,025,171,633**	**6,318,792,189**	**6,465,911,001**	**2,000,748,409**
Cost of Operations					
Indirect Costs	60,497,791	124,430,299	165,108,066	176,180,941	78,112,228
Costs of Operations	1,020,440,224	2,514,959,337	3,154,386,956	3,158,495,542	956,641,783
Total Cost of Operations	**1,080,938,015**	**2,639,389,636**	**3,319,495,022**	**3,334,676,484**	**1,034,754,011**
Gross Operating Profit					
Gross Operating Profit	**990,632,116**	**2,385,781,996**	**2,999,297,167**	**3,131,234,517**	**965,994,398**
	2012	**2013**	**2014**	**2015**	**2016**
Gross Revenue					
Gross Revenue	**7,701,834,781**	**12,037,901,013**	**18,815,134,953**	**29,407,892,864**	**45,964,281,674**
Cost of Operations					
Indirect Costs	226,591,361	330,230,067	486,588,465	725,117,743	1,089,139,891
Costs of Operations	3,162,335,311	4,840,304,592	7,409,966,421	11,345,914,631	17,375,745,173
Total Cost of Operations	**3,388,926,671**	**5,170,534,659**	**7,896,554,886**	**12,071,032,374**	**18,464,885,064**
Gross Operating Profit					
Gross Operating Profit	**4,312,908,110**	**6,867,366,354**	**10,918,580,067**	**17,336,860,490**	**27,499,396,610**

C. Economic Evaluation

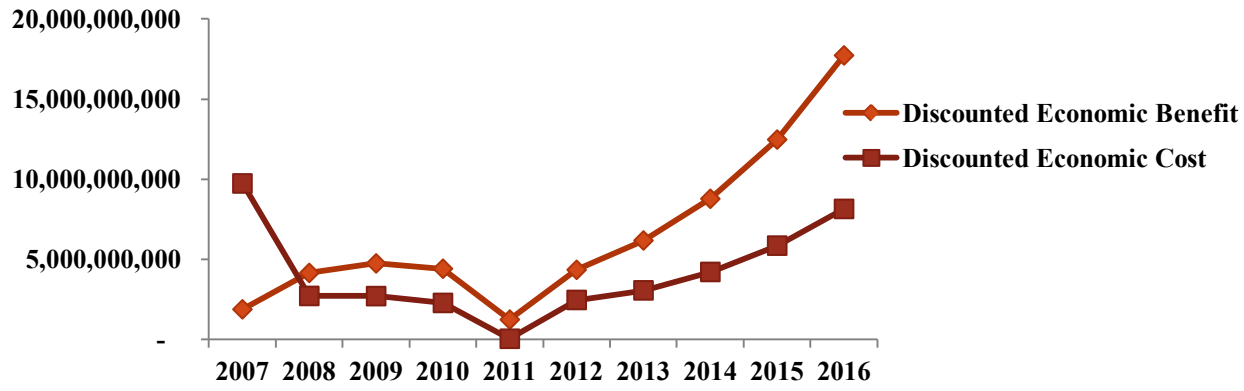
The economic evaluation will be done based on o the economic statements that were adjusted to account for shadow prices and remove distortions. The economic valuation tests the economic viability of the marble production base in which it determines the extent of economic feasibility of the marble processing plane.

i. Net Economic Present Value

The net economic present value is the main indicator towards measuring the economic viability if the NEPV is positive, then the marble production facilities is economically viable. The NEPV is the difference between the PV of economic benefit and the PV of economic cost. The PV of the economic benefit and cost will be

calculated based on the discounted case flow method having the discount rate the SDR at 10%. The economic benefit is mainly the economic cash inflows of the marble production facilities, while the economic cost is the economic cash out flows which include the cost of operations, investment in fixed capital, and net working capital. The economic benefit as well as costs account for the terminal value of the marble processing base. Figure ten presents the annual discounted economic benefit and cost of the marble production base.

Figure 10: Discounted Economic Benefit and Cost of the Marble Processing (2007-2016)



The discounted economic benefit and cost will be summed up to get the PV of the economic benefit and cost. After calculating the PV of the economic benefit and cost and obtaining the NEPV, the marble production facilities were found to have a positive value indicating its economic viability.

Table 28: Economic Viability of the Marble Production Base (2007-2016)

Economic Viability	
PV of Economic Benefit	227,039,565,419
PV of Economic Cost	113,608,804,405
NEPV	113,430,761,013
Viability	Viable

The significant value of the NEPV means that the marble production base was found to be economically feasible after including all its indirect costs and adjusting for the market distortions.

iii. Economic Rate of Return

The ERR is the rate of return of the marble production facilities that will equate the NEPV to zero, or the PV of economic benefit to the present value of economic cost.

The ERR will be obtained using the trial and error method in which several discount rates are chosen and used in the NEPV formula until reaching the rate that will equate the PV of the EB and EC. For the marble production facilities, the ERR was found to be 44%.

Table 29: The ERR of the Marble Production Base

ERR	
ERR	0.45720
PV of Economic Benefit	13,816,572,706
PV of Economic Cost	13,816,572,706
NEPV	0
Viability	Viable

It is found that the ERR is higher than the SDR. This ensures the viability of the marble production base.

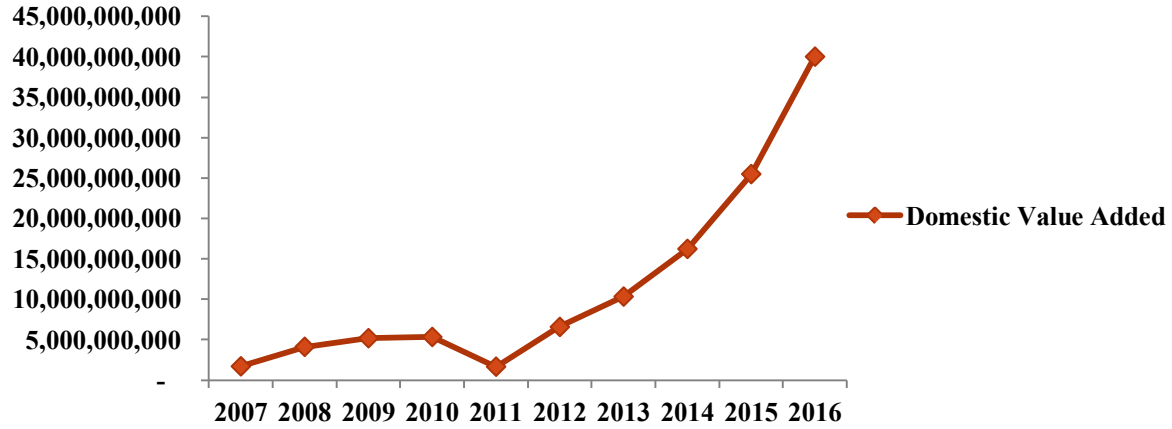
D. Economic Contribution

The marble production base economic contribution will be estimated and analyzed in this section in terms of value added, employment, and foreign exchange earnings.

i. Value Added

The value added is the most important economic contribution of an industry. The domestic value added is measured as the difference between the gross output and the material inputs. For the marble production facilities, the value added is estimated as the gross revenue minus the cost of raw materials. It was found to be positive in the ten studied years. Figure ten presents the value added estimates per annum.

Figure 11: The Domestic Value Added of the Marble Processing (2007-2016)



The domestic value added is equivalent to the national value added as there is no transfer abroad of the Egyptian employees in the industry. To test the relation between the value added and the investment of the marble production facilities, the absolute efficiency test (AET) will be used. The NPVVA is the difference between the PV of the value added and the PV of the investment. If the NPVVA was found to be positive, this means that the value added exceeds the investments incurred for the marble factories. The NPVVA was found to be positive and significant for the marble production facilities.

Table 30: NPV of Value Added of the Marble Production Facilities (2007-2016)

NPV of Value Added	
PV of Value Added	56,370,939,577
PV of Investment	12,532,623,111
NPVVA	43,838,316,466

After conducting the AET, the relative efficiency test (RET) will be applied to the marble production facilities. The RET estimated to marginal productivity of the capital invested. The RET for the marble processing base was found to be 4.49 which means that the PV of the value added is almost four times the PV of the invested capital. For every pound invested in the marble production, 4.49 pounds of value added is generated.

ii. Employment Effect

The second economic contribution is the employment effect which estimated the degree of employment creation of the marble facilities. The employment effect measures the amount of employment created by the amount of investments incurred as well as the cost of creating a job in the marble extraction facilities. The employment effect test is evaluated at the number of employees in a normal year in terms of production which was chosen to be 2010. The PV of investment of the marble production plants 12,532,623,111 EGP creates 52,342 jobs. In addition, the cost per job created was found to be 255,787 EGP. The employment effect for the marble production was found to be 0.0000039095 which means that for every million EGP investment 3 jobs are created.

iii. Foreign Exchange Earnings

The marble factories sell the processed marble tons domestically as well as internationally. The foreign exchange earnings are the generated revenue of foreign currency that the marble factories generated due to the exportation of the goods. The PV of the foreign exchange earnings for the ten studied years will be estimated at a discount rate of 10%. The foreign exchange earnings measures the net earnings which are the foreign currency revenue generated by the industry minus the foreign currency spent for buying the imports of the machines. To measure the foreign exchange contribution of the marble factories to the economy, the PV of the foreign exchange earnings will be related to the PV of the investment. The PV of the foreign exchange earnings was found to be 2,484,045,949 EGP .The foreign exchange effect was found to be 0.20 which means that a pound invested in the marble production generates 0.20 pound.

V. ECONOMIC VALUATION COMPARISON BETWEEN THE MARBLE EXTRACTION AND PROCESSING

After carrying out the economic valuation for the marble extraction and production, it was found out that both processes are economically feasible after applying shadow pricing, removing monetary transactions, and incorporating all the indirect costs of the industry on the economy, society, and environment. It is important to compare the results obtained for the extraction and processing from the economic valuation. Table thirty one present the main economic indicators for the extraction and processing of marble.

Table 31: Economic Valuation Comparison of the Marble Extraction and Processing

Indicators	Year	Marble Extraction	Marble Processing
Initial Investment Requirements	2007	3,145,099,874	9,629,968,170
Reinvestments in Fixed Capital	2013	23,915,769	59,789,422
Shadow Discount Rate	(2207-2016)	10%	10%
Present Value of Economic Benefit	(2007-2016)	25,392,605,686	227,039,565,419
Present Value of Economic Cost	(2007-2016)	16,879,461,455	113,608,804,405
Net Present Value	(2007-2016)	8,513,144,231	113,430,761,013
Economic Rate of Return	(2007-2016)	40.3%	45%
Present Value of Value Added	(2007-2016)	10,660,224,750	56,370,939,557
Present Value of Investment	(2007-2016)	3,283,333,507	12,532,623,111
Net Present Value of Value Added	(2007-2016)	7,376,891,243	43,838,316,466
Relative Efficiency Test	(2007-2016)	3.24	4.49
Number of Jobs Created	2010	33,275	52,342
Cost of Creating a Job	(2007-2016)	98,673	225,787
Employment Effect	(2007-2016)	0.00001013452	0.0000039095
Labor to Capital Ratio	(2007-2016)	10.1	3.9
Present Value of Foreign Exchange Earnings	(2007-2016)	7,588,481,629	2,484,045,946
Foreign Exchange Effect	(2007-2016)	2.3	0.20

Referring to the summarized results of the economic valuation, both the extraction and processing of marble are economically viable. It is shown that the ERR of the extraction is lower than the processing ERR. This is mainly due to the fact that the extraction process has more significant indirect costs than those of the processing which affected its economic cost. Both have a significant value added contribution to the economy. However, it is shown from the RET, that the value added effect of the production process is 4.49 which it is higher than the value added effect of the extraction that is 3.24.

Concerning the employment creation of both processes, the marble processing created in 2010 52,342 jobs which is higher than the jobs created by the extraction that were 33,275 jobs. However, the cost of creating a job in the quarries is 98,673 EGP per job that much lower than the cost of job creation in the factories which was found to be 225,787 EGP. Therefore, it is shown that although the production base employs more workers than the extraction base, the cost of job creation is higher in the factories. The labor to capital ratio is higher for the extraction in which the million EGP invested creates 10.1 jobs. However, for the processing, the ratio is lower and equal to 3. This is mainly due to the high capital investment requirements needed for the marble factories relative to the marble quarries.

The foreign exchange effect of the extraction base was found to be 2.3 which is much higher than the 0.20 foreign exchange effect of the production facilities. In addition, the present value of the foreign exchange earnings of the extraction is almost three times that of the production facilities. This is explained by the fact that the exports of raw materials of the quarries are extremely higher than the exports of the processed marble. The extraction base generates more foreign exchange earnings as they rely mostly on exporting unlike the production facilities which exports but with a lower ratio in comparison to the processed marble which is sold domestically.

Chapter Five: Conclusion and Policy Inferences

I. CONCLUSION

After carrying out the financial and economic valuation of the marble industry in Egypt, it was found that the extraction and processing are economically and financially viable. Table one presents the main financial indicators of the marble extraction and processing.

Table 1: Main Financial Indicators for the Marble Extraction and Processing

Indicators	Year	Marble Extraction	Marble Processing
IRR	(2007-2016)	20%	27.2%
Payback Period	(2007-2016)	4.9	3.6
Discounted Payback Period	(2007-2016)	2.7	2.03
ROI	2010	22%	21%
β	2012	0.27	1.12

The marble processing segment was found to be more financially profitable in terms of IRR, ROA, ROE, and profit margin. However, the extraction was found to have lower level of risk which was estimated using the CAPM model in comparison to the processing. The extraction output is at least double the production output besides the exports of raw material are far higher than those of the processing. Also, the extraction investment requirements are lower than the capital requirements of the processing. However, the processing was found to be more financially sound in which the IRR of processing is 27.2% and of the extraction is 20%. This is mainly because the processing is subsidized and the extraction is taxed in several forms including the export duty imposed on exports which are 90% of the extraction sales, and the government duty paid per each block extracted to the governorate.

Table two provides the main economic indicators for the marble extraction as well as processing.

Table 2: Main Economic Indicators for the Marble Extraction and Processing

Indicators	Year	Marble Extraction	Marble Processing
Economic Rate of Return	(2007-2016)	40.3%	45%
Relative Efficiency Test	(2007-2016)	3.24	4.49
Number of Jobs Created	2010	33,275	52,342
Employment Effect: Labor-Capital Ratio	(2007-2016)	10.1	3.9
Foreign Exchange Earnings Effect	(2007-2016)	2.3	0.20
Resource Depletion % of PV of Economic Benefit	(2007-2016)	36%	-
Air Pollution % of PV of Economic Benefit	(2007-2016)	-	0.16%

However, the processing was found to be more economically viable than the extraction in terms of ERR, value added, and environmental effect. The resource depletion, which is the major environmental problem for the marble extraction, was found to account for 36% of the present value of economic benefit of the marble extraction. Concerning the air pollution that is created from the marble production processes, it was found to be 0.16% of the economic benefit of the marble processing.

Concerning the economic contribution, the extraction and processing had significant economic contributions in terms of value added employment, and net foreign exchange earnings effect. The value added was higher for the marble processing and this is mainly due to the several production processes which are done to transform the blocks of marble raw materials to slabs and tiles. However, the net foreign exchange earnings effect was more significant for the marble extraction in which it was found to be almost eleven times the foreign exchange earnings effect of the marble processing. This is mainly due to the high level of exporting Egyptian marble raw materials relative to the exports of tiles and slabs. In addition, the extraction employment effect was higher in comparison to the processing although the amount of employment created by the processing facilities is higher than that of the extraction.

It is important to mention that the financial and economic valuation of the marble extraction and processing was also conducted by using constant prices based on the year 2009. Under the use of constant prices, the same conclusion was reached but the financial and economic ratios and tests had different values accounting for fixing the prices to the base year 2009. Financially, the IRR was found to be 20.5% for the extraction and 22% for the processing; both were financially viable but the processing is more financially profitable. Economically, the ERR was found to be 35% for the extraction and 49% for the processing which means that both are economically viable but the processing is more economically viable. In addition, under the constant prices, the value added for the processing was more than the extraction value added. The employment and foreign exchange earnings effects were more significant for the extraction than the processing of marble. In addition, it is important to mention that if we benchmark on the competitive market scenario at which the price of the marble ton is equal to the average cost per ton, it was found that -52% is the extent of inefficiency in price, based on a perfectly competitive market scenario, which accounts for the market imperfections.

The marble extraction base in Egypt has a strong capacity of extraction and high exports' market share in the international market which account for 12.56% of the total raw material exports. In addition to the high level of the exports of the Egyptian raw material marble, the processed marble has a significant demand in Egypt and the globe. In order to enhance the competitiveness of the marble raw materials, slabs, and tiles, several measures and policy recommendations should be done. From the economic and financial valuation that were carried out on the marble quarries and factories, several policy suggestions were derived to account for the economic costs of the marble industry and enhance the economic benefits of both the extraction and processing. The recommendations will be discussed in the following section.

II. POLICY INFERENCES

A set of policy inferences was developed based on the results of the financial and economic valuation analysis. The policy recommendations are divided into: marble

extraction policy inferences, marble processing policy inferences, and marble industry policy inferences.

A. Marble Extraction Policy Inferences

The recommendations derived for the marble extraction are as follows:

- *Removal of the export duty on marble blocks*

The marble extraction base was found to have various economic contributions including: economic value added, employment, and net foreign exchange effect. The export duty on marble blocks which rose to 150 EGP/ton that is almost equivalent to 20% of the average price of the marble ton highly increases the cost as the export duty is on average 48% of the total cost of operations of the extraction base. In addition, it is important to mention that the quarrying capacity in Egypt is significantly higher than the production capacity. Thus, exporting the excess market supply should not be restricted.

- *Imposition of a Pigouvian tax of 36% on the marble quarries*

The Pigouvian tax is a tax imposed on the negative externalities created by any production process. Since the marble is an exhaustible natural resource, it is important to impose a tax to account for the resource depletion. According to Hotelling's rent, the resource depletion of marble was estimated to be 36% of the present value of economic benefit. Therefore, a tax should be imposed to account to the resource depletion and save the marble natural resources for the future generations.

- *Restriction of the irrational marble extraction methods*

There are irrational extraction techniques used by the marble quarries in Egypt which include the dynamite and explosives which are mainly used due to their cheap cost relative to the advanced machines like the chain saw and diamond wire. These techniques create significant waste of raw material of the marble natural resources. Thus, the initiation of extraction regulations that require a minimum level of technology to be used in extraction is needed by the government to ensure the lack of exploitation of the marble resources. In addition, a better administration and control should be done by the government to monitor the inefficient extraction methods used.

B. Marble Processing Policy Inferences

For the marble processing, the recommendations are as follows:

- *Investment in higher quality standards*

The processed marble exports account for 10% of the total exports of Egyptian marble although the Egyptian marble products are highly demanded in the international market. Thus, the marble producers should work intensely on improving the quality of processed marble to increase the market share of the processed marble internationally. The processed marble was found to have a high level of economic value added relative to the extracted marble. Therefore, investment in quality standards is necessary to attain a higher competitiveness level of processed marble locally and internationally.

- *Recycling of the processing wastes*

The marble processing operations suffer from the generation of huge amounts of wastes which consume large space in the plants. Thus, the marble waste recycling should be promoted by the firms as well as the government to reduce the burden of dealing with the waste especially that there are no waste dumping areas. In addition, waste recycling of marble like selling them to mosaic producers or for other uses will be a good source of revenue generation.

C. Marble Industry Policy Inferences

After providing the main recommendations for the marble extraction and processing, the general recommendations for the industry are:

- *Linking extraction with processing, rather than exporting extraction only*

The extraction and processing should be more integrated because several quarrymen tend to extract and sell raw materials only due to the fact that the extraction process is more profitable than the manufacturing and this creates lack of collaboration and lack of common interest between both processes. The large factories tend to operate their own quarries. However, the small factories and workshops don't have any links with the quarrying process. Hence, creating better linkages and integration between both processes is extremely important in strengthening the marble industry as a whole.

- *Intensive investments in labors' training*

The marble industry is suffering from the lack of trained labors that not only increases the cost on the firms and quarries level but also reduces efficiency. Thus, the establishment of a vocational school for training labors who are interested in working for the marble quarries and processing plants is very important in solving part of the problem of the unskilled labor. The well trained labor will increase the efficiency level and economies of scale in the extraction and production processes.

- *Promotion of the domestic demand of marble and granite products*

A lot of citizens in Egypt are not aware with the high quality and variations of marble and granite products which are available in the market that results in reducing the level of local demand. Thus, the firms should work on marketing their products locally through doing advertisings to increase the Egyptian awareness and demand for the Egyptian marble and granite.

- *Coordination between the marble supporting agencies and stakeholders*

There are more than five supporting agencies to the marble and granite cluster including: IMC, NRC, ITC, EMGTIC, and EGSMA. Although these agencies are government related ones, they work in isolation and there is no common vision or works together. Thus, the government supporting agencies must coordinate not only with each others, but also with representatives from the marble industry to present the needs of the cluster. This can be implemented through forming a committee for the purpose of the cluster development and enhancement of competitiveness that will include representatives from the private sector, the supporting agencies, and the cluster to form unified vision and implementation strategies for comprehensive cluster advancement.

- *Investment in infrastructure in the marble and granite quarries areas as well as cluster*

The poor quality of infrastructure, which lacks asphalt paved roads and waste dumping areas, of the marble industrial areas and quarries areas need to be improved. The government should work on the infrastructural development of the marble and granite cluster in collaboration with donors and the marble supporting agencies that must direct a part of their budgets for the purpose of improving the infrastructure.

- *Continuous investments in innovation, R&D, and technology*

Continuous investment in innovation, technology, and R&D is very important for the marble industry not only to increase its share in the international market, but also to sustain its level of growth. This should be done by the firms in which they should innovate their products such as developing new finishes of the marble slabs to encourage product differentiation and add value to the market. Upgrading technology of processing and extraction to promote efficiency is needed. Innovation, R&D, technology can also be encouraged by the government supporting agencies like the EMGTIC in collaboration with the firms.

III. SUGGESTED AREAS OF RESEARCH

Further research can be conducted for the marble industry in Egypt other than the financial and economic valuation of the marble extraction and processing.

First, estimating the level of sustainability of the natural stone resources of marble in Egypt based on the current extraction level and available resources is an important field of research. Measuring the sustainability of the Egyptian natural stone resources is vital as it will provide estimates of the efficient current annual extraction level of marble to guarantee the future sustainability of resources. The sustainability and efficient utilization of the marble natural resources research can be conducted based on the exhaustible natural resources models by using other approaches than the Hotelling's rent such as Hartwick's rule, Heals and Dasagupta, and Solow criteria that were previously explained in the literature review section.

Second, an applied microeconomic analysis and theory of the firm can be applied on the marble extraction as well as processing levels. This could include: the relationship between total revenue, total cost, and output, the average cost curve, and the Cobb Douglas production functions for the extraction and production processes. In addition, the industrial profit maximization and cost minimization can be estimated further. This will be important on providing the marble firms and quarries information regarding the output level to produce in terms of maximizing profit and minimizing cost.

Third, a comparative analysis can be done on the Egyptian marble industry in comparison other marble industries in developing nations such as Pakistan, Afghanistan, Jordan, and Turkey in order to benchmark Egyptian marble industry in comparison to them and compare and contrast the differences between the studied industries. This research would be important in finding the best practices and recommendations in terms of market efficiency, level of technology and its transfer, inputs markets, demand conditions, related and supporting industries, and others for the Egyptian marble industry to improve and enhance a higher level of competitiveness in the local and international market.

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Appendices

Appendix A: Financial Valuation of the Marble Extraction

Outline

I. Pro Forma Income Statement (2007-2016)

II. Capital Requirements

III. Optimum Financial Structure

IV. Present Value of The Marble Extraction Base (2007-2016)

   a. PV discounted at The WACC

   b. PV discounted at The IRR

V. Payback Period (2007-2016)

VI. Breakeven Point

VII. CAPM Model

VIII. Profitability Ratios and Dupont Analysis

I. Pro Forma Income Statement (2007-2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)										
Export Current Price (EGP/Ton)	455	559	541	563	450	454	459	464	468	473
Domestic Current Price (EGP/Ton)	300	332	375	400	420	458	499	544	593	646
Quantities (Tons)										
Exported Quantity (Tons)	2,050,296	2,028,947	1,742,938	1,935,151	2,029,352	2,562,870	3,203,588	4,004,484	5,005,605	6,257,007
Domestic Quantity (Tons)	135,919	119,866	262,540	330,173	108,925	169,899	212,374	328,174	410,218	136,156
Gross Revenue (EGP)										
Export Revenue	933,000,000	1,134,000,000	943,000,000	1,090,000,000	913,000,000	1,164,558,595	1,470,255,226	1,856,197,222	2,343,448,993	2,958,604,354
Domestic Revenue	40,775,730	39,795,578	98,452,313	132,069,360	45,748,332	77,779,705	105,974,848	178,498,040	243,203,579	87,986,849
Gross Revenue	**973,775,730**	**1,173,795,578**	**1,041,452,313**	**1,222,069,360**	**958,748,332**	**1,242,338,300**	**1,576,230,074**	**2,034,695,262**	**2,586,652,572**	**3,046,591,203**
Cost of Operations (EGP)										
Salaries and Wages	53,813,323	64,525,196	58,897,745	69,383,448	53,514,273	53,514,273	69,590,649	88,558,789	114,415,996	145,769,883
Cost of Energy, Fuel, and Water	76,876,176	92,178,851	84,139,636	99,119,212	76,448,961	76,448,961	99,415,214	126,512,556	163,451,423	208,242,690
Cost of Consumables	57,657,132	69,134,138	63,104,727	74,339,409	57,336,721	57,336,721	74,561,410	94,884,417	122,588,567	156,182,017
Cost of Maintenance	28,828,566	34,567,069	31,552,364	37,169,704	28,668,360	28,668,360	37,280,705	47,442,209	61,294,283	78,091,009
Cost of Management, Marketing, and Administration	13,453,331	13,223,170	12,341,124	13,940,146	13,158,331	13,158,331	16,816,664	21,020,829	26,661,920	33,327,400
Miscellaneous	9,609,522	11,522,356	10,517,455	12,389,901	9,556,120	12,426,902	15,814,070	20,431,428	26,030,336	31,338,269
Government Fees	19,219,044	23,044,713	21,034,909	24,779,803	19,447,055	24,853,803	31,628,139	40,862,856	52,060,672	62,676,538
License Fees	22,500,000	25,000,000	27,500,000	30,000,000	32,500,000	35,000,000	37,500,000	40,000,000	42,500,000	45,000,000
Export Duty	-	-	139,435,040	154,812,080	304,402,800	384,430,500	480,538,125	600,672,656	750,840,820	938,551,025
Total Cost of Operations	**281,957,095**	**333,195,494**	**448,523,000**	**515,933,705**	**595,032,621**	**310,091,544**	**394,232,871**	**508,843,617**	**647,643,335**	**778,924,807**
Gross Operating Profit (EGP)										
Gross Operating Profits	**691,818,635**	**840,600,084**	**592,929,312**	**706,135,655**	**364,050,525**	**487,962,453**	**632,330,939**	**844,316,134**	**1,093,607,745**	**1,221,438,833**
Taxes (20%)	138,363,727	168,120,017	118,585,862	141,227,131	72,810,105	97,592,491	126,466,188	168,863,227	218,721,549	244,287,767
Net Profit after Taxes	**553,454,908**	**672,480,067**	**474,343,450**	**564,908,524**	**291,240,420**	**390,369,962**	**505,864,751**	**675,452,907**	**874,886,196**	**977,151,067**

II. Capital Requirements

The capital requirements formula is:

$$\boldsymbol{Capital\ Requriments} = Fixed\ Assets + Net\ Working\ Capital$$

The formula for the net working capital is presented below.

$$\boldsymbol{Net\ Working\ Capital} = Accounts\ Receivable + Inventory\ of\ Final\ Goods + Inventory\ of\ Raw\ Material - Accounts\ Payable$$

$$\boldsymbol{Accounts\ Receivable} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}, \boldsymbol{Inventory\ of\ Final\ Goods} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient},$$
$$\boldsymbol{Inventory\ of\ Raw\ Material} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}, \text{ and } \boldsymbol{Accounts\ Payable} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$$

The following table presents the calculations of the initial capital requirements:

Capital Requirements	
Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Machinery and Equipments	1,960,000,000
Buildings and Construction	28,000,000
Means of Transportation	560,000,000
Total Tangible Fixed Assets	**2,548,000,000**
Intangible Fixed Assets	
Exploration Fees	252,000,000
Total Intangible Fixed Assets	**252,000,000**
Total Fixed Capital Requirement	**2,800,000,000**
10% Contingency	280,000,000
Total Fixed Capital after Contingency	**3,080,000,000**

Working Capital	
Year	**2007**
Accounts Receivable	70,489,274
Inventory of Final Product	46,992,849
Inventory of Raw Material	-
Gross Working Capital	**117,482,123**
Accounts Payable	-
Net Working Capital	**117,482,123**
Investment Cost	**3,197,482,123**

In addition to the initial capital requirements, additional investments are needed in fixed capital in 2013:

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	20,000,000
Total Tangible Fixed Assets	**20,000,000**

III. Optimum Financial Structure

The optimum financial structure is obtained through these formulas:

$$\boldsymbol{Repayment} = (Investment * Return\ on\ Investment) - (Loan * Interest\ Rate)$$

$$\boldsymbol{Repayment} = \frac{Investment * Return\ on\ Investment}{1 + (Installements * Interest\ Rate)}$$

The optimum loan is derived from the above formula, leading to:

$$\boldsymbol{Optimum\ Loan} = Repayment * Installment$$

	2007
GOP	691,818,635
Lending Interest Rate	12%
Installments	4
Repayment	**467,445,023**
Optimum Loan	**1,869,780,094**

The optimum loan for the marble extraction base was estimated as follows:

IV. Weighted Average Cost of Capital

This formula was used to calculate the WACC:

$$\boldsymbol{WACC} = Lending\ Interest\ Rate(1 - Taxes) * Equity\ Ratio + (Deposit\ Interest\ Rate * (International\ Risk * Country\ Risk) * Debt\ Ratio$$

WACC	
Years	**(2007-2016)**
Deposit Interest Rate (I_d)	9%
International Risk (R)	6%
Country Risk (α)	1.3
Equity Ratio $\left(\frac{E}{I}\right)$	40%
Lending Interest Rate (I_b)	12%
Taxes(T)	20%
Debt Ratio $\left(\frac{L}{I}\right)$	60%
WACC $=\left((I_d + R\alpha) * \frac{E}{I}\right) + \left(I_b * (1 - T) * \frac{L}{I}\right)$	**12.5%**
Real WACC	**4.5%**

V. Net Present Value of The Marble Extraction Base (2007-2016)

a. PV of Cash Inflows and Outflows discounted at The WACC

The calculations of present value of the marble extraction base cash inflows as well as outflows is based on the discounted cash flow method for the ten studied years discounted at the WACC which is denoted by P. The cash inflows for the ten studied years are as follows:

Cash Inflows										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Export Revenue	933,000,000	1,134,000,000	943,000,000	1,090,000,000	913,000,000	1,164,558,595	1,470,255,226	1,856,197,222	2,343,448,993	2,958,604,354
Domestic Revenue	40,775,730	39,795,578	98,452,313	132,069,360	45,748,332	77,779,705	105,974,848	178,498,040	243,203,579	87,986,849
Total Cash Inflows	**973,775,730**	**1,173,795,578**	**1,041,452,313**	**1,222,069,360**	**958,748,332**	**1,242,338,300**	**1,576,230,074**	**2,034,695,262**	**2,586,652,572**	**3,046,591,203**

The discounted cash inflow formula used is the following:

$$\textbf{\textit{Present Value of Cash Inflows}} = \frac{CIF_1}{(1+P)^1} + \frac{CIF_2}{(1+P)^2} + \frac{CIF_3}{(1+P)^3} + \frac{CIF_4}{(1+P)^4} + \frac{CIF_5}{(1+P)^5} + \frac{CIF_6}{(1+P)^6} + \frac{CIF_7}{(1+P)^7} \frac{CIF_8}{(1+P)^8} + \frac{CIF_9}{(1+P)^9} + \frac{CIF_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\textbf{\textit{Residual}} = \frac{CIF_{10}}{WACC}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Cash Inflows	973,775,730	1,173,795,578	1,041,452,313	1,222,069,360	958,748,332	1,242,338,300	1,576,230,074	2,034,695,262	2,586,652,572	3,046,591,203	973,775,730
WACC	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800
Residual											24,411,788,489
$\frac{\textbf{\textit{Residual}}}{(1+WACC)^{11}}$											6,695,318,077
$\frac{CIF_N}{(1+WACC)^N}$	865,732,335	927,773,266	731,835,488	763,474,656	532,510,386	613,462,511	691,978,268	794,139,709	897,553,472	939,855,543	6,695,318,077
Present Value of Cash Inflows											14,453,633,711

The cash outflows for the ten studied years of the marble extraction base are:

Cash Outflows										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Operations	281,957,095	333,195,494	448,523,000	515,933,705	594,697,807	754,375,847	943,899,135	1,190,379,129	1,493,044,827	1,825,152,370
Fixed Assets	3,080,000,000	-	-	-	-	-	20,000,000	-	-	-
Intangible Assets	252,000,000	-	-	-	-	-	-	-	-	-
Taxes on Profit (20%)	138,363,727	168,120,017	118,585,862	141,227,131	72,810,105	97,592,491	126,466,188	168,863,227	218,721,549	244,287,767
Change in Net Working Capital	117,482,123	21,349,333	48,053,127	28,087,794	32,818,376	66,532,517	78,968,037	102,699,997	126,110,708	138,378,143
Total Cash Outflows	**3,869,802,945**	**522,664,844**	**615,161,990**	**685,248,630**	**700,326,287**	**918,500,854**	**1,169,333,359**	**1,461,942,353**	**1,837,877,084**	**2,207,818,280**

The present value formula of the cash outflows is:

$$\boldsymbol{Present\ Value\ of\ Cash\ Outflows} = \frac{COF_1}{(1+P)^1} + \frac{COF_2}{(1+P)^2} + \frac{COF_3}{(1+P)^3} + \frac{COF_4}{(1+P)^4} + \frac{COF_5}{(1+P)^5} + \frac{COF_6}{(1+P)^6} + \frac{COF_7}{(1+P)^7} \frac{COF_8}{(1+P)^8} + \frac{COF_9}{(1+P)^9} + \frac{COF_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\boldsymbol{Residual} = \frac{COF_{10} + Depreciation}{WACC}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Cash Outflows	3,869,802,945	522,664,844	615,161,990	685,248,630	700,326,287	918,500,854	1,169,333,359	1,461,942,353	1,837,877,084	2,207,818,280	
WACC	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	
Depreciation											254,560,000
Residual											15,651,108,010
$\frac{\boldsymbol{Residual}}{(\boldsymbol{1+WACC})^{\boldsymbol{11}}}$											4,292,563,260
$\frac{\boldsymbol{COF_N}}{(\boldsymbol{1+WACC})^{\boldsymbol{N}}}$	3,440,436,473	413,116,626	432,278,435	428,101,693	388,976,971	453,552,660	513,347,186	570,594,770	637,732,711	681,099,008	4,292,563,260
Present Value of COF											**12,251,799,793**

The depreciation calculations of the marble quarries' assets in year 11 are provided in the table below.

Fixed Capital	2017	Depreciation Rate	Depreciation
Land	-	0%	
Building and Construction	28,000,000	2%	560,000
Machinery and Equipments	1,960,000,000	10%	196,000,000
Means of Transportation	560,000,000	10%	56,000,000
Re-investments in Machineries	20,000,000	10%	2,000,000
Depreciation Value			**254,560,000**

b. PV of Cash Inflows and Outflows discounted at The IRR

The tables below provide the present value calculations of the cash inflows and outflows based on the IRR.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Cash Inflows	973,775,730	1,173,795,578	1,041,452,313	1,222,069,360	958,748,332	1,242,338,300	1,576,230,074	2,034,695,262	2,586,652,572	3,046,591,203	
IRR	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	
Residual											15,135,309,013
$\frac{Residual}{(1+WACC)^{11}}$											2,013,091,601
$\frac{CIF_N}{(1+WACC)^N}$	810,608,155	813,385,664	600,752,318	586,818,699	383,234,618	413,382,424	436,600,034	469,154,139	496,485,193	486,781,883	2,013,091,601
Present Value of CIF											**7,510,294,728**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Cash Outflows	3,869,802,945	522,664,844	615,161,990	685,248,630	700,326,287	918,500,854	1,169,333,359	1,461,942,353	1,837,877,084	2,207,818,280	
IRR	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	0.201290	
Depreciation											254,560,000
Residual											9,703,687,062
$\frac{Residual}{(1+WACC)^{11}}$											1,290,651,609
$\frac{COF_N}{(1+WACC)^N}$	3,221,371,952	362,182,393	354,850,613	329,045,734	279,937,152	305,626,986	323,893,696	337,090,432	352,764,329	352,763,422	1,290,651,609
Present Value of COF											**7,510,178,317**

VI. Payback Period (2007-2016)

The payback period formula is as follows:

$$\textbf{Payback Period} = \frac{100}{Internal\ Rate\ of\ Return}$$

$$\textbf{Discounted Payback Period} = \frac{Payback\ Period}{(1+WACC)^N}$$

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
IRR	0.201	0.201	0.201	0.201	0.201	0.201	0.201	0.201	0.201	0.201	
PBP	4.968	4.968	4.968	4.968	4.968	4.968	4.968	4.968	4.968	4.968	
$(1+WACC)^N$	1.125	1.265	1.423	1.601	1.800	2.025	2.278	2.562	2.882	3.242	
DPBP	**4.417**	**3.927**	**3.491**	**3.104**	**2.759**	**2.453**	**2.181**	**1.939**	**1.724**	**1.533**	
Average DPBP											**2.753**

VII. Breakeven Point

The formula used for the breakeven quantity is as follows:

$$\boldsymbol{Breakeven\ Quantity} = \frac{Total\ Fixed\ Cost}{Price - Average\ Variable\ Cost}$$

While the formula of the breakeven sales is:

$$\boldsymbol{Breakeven\ Sales} = Price\ per\ ton * Breakeven\ Quantit$$

The calculation of the breakeven quantity and sales is given in the below table.

Year	2010
Total Fixed Cost	184,379,378
Total Variable Cost	176,742,246
Export Quantity (Ton)	1,935,151
Domestic Quantity (Ton)	330,173
$\boldsymbol{Average\ Variable\ Cost} = \frac{\boldsymbol{Total\ Variable\ Cost}}{\boldsymbol{Quantity}}$	78
Export Price (EGP)	563
Domestic Price (EGP)	400
Export Weight of Sales	85%
Domestic Weight of Sales	15%
Price Index	539
$\boldsymbol{Breakeven\ Quantity} = \frac{\boldsymbol{Total\ Fixed\ Cost}}{\boldsymbol{Price - Average\ Variable\ Cost}}$	399,568
$\boldsymbol{Breakeven\ Sales = Price\ per\ ton * Breakeven\ Quantity}$	**215,553,951**

VIII. CAPM Model

The CAPM formula is as follows:

$$\boldsymbol{E(R)} = R_f + \beta\,(R_m - R_f)$$

Whereas:

R_f is the deposit interest rate of The Central Bank in Egypt 9.25%

R_m is the market return on CASE30 in 2012 which is 31.4%,

$\beta = 0.27$,

$E(R)$ =15.3% and Adjusted $\beta = \beta * \frac{2}{3} + \frac{1}{3} = 0.50$

IX. Profitability Ratios and Dupont Analysis (2010)

The formulas used to estimate the ROA are as follows:

$$\boldsymbol{ROA} = \frac{Net\ Profit}{Assets} = 3.2\%$$

According to the Dupont analysis, the ROA can be decomposed into two ratios

$$\boldsymbol{ROA} = \boldsymbol{Profit\ Margin} * \boldsymbol{Asset\ Turnover} = 3.2\%$$

Whereas:

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 6.6\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 48\%$$

Concerning the ROE, it formula is:

$$\text{ROE} = \frac{\text{Net Profit}}{\text{Equity}} = 8\%$$

The ROE can be looked at as:

$$\boldsymbol{ROE = Profit\ Margin * Asset\ Turnover * Financial\ Leverage\ Ratio} = 8\%$$

Where:

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 6.6\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 48\%$$

$$\boldsymbol{Financial\ Leverage\ Ratio} = \frac{Assets}{Equity} = 250\%$$

The ROE can be further decomposed to five ratios which are called the Dupont System, in which:

$$\boldsymbol{ROE = Tax\ Burden * Interest\ Burden * Return\ on\ Sales * Asset\ Turnover * Profit\ Margin * Financial\ Leverage\ Ratio} = 8\%$$

Where:

$$\boldsymbol{Tax\ Burden} = \frac{Net\ Profit}{Pretax\ Profit} = 35.9\%$$

$$\boldsymbol{Interest\ Burden} = \frac{Pretax\ Profit}{Earnings\ before\ Interesst\ and\ Taxes} = 49.5\%$$

$$\boldsymbol{Return\ on\ Sales} = \frac{Earnings\ before\ Interests\ and\ Taxes}{Sales} = 37.1\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 48\%$$

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 6.6\%$$

$$\boldsymbol{Financial\ Leverage\ Ratio} = \frac{Assets}{Equity} = 250\%$$

Appendix B: Financial Valuation of the Marble Processing

Outline

I. Pro Forma Income Statement (2007-2016)

II. Capital Requirements

III. Optimum Financial Structure

IV. Present Value of The Marble Production Base (2007-2016)

   a. PV discounted at The WACC

   b. PV discounted at The IRR

V. Payback Period (2007-2016)

VI. Breakeven Point

VII. CAPM Model

VIII. Profitability Ratios Dupont Analysis

I. Pro Forma Income Statement

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)										
Export Current Price (EGP/Ton)	1,389	3,875	2,272	1,727	1,242	1,508	1,830	2,222	2,697	3,275
Domestic Current Price (EGP/Ton)	1,000	1,270	1,444	1,332	1,400	1,533	1,679	1,839	2,014	2,205
Quantities (Tons)										
Exported Quantity (Tons)	90,013	88,006	131,189	285,968	380,846	476,058	595,072	743,840	929,800	1,162,250
Domestic Quantity (Tons)	1,223,272	1,078,796	2,362,856	2,971,561	980,321	3,714,451	4,643,063	5,803,829	7,254,787	9,068,483
Gross Revenue (EGP)										
Export Revenue	125,000,000	341,000,000	298,000,000	494,000,000	473,000,000	717,762,039	1,089,180,434	1,652,795,707	2,508,063,462	3,805,904,325
Domestic Revenue	1,223,271,900	1,370,070,666	3,411,963,342	3,958,118,719	1,372,449,960	5,694,898,606	7,795,776,241	10,671,678,532	14,608,516,096	19,997,673,458
Export Subsidy	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	-	-	-
Gross Revenue	**1,379,271,900**	**1,742,070,666**	**3,740,963,342**	**4,483,118,719**	**1,876,449,960**	**6,443,660,646**	**8,915,956,675**	**12,324,474,240**	**17,116,579,558**	**23,803,577,782**
Cost of Operations (EGP)										
Cost of Consumables	313,796,072	410,724,646	875,791,792	1,027,606,024	433,348,538	1,307,521,346	1,808,830,476	2,504,912,973	3,472,722,857	4,820,246,404
Salaries and Wages	272,866,150	357,151,866	761,558,080	893,570,456	376,824,816	1,136,975,084	1,572,896,066	2,178,185,194	3,019,759,006	4,191,518,612
Cost of Raw Material	87,862,900	78,062,719	166,859,440	217,938,933	91,066,390	216,094,318	270,117,897	337,647,372	422,059,215	527,574,018
Cost of Maintenance	36,836,930	48,215,502	102,810,341	120,632,012	50,871,350	153,491,636	212,340,969	294,055,001	407,667,466	565,855,013
Cost of Management, Marketing, and Administration	19,100,630	25,000,631	53,309,066	62,549,932	26,377,737	79,588,256	110,102,725	152,472,964	211,383,130	293,406,303
Cost of Energy, Fuel, and Water	17,736,300	23,214,871	49,501,275	58,082,080	24,493,613	73,903,380	102,238,244	141,582,038	196,284,335	272,448,710
Miscellaneous	13,643,307	17,857,593	38,077,904	44,678,523	18,841,241	56,848,754	78,644,803	108,909,260	150,987,950	209,575,931
Total Cost of Operations	**761,842,289**	**960,227,828**	**2,047,907,897**	**2,425,057,959**	**1,021,823,686**	**3,024,422,775**	**4,155,171,180**	**5,717,764,802**	**7,880,863,960**	**10,880,624,990**
Gross Operating Profit (EGP)										
Gross Operating Profits	123,485,922	156,368,568	338,611,089	411,612,152	170,925,255	3,419,237,870	4,760,785,495	6,606,709,438	9,235,715,599	12,922,952,793
Taxes (20%)	**493,943,688**	**625,474,271**	**1,354,444,356**	**1,646,448,608**	**683,701,020**	683,847,574	952,157,099	1,321,341,888	1,847,143,120	2,584,590,559
Net Profit after Taxes	123,485,922	156,368,568	338,611,089	411,612,152	170,925,255	**2,735,390,296**	**3,808,628,396**	**5,285,367,550**	**7,388,572,479**	**10,338,362,234**

II. Capital Requirements

The capital requirements formula is:

$$\boldsymbol{Capital\ Requriments} = Fixed\ Assets + Net\ Working\ Capital$$

The formula for the net working capital is presented below.

$$\boldsymbol{Net\ Working\ Capital} = Accounts\ Receivable + Inventory\ of\ Final\ Goods + Inventory\ of\ Raw\ Material - Accounts\ Receivable$$

$\boldsymbol{Accounts\ Receivable} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}$, $\boldsymbol{Inventory\ of\ Final\ Goods} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}$, $\boldsymbol{Inventory\ of\ Raw\ Material} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$, and $\boldsymbol{Accounts\ Payable} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$

The following table presents the calculations of the capital requirements:

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Land	2,887,500,000
Machinery and Equipments	3,843,125,000
Buildings and Construction	1,182,500,000
Means of Transportation	768,625,000
Furniture and Fixtures	118,250,000
Total Tangible Fixed Assets	**8,800,000,000**
Total Intangible Fixed Assets	**0**
Total Fixed Capital Requirement	**8,800,000,000**
10% Contingency	880,000,000
Total Fixed Capital Requirement after Contingency	**9,680,000,000**

Working Capital	
Year	**2007**
Accounts Receivable	126,973,715
Inventory of Final Product	152,368,458
Inventory of Raw Material	45,477,692
Gross Working Capital	**324,819,864**
Accounts Payable	27,286,615
Net Working Capital	**297,533,249**
Investment Cost	**10,117,263,902**

The calculation of the land value was done as follows:

Land Calculation			
Factory Size	**Land Size/Factory**	**Factories**	**Meters/Factory**
Small	5,000	385	192,5000
Medium	7,500	90	675000
Large	15,000	25	375000
Total Meters		500	**2,975,000**
Land Value			**2,082,500,000**

In addition to the initial investment cost of the marble processing base, in order to meet the increasing future demand of marble, re investments are needed in fixed capital by 2013:

Fixed Capital	
Year	**2013**
Machinery and Equipments	50,000,000
Total Tangible Fixed Assets	**50,000,000**

III. Optimum Financial Structure

The optimum financial structure is obtained through these formulas:

$$\boldsymbol{Repayment} = (Investment * Return\ on\ Investment) - (Loan * Interest\ Rate)$$

$$\boldsymbol{Repayment} = \frac{Investment * Return\ on\ Investment}{1 + (Installements * Interest\ Rate)}$$

The optimum loan is derived from the above formula, leading to:

$$\boldsymbol{Optimum\ Loan} = Repayment * Installment$$

The optimum loan for the marble processing base was estimated as follows:

Optimum Loan	
	2007
GOP	617,429,611
Lending Interest Rate	12%
Installments	4
Repayment	**417,182,169**
Optimum Loan	**1,668,728,677**

IV. Weighted Average Cost of Capital

This formula was used to calculate the WACC:

$$\boldsymbol{WACC} = Lending\ Interest\ Rate(1 - Taxes) * Equity\ Ratio + (Deposit\ Interest\ Rate * (International\ Risk * Country\ Risk) * Debt\ Ratio$$

WACC	
Years	**(2007)**
Deposit Interest Rate (I_d)	9%
International Risk (R)	6%
Country Risk (α)	1.3
Equity Ratio $\left(\frac{E}{I}\right)$	40%
Lending Interest Rate (I_b)	12%
Taxes(T)	20%
Debt Ratio $\left(\frac{L}{I}\right)$	60%
WACC $=\left((I_d + R\alpha) * \frac{E}{I}\right) + \left(I_b * (1 - T) * \frac{L}{I}\right)$	**12.5%**
Real WACC	**4.5%**

V. Net Present Value of The Marble Manufacturing Base (2007-2016)

a. PV of Cash Inflows and Outflows discounted at The WACC

The calculations of present value of the marble processing base cash inflows and outflows are based on the discounted cash flow method for the ten studied years discounted at the WACC which is denoted by P. The cash inflows for the ten studied years are as follows:

Cash Inflows										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Export Revenue	125,000,000	341,000,000	298,000,000	494,000,000	473,000,000	717,762,039	1,089,180,434	1,652,795,707	2,508,063,462	3,805,904,325
Domestic Revenue	1,223,271,900	1,370,070,666	3,411,963,342	3,958,118,719	1,372,449,960	5,694,898,606	7,795,776,241	10,671,678,532	14,608,516,096	19,997,673,458
Export Subsidy	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	31,000,000	-	-	-
Total Cash Inflows	**1,379,271,900**	**1,742,070,666**	**3,740,963,342**	**4,483,118,719**	**1,876,449,960**	**6,443,660,646**	**8,915,956,675**	**12,324,474,240**	**17,116,579,558**	**23,803,577,782**

The discounted cash inflow formula used is the following:

$$\boldsymbol{Present\ Value\ of\ Cash\ Inflows} = \frac{CIF_1}{(1+P)^1} + \frac{CIF_2}{(1+P)^2} + \frac{CIF_3}{(1+P)^3} + \frac{CIF_4}{(1+P)^4} + \frac{CIF_5}{(1+P)^5} + \frac{CIF_6}{(1+P)^6} + \frac{CIF_7}{(1+P)^7} \frac{CIF_8}{(1+P)^8} + \frac{CIF_9}{(1+P)^9} + \frac{CIF_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\boldsymbol{Residual} = \frac{CIF_{10}}{WACC}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Cash Inflows	1,379,271,900	1,742,070,666	3,740,963,342	4,483,118,719	1,876,449,960	6,443,660,646	8,915,956,675	12,324,474,240	17,116,579,558	23,803,577,782	
WACC	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	
Residual											190,733,796,332
$\frac{Residual}{(1+WACC)^{11}}$											52,311,752,373
$\frac{CIF_N}{(1+WACC)^N}$	1,226,237,464	1,376,940,432	2,628,799,900	2,800,780,081	1,042,222,510	3,181,858,148	3,914,180,020	4,810,231,079	5,939,354,040	7,343,264,332	52,311,752,373
Present Value of CIF											**86,575,620,379**

The cash outflows for the ten studied years of the marble extraction base are:

Cash Outflows										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Operations	761,842,289	960,227,828	2,047,907,897	2,425,057,959	1,021,823,686	3,024,422,775	4,155,171,180	5,717,764,802	7,880,863,960	10,880,624,990
Fixed Assets	9,680,000,000						50,000,000			
Taxes on Profit (20%)	123,485,922	156,368,568	338,611,089	411,612,152	170,925,255	683,847,574	952,157,099	1,321,341,888	1,847,143,120	2,584,590,559
Change in Net Working Capital	297,533,249	110,368,006	462,032,442	159,660,850	(595,743,419)	851,716,320	481,360,761	665,390,057	921,344,584	1,278,021,719
Total Cash Outflows	**10,862,861,461**	**1,226,964,401**	**2,848,551,428**	**2,996,330,961**	**597,005,522**	**4,559,986,670**	**5,638,689,039**	**7,704,496,747**	**10,649,351,663**	**14,743,237,267**

The present value formula of the cash outflows is:

$$\boldsymbol{Present\ Value\ of\ Cash\ Outflows} = \frac{COF_1}{(1+P)^1} + \frac{COF_2}{(1+P)^2} + \frac{COF_3}{(1+P)^3} + \frac{COF_4}{(1+P)^4} + \frac{COF_5}{(1+P)^5} + \frac{COF_6}{(1+P)^6} + \frac{COF_7}{(1+P)^7} \frac{COF_8}{(1+P)^8} + \frac{COF_9}{(1+P)^9} + \frac{COF_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where;

$$\boldsymbol{Residual} = \frac{COF_{10} + Depreciation}{WACC}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Cash Outflows	10,862,861,461	1,226,964,401	2,848,551,428	2,996,330,961	597,005,522	4,559,986,670	5,638,689,039	7,704,496,747	10,649,351,663	14,743,237,267	
WACC	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	0.124800	
Depreciation											501,650,000
Residual											114,115,282,590
$\frac{Residual}{(1+WACC)^{11}}$											31,297,916,361
$\frac{COF_N}{(1+WACC)^N}$	9,657,593,760	969,798,141	2,001,696,094	1,871,925,460	331,590,294	2,251,706,217	2,475,431,945	3,007,058,068	3,695,263,391	4,548,202,348	31,297,916,361
Present Value of COF											**62,108,182,079**

The depreciation calculations of the marble quarries' assets in year 11 are provided in the table below.

Fixed Capital		Depreciation Rate	Depreciation
Land	2,887,500,000	0%	-
Building and Construction	1,182,500,000	2%	23,650,000
Machinery and Equipments	3,843,125,000	10%	384,312,500
Means of Transportation	768,625,000	10%	76,862,500
Furniture and Fixtures	118,250,000	10%	11,825,000
Re-investments in Machineries	50,000,000	10%	5,000,000
Depreciation Value			**501,650,000**

b. PV discounted at The IRR

The tables below provide the present value calculations of the cash inflows and outflows based on the IRR.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Cash Inflows	1,379,271,900	1,742,070,666	3,740,963,342	4,483,118,719	1,876,449,960	6,443,660,646	8,915,956,675	12,324,474,240	17,116,579,558	23,803,577,782	
IRR	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	
Residual											87,342,679,512
$\frac{Residual}{(1+WACC)^{11}}$											6,164,173,597
$\frac{CIF_N}{(1+WACC)^N}$	1,083,880,883	1,075,793,966	1,815,425,607	1,709,648,826	562,335,276	1,517,478,929	1,650,021,589	1,792,345,570	1,956,149,291	2,137,759,869	6,164,173,597
Present Value of CIF											**21,465,013,403**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Cash Outflows	10,862,861,461	1,226,964,401	2,848,551,428	2,996,330,961	597,005,522	4,559,986,670	5,638,689,039	7,704,496,747	10,649,351,663	14,743,237,267	
IRR	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	0.272531	
Depreciation											501,650,000
Residual											52,256,782,733
$\frac{Residual}{(1+WACC)^{11}}$											3,688,000,897
$\frac{COF_N}{(1+WACC)^N}$	8,536,422,640	757,696,531	1,382,353,349	1,142,658,500	178,910,854	1,073,874,629	1,043,517,705	1,120,463,262	1,217,049,331	1,324,065,704	3,688,000,897
Present Value of COF											**21,465,013,403**

VI. Payback Period (2007-2016)

The payback period formula is as follows:

$$\textbf{Payback Period} = \frac{100}{Internal\ Rate\ of\ Return}$$

$$\textbf{Discounted Payback Period} = \frac{Payback\ Period}{(1+WACC)^N}$$

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
IRR	0.2725	0.2725	0.2725	0.2725	0.2725	0.2725	0.2725	0.2725	0.2725	0.2725	
PBP	3.6693	3.6693	3.6693	3.6693	3.6693	3.6693	3.6693	3.6693	3.6693	3.6693	
$(1+WACC)^N$	1.1248	1.2652	1.4231	1.6007	1.8004	2.0251	2.2779	2.5621	2.8819	1.1248	
DPBP	3.2622	2.9002	2.5784	2.2924	2.0380	1.8119	1.6109	1.4321	1.2732	3.2622	
Average DPBP											**2.033**

VII. Breakeven Point

The formula used for the breakeven quantity is as follows:

$$\boldsymbol{Breakeven\ Quantity} = \frac{Total\ Fixed\ Cost}{Price - Average\ Variable\ Cost}$$

While the formula of the breakeven sales is:

$$\boldsymbol{Breakeven\ Sales} = Price\ per\ ton * Breakeven\ Quantity$$

The calculation of the breakeven quantity and sales is given in the below table.

Year	2010
Total Fixed Cost	688,942,821
Total Variable Cost	2,411,746,660
Export Quantity (Ton)	285,968
Domestic Quantity (Ton)	2,971,561
$\boldsymbol{Average\ Variable\ Cost} = \frac{\boldsymbol{Total\ Variable\ Cost}}{\boldsymbol{Quantity}}$	740
Export Price (EGP)	1,727
Domestic Price (EGP)	1,332
Export Weight of Sales	9%
Domestic Weight of Sales	91%
Price Index	1,367
$\boldsymbol{Breakeven\ Quantity} = \frac{\boldsymbol{Total\ Fixed\ Cost}}{\boldsymbol{Price - Average\ Variable\ Cost}}$	**1,099,922**
$\boldsymbol{Breakeven\ Sales = Price\ per\ ton * Breakeven\ Quantity}$	**1,503,282,315**

VIII. CAPM Model

The CAPM formula is as follows:

$$\boldsymbol{E(R)} = R_f + \beta\,(R_m - R_f)$$

Whereas:
R_f is the deposit interest rate of The Central Bank in Egypt 9.25%
R_m is the market return on CASE30 in 2012 which is 31.4%,
$\beta = 1.12$
$E(R)$ =34.3% and Adjusted $\beta = \beta * \frac{2}{3} + \frac{1}{3} = 1.08$

IX. Profitability Ratios and Dupont Analysis (2010)

The formulas used to estimate the ROA are as follows:

$$\boldsymbol{ROA} = \frac{Net\ Profit}{Assets} = 6.65\%$$

According to the Dupont analysis, the ROA can be decomposed into two ratios

$$\boldsymbol{ROA} = \boldsymbol{Profit\ Margin} * \boldsymbol{Asset\ Turnover} = 6.65\%$$

Whereas:

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 10.8\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 61.3\%$$

Concerning the ROE, it formula is:

$$\boldsymbol{ROE} = \frac{Net\ Profit}{Equity} = 16.5\%$$

The ROE can be looked at as:

$$\boldsymbol{ROE} = \boldsymbol{Profit\ Margin} * \boldsymbol{Asset\ Turnover} * \boldsymbol{Financial\ Leverage\ Ratio} = 6.5\%$$

Where:

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 10.8\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 61.3\%$$

$$\boldsymbol{Financial\ Leverage\ Ratio} = \frac{Assets}{Equity} = 250\%$$

The ROE can be further decomposed to five ratios which are called the Dupont System, in which:

$$\boldsymbol{ROE = Tax\ Burden * Interest\ Burden * Return\ on\ Sales * Asset\ Turnover * Profit\ Margin * Financial\ Leverage\ Ratio} = 6.5\%$$

$$\boldsymbol{Tax\ Burden} = \frac{Net\ Profit}{Pretax\ Profit} = 54\%$$

$$\boldsymbol{Interest\ Burden} = \frac{Pretax\ Profit}{Earnings\ before\ Interesst\ and\ Taxes} = 57.3\%$$

$$\boldsymbol{Return\ on\ Sales} = \frac{Earnings\ before\ Interests\ and\ Taxes}{Sales} = 34.8\%$$

$$\boldsymbol{Asset\ Turnover} = \frac{Sales}{Assets} = 61.3\%$$

$$\boldsymbol{Profit\ Margin} = \frac{Net\ Profit}{Sales} = 10.8\%$$

$$\boldsymbol{Financial\ Leverage\ Ratio} = \frac{Assets}{Equity} = 250\%$$

Appendix C: Economic Valuation of the Marble Extraction

Outline

I. Shadow Prices
   a. Commodity Market
   b. Labor Market
   c. Capital Market
   d. Foreign Exchange Market

II. Adjustments in Cost of Operations
   a. Salaries and Wages
   b. Cost of Consumables
   c. Cost of Energy, Fuel, and Water

III. Economic Capital Requirements

IV. Quantifying Indirect Costs
   a. Opportunity Cost of Wasted Marble Material
   b. Opportunity Cost of Resource Depletion
   c. Mitigation Cost of Safety
   d. Total Indirect Cost

V. Economic Income Statement (2007-2016)

VI. Net Economic Present Value of The Marble Extraction Base (2007-2016)
   a. Present Value of Net Benefit and Cost discounted at SDR
   b. Present Value of Net Benefit and Cost discounted at IRR

VII. Economic Contribution
   a. Value Added
   b. Employment Effect
   c. Foreign Exchange Earnings

I. Shadow Prices

The methods of deriving the shadow prices of the four markets will be presented in this section.

a. Commodity Market

The shadow price of the marble ton is the FOB price.

FOB Prices										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FOB Prices (USD/Ton)	76	93	90	94	75	76	76	77	78	79
FOB Prices (EGP/Ton)	455	559	541	563	450	454	459	464	468	473
Adjusted FOB Pries to Estimated Shadow Exchange Rate	516.9	621.2	603.4	647.2	532.5	553.9	576.2	599.5	623.6	648.7

b. Labor Market

The shadow wage rate of the very unskilled labor in the quarries is based on the value of the marginal productivity forgone in agriculture which is estimated through the following formula:

$$\boldsymbol{Shadow\ Wage\ Rate} = Productivity\ Lost\ in\ Agriculture + Training\ Cost + Change\ in\ the\ Cost\ of\ Living\ from\ Rural\ to\ Urban$$

$$= 4800\ EGP/Year$$

Thus, the shadow wage rate of the very unskilled labor is:

Shadow Wage Rate of Very Unskilled Labor	
SWR (EGP/Month)	400

The shadow wage rate of the unskilled labor in the quarries is based on the minimum wage rate:

Shadow Wage Rate of Unskilled Labor	
SWR (EGP/Month)	700

c. Capital Market

The shadow discount rate is obtained as follows:

$$\boldsymbol{Shadow\ Discount\ Rate} = Borrowing\ Rate + Risk\ Factor$$

$$\boldsymbol{SDR} = 7\% + 3\% = 10\%$$

The 3 % is the forecasted devaluation risk of the Egyptian currency per year.

d. Foreign Exchange Market

The shadow exchange rate is derived using the supply and demand approach.

$$\textbf{\textit{Shadow Exchange Rate}} = Official\ Exchange\ Rate\ \left(\frac{Imports\ of\ Goods\ \&\ Services + Capital\ Outflow}{Exports\ of\ Goods\ \&\ Service + Capital\ Inflow}\right)$$

The below table provides the calculations of the supply and demand formula of the shadow exchange rate. The official exchange rate, imports, exports, capital inflow, and capital outflow are obtained from the International Financial Statistics Database. From 2007 to 2010, the shadow exchange rate is obtained through the formula. From 2011 to 2016, the shadow exchange rate is forecasted based on the 3 % devaluation risk per year.

Shadow Exchange Rate (2007-2016)										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Official Exchange Rate (EGP/USD)	5.64	5.43	5.54	5.62	-	-	-	-	-	-
Imports of Goods and Services (Million/ USD)	53,697	67,223	53,842	59,862	-	-	-	-	-	-
Capital Outflow (Million/ USD)	3.400	1.100	20.000	39.600	-	-	-	-	-	-
Exports of Goods and Services (Million/ USD)	44,398	54,761	44,609	48,831	-	-	-	-	-	-
Capital Inflow (Million/ USD)	5.300	0.600	1.200	0.400	-	-	-	-	-	-
Shadow Exchange Rate (EGP/USD)	**6.82**	**6.67**	**6.69**	**6.89**	**7.10**	**7.31**	**7.53**	**7.76**	**7.99**	**8.23**

II. Adjustments in Cost of Operations

The below items were adjusted to adjusted to remove the distortions and transform the cost of operations to economic.

a. Salaries and Wages

The salaries and wages cost will be adjusted to account for the shadow wage rates of the very unskilled labor and the unskilled labor which are 75% and 71% respectively above the current unskilled wage rate.

Adjustments in Salaries and Wages										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Salaries and Wages	**55,711,647**	**67,255,691**	**60,762,492**	**71,454,580**	**53,872,274**	**69,538,561**	**87,792,433**	**112,465,683**	**141,987,925**	**169,287,168**
Very Unskilled Labor Wages	16,713,494	20,176,707	18,228,748	21,436,374	16,161,682	20,861,568	26,337,730	33,739,705	42,596,378	50,786,150
Unskilled Labor Wages	27,855,823	33,627,846	30,381,246	35,727,290	26,936,137	34,769,280	43,896,216	56,232,842	70,993,963	84,643,584
Skilled Labor Wages	11,142,329	13,451,138	12,152,498	14,290,916	10,774,455	13,907,712	17,558,487	22,493,137	28,397,585	33,857,434
Adjustment for Very Unskilled Labor (75%)	12,535,121	15,132,531	13,671,561	16,077,280	12,121,262	15,646,176	19,753,297	25,304,779	31,947,283	38,089,613
Adjustment for Unskilled Labor (71%)	19,777,635	23,875,770	21,570,685	25,366,376	19,124,657	24,686,189	31,166,314	39,925,318	50,405,713	60,096,945
Adjusted Very Unskilled Labor Wages	4,178,374	5,044,177	4,557,187	5,359,093	4,040,421	5,215,392	6,584,432	8,434,926	10,649,094	12,696,538
Adjusted Unskilled Labor Wages	8,078,189	9,752,075	8,810,561	10,360,914	7,811,480	10,083,091	12,729,903	16,307,524	20,588,249	24,546,639
Adjusted Salaries and Wages	**23,398,892**	**28,247,390**	**25,520,247**	**30,010,923**	**22,626,355**	**29,206,195**	**36,872,822**	**47,235,587**	**59,634,929**	**71,100,610**

b. Cost of Consumables

The imported cost of consumables will be adjusted to remove tariffs and account for the annual derived shadow exchange rate.

Adjustments in Cost of Consumables										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Consumables	**59,691,050**	**72,059,669**	**65,102,670**	**76,558,478**	**57,720,293**	**74,505,601**	**94,063,321**	**120,498,946**	**152,129,920**	**181,379,108**
Domestic Consumables Cost (40%)	23,876,420	28,823,868	26,041,068	30,623,391	23,088,117	29,802,240	37,625,328	48,199,579	60,851,968	72,551,643
Imported Consumables Cost (60%)	35,814,630	43,235,802	39,061,602	45,935,087	34,632,176	44,703,360	56,437,993	72,299,368	91,277,952	108,827,465
Adjustment (5%)	1,790,732	2,161,790	1,953,080	2,296,754	1,731,609	2,235,168	2,821,900	3,614,968	4,563,898	5,441,373
Adjusted Imported Consumables Cost	34,109,171	41,176,954	37,201,526	43,747,702	32,983,025	42,574,629	53,750,469	68,856,541	86,931,383	103,645,205
Adjusted Imported Consumables Cost in USD	5,684,862	6,862,826	6,200,254	7,291,284	5,497,171	7,095,771	8,958,412	11,476,090	14,488,564	17,274,201
Adjusted Imported Consumables Cost in EGP	38,744,234	45,768,421	41,492,708	50,267,492	39,035,494	51,898,798	67,487,899	89,048,390	115,796,301	142,201,617
Adjusted Cost of Consumables	**62,620,654**	**74,592,289**	**67,533,776**	**80,890,883**	**62,123,611**	**81,701,038**	**105,113,227**	**137,247,969**	**176,648,269**	**214,753,261**

c. Cost of Electricity, Fuel, and Water

The cost of electricity, fuel, and water will be adjusted to account for their subsidy rates which are 44%, 50%, and 60% respectively.

Adjustments in Cost of Electricity, Fuel, and Water										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Electricity, Water, and Fuel	**79,588,067**	**96,079,559**	**86,803,560**	**102,077,971**	**76,960,391**	**99,340,801**	**125,417,761**	**160,665,262**	**202,839,893**	**241,838,811**
Electricity Cost	7,958,807	9,607,956	8,680,356	10,207,797	7,696,039	9,934,080	12,541,776	16,066,526	20,283,989	24,183,881
Fuel Cost	63,670,453	76,863,647	69,442,848	81,662,377	61,568,313	79,472,641	100,334,209	128,532,210	162,271,915	193,471,049
Water Cost	7,958,807	9,607,956	8,680,356	10,207,797	7,696,039	9,934,080	12,541,776	16,066,526	20,283,989	24,183,881
Adjustments in Electricity (44%)	3,501,875	4,227,501	3,819,357	4,491,431	3,386,257	4,370,995	5,518,381	7,069,272	8,924,955	10,640,908
Adjustments in Fuel (50%)	32,077,013	38,723,711	34,985,131	41,141,299	31,017,960	40,038,115	50,548,120	64,754,202	81,752,180	97,470,225
Adjustments in Water (60%)	4,775,284	5,764,774	5,208,214	6,124,678	4,617,623	5,960,448	7,525,066	9,639,916	12,170,394	14,510,329
Adjusted Electricity Cost	11,460,682	13,835,457	12,499,713	14,699,228	11,082,296	14,305,075	18,060,158	23,135,798	29,208,945	34,824,789
Adjusted Fuel Cost	95,505,680	115,295,471	104,164,272	122,493,565	92,352,469	119,208,961	150,501,313	192,798,314	243,407,872	290,206,573
Adjusted Water Cost	12,734,091	15,372,729	13,888,570	16,332,475	12,313,663	15,894,528	20,066,842	25,706,442	32,454,383	38,694,210
Adjusted Cost of Electricity, Water, and Fuel	**119,700,453**	**144,503,657**	**130,552,554**	**153,525,268**	**115,748,428**	**149,408,565**	**188,628,313**	**241,640,554**	**305,071,199**	**363,725,572**

III. Economic Capital Requirements

The capital requirements formula is:

$$\boldsymbol{Capital\ Requriments} = Fixed\ Assets + Net\ Working\ Capital$$

The formula for the net working capital is presented below.

$$\boldsymbol{Net\ Working\ Capital} = Accounts\ Receivable + Inventory\ of\ Final\ Goods + Inventory\ of\ Raw\ Material - Accounts\ Receivable$$

$$\boldsymbol{Accounts\ Receivable} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}, \boldsymbol{Inventory\ of\ Final\ Goods} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient},$$

$$\boldsymbol{Inventory\ of\ Raw\ Material} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}, \text{ and } \boldsymbol{Accounts\ Payable} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$$

The following table presents the calculations of the economic capital requirements after the adjustments in the machinery and means of transportation to exclude the 5% tariff rate.

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Machinery and Equipments	28,000,000
Buildings and Construction	2,120,326,227
Means of Transportation	605,807,493
Total Tangible Fixed Assets	**2,754,133,720**
Intangible Fixed Assets	
Exploration Fees	252,000,000
Total Intangible Fixed Assets	**252,000,000**
Total Fixed Capital Requirement	**3,006,133,720**

Working Capital	
Year	**2007**
Accounts Receivable	83,379,692
Inventory of Final Product	55,586,461
Inventory of Raw Material	-
Gross Working Capital	**138,966,154**
Accounts Payable	-
Net Working Capital	**138,966,154**
Investment Cost	**3,145,099,874**

In addition to the initial investment cost of the marble processing base, in order to meet the increasing future demand of marble, re investments are needed in fixed capital by 2013:

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	23,915,769
Total Tangible Fixed Assets	**23,915,769**

IV. Quantifying Indirect Costs

In this section the calculations of the indirect costs will be presented.

a. Opportunity Cost of Wasted Marble Material

The table below shows the calculations of the opportunity cost of wasted marble.

Opportunity Cost of Wasted Marble Material										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Amount Irrationally Extracted (Tons)	1,530,351	1,504,169	1,403,834	1,585,727	1,496,794	1,912,938	2,391,173	3,032,861	3,791,076	4,475,214
Wasted Amount (Tons)	382,588	376,042	350,959	396,432	374,198	478,235	597,793	758,215	947,769	1,118,803
Price of Wasted Marble (EGP/Ton)	103	124	121	129	106	111	115	120	125	130
Opportunity Cost of Wasted Marble (EGP)	**39,551,406**	**46,721,930**	**42,357,140**	**51,314,731**	**39,848,733**	**52,980,022**	**68,893,897**	**90,903,565**	**118,208,724**	**145,164,151**

b. Opportunity Cost of Resource Depletion

The opportunity cost of resource depletion is estimated based on the Hotelling Rent as follows:

Opportunity Cost of Resource Depletion										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Sales Price (EGP/Ton)	517	621	603	647	532	554	576	599	624	649
Extraction Cost (EGP/Ton)	129	155	153	159	133	132	132	133	133	134
Hotelling's Rent	388	466	450	489	399	422	444	466	491	515
SDR	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Discounted Hotelling's Rent	388	424	372	367	273	262	251	239	229	218
Divergence from Period 0	0	35	(16)	(21)	(115)	(126)	(138)	(149)	(159)	(170)
Quantity of Marble Extracted (Tons)	2,186,215	2,148,813	2,005,478	2,265,324	2,138,277	2,732,769	3,415,961	4,332,659	5,415,823	6,393,163
Divergence from Period 0 in Quantities	-	76,222,801	(31,846,078)	(47,776,982)	(246,741,584)	(345,469,245)	(469,840,392)	(645,717,007)	(861,790,231)	(1,085,057,751)
Opportunity Cost of Resource Depletion	**-**	**76,222,801**	**31,846,078**	**47,776,982**	**246,741,584**	**345,469,245**	**469,840,392**	**645,717,007**	**861,790,231**	**1,085,057,751**

c. Mitigation Cost of Safety

The safety cost is calculated as follows:

Mitigation Cost of Safety										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Amount of Workers	25,000	27,500	30,250	33,275	36,603	40,263	44,289	48,718	53,590	58,949
Cost of Safety Tools (EGP/Worker)	400	400	400	400	400	400	400	400	400	400
Cost of Training (EGP/Worker)	100	100	100	100	100	100	100	100	100	100
Mitigation Cost of Safety (EGP)	**12,500,000**	**13,750,000**	**15,125,000**	**16,637,500**	**18,301,250**	**20,131,375**	**22,144,513**	**24,358,964**	**26,794,860**	**29,474,346**

d. Total Indirect Cost

The total indirect cost per year is:

Total Indirect Cost										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total indirect Cost (EGP)	**52,051,406**	**136,694,731**	**89,328,218**	**115,729,214**	**304,891,567**	**418,580,643**	**560,878,802**	**760,979,536**	**1,006,793,815**	**1,259,696,248**

V. Economic Income Statement (2007-2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)										
Export Current Price (EGP/Ton)	517	621	603	647	532	554	576	599	624	649
Domestic Current Price (EGP/Ton)	517	621	603	647	532	554	576	599	624	649
Quantities (Tons)										
Exported Quantity (Tons)	2,050,296	2,028,947	1,742,938	1,935,151	2,029,352	2,562,870	3,203,588	4,004,484	5,005,605	6,257,007
Domestic Quantity (Tons)	135,919	119,866	262,540	330,173	108,925	169,899	212,374	328,174	410,218	136,156
Gross Revenue (EGP)										
Export Revenue	1,059,784,484	1,260,447,516	1,051,774,712	1,252,444,449	1,080,537,831	1,419,605,811	1,846,019,907	2,400,518,137	3,121,573,772	4,059,216,494
Domestic Revenue	70,255,687	74,464,761	158,429,277	213,690,736	57,997,406	94,109,116	122,377,142	196,726,586	255,818,334	88,330,680
Gross Revenue	**1,130,040,170**	**1,334,912,277**	**1,210,203,989**	**1,466,135,185**	**1,138,535,236**	**1,513,714,928**	**1,968,397,049**	**2,597,244,723**	**3,377,392,106**	**4,147,547,173**
Cost of Operations (EGP)										
Salaries and Wages	23,398,892	28,247,390	25,520,247	30,010,923	22,626,355	29,206,195	36,872,822	47,235,587	59,634,929	71,100,610
Cost of Energy, Fuel, and Water	119,700,453	144,503,657	130,552,554	153,525,268	115,748,428	149,408,565	188,628,313	241,640,554	305,071,199	363,725,572
Cost of Consumables	62,620,654	74,592,289	67,533,776	80,890,883	62,123,611	81,701,038	105,113,227	137,247,969	176,648,269	214,753,261
Cost of Maintenance	29,845,525	36,029,835	32,551,335	38,279,239	28,860,147	37,252,800	47,031,660	60,249,473	76,064,960	90,689,554
Cost of Management, Marketing, and Administration	13,453,331	13,223,170	12,341,124	13,940,146	13,158,331	16,816,664	21,020,829	26,661,920	33,327,400	39,341,660
Miscellaneous	9,948,508	12,009,945	10,850,445	12,759,746	9,620,049	12,417,600	15,677,220	25,354,987	25,354,987	30,229,851
Government Fees	-	-	-	-	-	-	-	-	-	-
License Fees	22,500,000	25,000,000	27,500,000	30,000,000	32,500,000	35,000,000	37,500,000	40,000,000	42,500,000	45,000,000
Export Duty	-	-	-	-	-	-	-	-	-	-
Indirect Cost	52,051,406	136,694,731	89,328,218	115,729,214	304,891,567	418,580,643	560,878,802	760,979,536	1,006,793,815	1,259,696,248
Total Cost of Operations	**333,518,769**	**470,301,017**	**396,177,698**	**475,135,421**	**589,528,487**	**780,383,505**	**1,012,722,873**	**1,339,370,026**	**1,725,395,558**	**2,114,536,756**
Gross Operating Profit (EGP)										
Gross Operating Profits	**796,521,401**	**864,611,260**	**814,026,291**	**990,999,764**	**549,006,749**	**733,331,423**	**955,674,175**	**1,257,874,697**	**1,651,996,548**	**2,033,010,417**
Taxes (20%)	-	-	-	-	-	-	-	-	-	-
Net Profit after Taxes	**796,521,401**	**864,611,260**	**814,026,291**	**990,999,764**	**549,006,749**	**733,331,423**	**955,674,175**	**1,257,874,697**	**1,651,996,548**	**2,033,010,417**

VI. Net Economic Present Value of The Marble Extraction Base (2007-2016)

a. Present Value of Economic Benefit and Cost discounted at SDR

The calculations of present value of the marble extraction base economic benefit as well as costs are based on the discounted cash flow method for the ten studied years discounted at the SDR which is denoted by P. The net benefit for the ten studied years is as follows:

Economic Benefit										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Export Revenue	1,059,784,484	1,260,447,516	1,051,774,712	1,252,444,449	1,080,537,831	1,419,605,811	1,846,019,907	2,400,518,137	3,121,573,772	4,059,216,494
Domestic Revenue	70,255,687	74,464,761	158,429,277	213,690,736	57,997,406	94,109,116	122,377,142	196,726,586	255,818,334	88,330,680
Total Economic Benefit	**1,130,040,170**	**1,334,912,277**	**1,210,203,989**	**1,466,135,185**	**1,138,535,236**	**1,513,714,928**	**1,968,397,049**	**2,597,244,723**	**3,377,392,106**	**4,147,547,173**

The discounted net benefit formula used is the following:

$$\boldsymbol{Present\ Value\ of\ Economic\ Benefit} = \frac{EB_1}{(1+P)^1} + \frac{EB_2}{(1+P)^2} + \frac{EB_3}{(1+P)^3} + \frac{EB_4}{(1+P)^4} + \frac{EB_5}{(1+P)^5} + \frac{EB_6}{(1+P)^6} + \frac{EB_7}{(1+P)^7} \frac{EB_8}{(1+P)^8} + \frac{EB_9}{(1+P)^9} + \frac{EB_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\boldsymbol{Residual} = \frac{EB_{10}}{SDR}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Economic Benefit	1,130,040,170	1,334,912,277	1,210,203,989	1,466,135,185	1,138,535,236	1,513,714,928	1,968,397,049	2,597,244,723	3,377,392,106	4,147,547,173	
SDR	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Residual											41,475,471,733
$\frac{Residual}{(1+SDR)^{11}}$											14,536,899,821
$\frac{EB_N}{(1+SDR)^N}$	1,027,309,246	1,103,233,287	909,244,169	1,001,390,059	706,940,805	854,452,614	1,010,098,926	1,211,633,831	1,432,343,948	1,599,058,980	14,536,899,821
Present Value of EB											**25,392,605,686**

The economic cost for the ten studied years of the marble extraction base is:

Economic Cost										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Operations	333,518,769	470,301,017	396,177,698	475,135,421	589,528,487	780,383,505	1,012,722,873	1,339,370,026	1,725,395,558	2,114,536,756
Fixed Assets	2,754,133,720						23,915,769			
Intangible Assets	252,000,000									
Taxes on Profit (20%)	-	-	-	-	-	-	-	-	-	-
Change in Net Working Capital	138,966,154	56,992,603	(30,884,716)	32,899,051	47,663,778	79,522,924	96,808,070	136,102,980	160,843,972	162,142,166
Total Economic Cost	**3,478,618,643**	**527,293,621**	**365,292,982**	**508,034,472**	**637,192,265**	**859,906,429**	**1,133,446,712**	**1,475,473,006**	**1,886,239,530**	**2,276,678,922**

The present value formula of the economic cost is:

$$\textbf{\textit{Present Value of Economic Cost}} = \frac{EC_1}{(1+P)^1} + \frac{EC_2}{(1+P)^2} + \frac{EC_3}{(1+P)^3} + \frac{EC_4}{(1+P)^4} + \frac{EC_5}{(1+P)^5} + \frac{EC_6}{(1+P)^6} + \frac{EC_7}{(1+P)^7} \frac{EC_8}{(1+P)^8} + \frac{EC_9}{(1+P)^9} + \frac{EC_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\textbf{\textit{Residual}} = \frac{EC_{10} + Depreciation}{SDR}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Economic Cost	3,478,618,643	527,293,621	365,292,982	508,034,472	637,192,265	859,906,429	1,133,446,712	1,475,473,006	1,886,239,530	2,276,678,922	
SDR	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Depreciation											242,951,577
Residual											25,196,304,987
$\frac{\textbf{\textit{Residual}}}{(1+SDR)^{11}}$											8,831,151,188
$\frac{NC_N}{(1+SDR)^N}$	3,162,380,584	435,779,852	274,450,024	346,994,380	395,646,264	485,394,761	581,637,382	688,319,047	799,949,692	877,758,281	8,831,151,188
Present Value of Economic Cost											**16,879,461,455**

The depreciation calculations of the marble quarries' assets in year 11 are provided in the table below.

Fixed Capital		Depreciation Rate	Depreciation
Land	-	0%	
Building and Construction	28,000,000	2%	560,000
Machinery and Equipments	1,866,666,667	10%	186,666,667
Means of Transportation	533,333,333	10%	53,333,333
Re-investments in Machineries	23,915,769	10%	2,391,577
Depreciation Value			**242,951,577**

VII. Economic Contribution

The estimations of the value added, employment, and foreign exchange earnings are provided in this section.

a. Value Added

The value added is calculated is calculated as follows:

$$\boldsymbol{Value\ added} = Gross\ Output - Material\ Inputs$$

The value added of the marble extraction base per year is as follows:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Output	1,130,040,170	1,334,912,277	1,210,203,989	1,466,135,185	1,138,535,236	1,513,714,928	1,968,397,049	2,597,244,723	3,377,392,106	4,147,547,173
Material Inputs	22,500,000	25,000,000	27,500,000	30,000,000	32,500,000	35,000,000	37,500,000	40,000,000	42,500,000	45,000,000
Value Added	**1,107,540,170**	**1,309,912,277**	**1,182,703,989**	**1,436,135,185**	**1,106,035,236**	**1,478,714,928**	**1,930,897,049**	**2,557,244,723**	**3,334,892,106**	**4,102,547,173**

The absolute efficiency test (AET) is the difference between the present value of value added and the present value of investment discounted at the SDR, for the marble quarries, the AET is estimated in the table below.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Value Added	1,107,540,170	1,309,912,277	1,182,703,989	1,436,135,185	1,106,035,236	1,478,714,928	1,930,897,049	2,557,244,723	3,334,892,106	4,102,547,173	
$\frac{VA_N}{(1+SDR)^N}$	1,006,854,700	1,082,572,130	888,583,012	980,899,655	686,760,862	834,696,027	990,855,496	1,192,973,536	1,414,319,800	1,581,709,532	**10,660,224,750**
Investment	3,145,099,874	56,992,603	(30,884,716)	32,899,051	47,663,778	79,522,924	120,723,839	136,102,980	160,843,972	162,142,166	
$\frac{I_N}{(1+SDR)^N}$	2,859,181,704	47,101,325	(23,204,144)	22,470,495	29,595,456	44,888,617	109,080,641	63,493,045	68,213,545	62,512,824	**3,283,333,507**
Net Present Value of Value Added											**7,376,891,243**

The relative efficiency test (RET) is:

$$\boldsymbol{RET} = \frac{Present\ Value\ of\ Value\ Added}{Present\ Value\ of\ Investment} = 3.24$$

b. Employment Effect

The estimation of the jobs created per capital investment is:

$$\boldsymbol{Jobs\ Created\ per\ Captial} = \frac{Labor}{Present\ Value\ of\ Investment} = 0.00001013452$$

The cost of creating a job is calculated as follows:

$$\boldsymbol{Jobs\ Created\ per\ Captial} = \frac{Present\ Value\ of\ Investment}{Labor} = 98{,}673\ \text{EGP}$$

c. Foreign Exchange Earnings

The foreign exchange earnings effect is calculated as follows:

$$\textbf{\textit{Foregin Exchange Earnings Effect}} = \frac{Present\ Value\ of\ Foregin\ Exchange\ Earnings}{Present\ Value\ of\ Investment} = 2.31$$

Where the foreign exchange earnings and their present value are obtained as follows:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Foreign Revenue Generated	1,059,784,484	1,260,447,516	1,051,774,712	1,252,444,449	1,080,537,831	1,419,605,811	1,846,019,907	2,400,518,137	3,121,573,772	4,059,216,494	
Foreign Exchange Payments	2,726,133,720						23,915,769				
Foreign Exchange Earnings	(1,514,862,942)	1,041,692,162	790,213,908	855,436,411	670,928,979	801,330,472	935,027,531	1,119,859,427	1,323,852,002	1,565,003,680	**7,588,481,629**
$\frac{FEE_N}{(1+SDR)^N}$											
Investment	3,145,099,874	56,992,603	(30,884,716)	32,899,051	47,663,778	79,522,924	120,723,839	136,102,980	160,843,972	162,142,166	
$\frac{I_N}{(1+SDR)^N}$	2,859,181,704	47,101,325	(23,204,144)	22,470,495	29,595,456	44,888,617	109,080,641	63,493,045	68,213,545	62,512,824	**3,283,333,507**

Appendix D: Economic Valuation of the Marble Processing

Outline

I. Shadow Prices
   a. Commodity Market
   b. Labor Market
   c. Capital Market
   d. Foreign Exchange Market

II. Adjustments in Cost of Operations
   a. Salaries and Wages
   b. Cost of Consumables
   c. Cost of Energy, Fuel, and Water

III. Economic Capital Requirements

IV. Quantifying Indirect Costs
   a. Opportunity Cost of Wasted Marble
   b. Mitigation Cost of Air Pollution
   c. Mitigation Cost of Safety
   d. Total Indirect Cost

V. Economic Income Statement (2007-2016)

VI. Net Economic Present Value of The Marble Extraction Base (2007-2016)
   a. Present Value of Net Benefit and Cost discounted at SDR
   b. Present Value of Net Benefit and Cost discounted at IRR

VII. Economic Contribution
   a. Value Added
   b. Employment Effect
   c. Foreign Exchange Earnings

I. Shadow Prices

The methods of deriving the shadow prices of the four markets will be presented in this section.

a. Commodity Market

The shadow price of the marble ton is the FOB price.

FOB Prices										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FOB Prices (USD/Ton)	231	646	379	288	207	251	305	370	450	546
FOB Prices (EGP/Ton)	1389	3875	2272	1727	1242	1508	1830	2222	2697	3275
Adjusted FOB Pries to Estimated Shadow Exchange Rate	1577	4306	2533	1984	1469	1837	2298	2873	3593	4492

b. Labor Market

The shadow wage rate of the very unskilled labor in the quarries is based on the value of the marginal productivity forgone in agriculture which is estimated through the following formula:

$$\boldsymbol{Shadow\ Wage\ Rate} = Productivity\ Lost\ in\ Agriculture + Training\ Cost + Change\ in\ the\ Cost\ of\ Living\ from\ Rural\ to\ Urban$$
$$= 4800\ EGP/Year$$

Thus, the shadow wage rate of the very unskilled labor is:

Shadow Wage Rate of Very Unskilled Labor	
SWR (EGP/Month)	400

The shadow wage rate of the unskilled labor in the quarries is based on the minimum wage rate:

Shadow Wage Rate of Unskilled Labor	
SWR (EGP/Month)	700

c. Capital Market

The shadow discount rate is obtained as follows:

$$\boldsymbol{Social\ Discount\ Rate} = Borrowing\ Rate + Risk\ Factor$$
$$\boldsymbol{SDR} = 7\% + 3\% = 10\%$$

The 3 % is the forecasted devaluation risk of the Egyptian currency per year.

d. Foreign Exchange Market

The shadow exchange rate is derived using the supply and demand approach.

$$\textbf{\textit{Shadow Exchange Rate}} = Official\ Exchange\ Rate\ \left(\frac{Imports\ of\ Goods\ \&\ Services + Capital\ Outflow}{Exports\ of\ Goods\ \&\ Service + Capital\ Inflow}\right)$$

The imports, exports, capital inflow, and capital outflow are obtained from the International Financial Statistics Database. From 2007 to 2010, the shadow exchange rate is obtained through the formula. From 2011 to 2016, the shadow exchange rate is forecasted based on the 3 % devaluation risk per year.

Shadow Exchange Rate (2007-2016)										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Official Exchange Rate (EGP/USD)	5.64	5.43	5.54	5.62	-	-	-	-	-	-
Imports of Goods and Services (Million/ USD)	53,697	67,223	53,842	59,862	-	-	-	-	-	-
Capital Outflow (Million/ USD)	3.400	1.100	20.000	39.600	-	-	-	-	-	-
Exports of Goods and Services (Million/ USD)	44,398	54,761	44,609	48,831	-	-	-	-	-	-
Capital Inflow (Million/ USD)	5.300	0.600	1.200	0.400	-	-	-	-	-	-
Shadow Exchange Rate (EGP/USD)	**6.82**	**6.67**	**6.69**	**6.89**	**7.10**	**7.31**	**7.53**	**7.76**	**7.99**	**8.23**

II. Adjustments in Cost of Operations

The below items were adjusted to adjusted to remove the distortions and transform the cost of operations to economic.

c. Salaries and Wages

The salaries and wages cost will be adjusted to account for the shadow wage rates of the very unskilled labor and the unskilled labor which are 75% and 71% respectively above the current unskilled wage rate.

Adjustments in Salaries and Wages										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Salaries and Wages	**117,449,073**	**291,155,538**	**364,845,428**	**362,396,184**	**108,870,232**	**313,626,723**	**475,928,552**	**722,221,578**	**1,095,971,245**	**1,663,136,364**
Very Unskilled Labor Wages	23,489,815	58,231,108	72,969,086	72,479,237	21,774,046	62,725,345	95,185,710	144,444,316	219,194,249	332,627,273
Unskilled Labor Wages	58,724,537	145,577,769	182,422,714	181,198,092	54,435,116	156,813,362	237,964,276	361,110,789	547,985,622	831,568,182
Skilled Labor Wages	35,234,722	87,346,661	109,453,628	108,718,855	32,661,070	94,088,017	142,778,566	216,666,473	328,791,373	498,940,909
Adjustment for Very Unskilled Labor (75%)	17,617,361	43,673,331	54,726,814	54,359,428	16,330,535	47,044,008	71,389,283	108,333,237	164,395,687	249,470,455
Adjustment for Unskilled Labor (71%)	16,442,870	40,761,775	51,078,360	50,735,466	15,241,832	43,907,741	66,629,997	101,111,021	153,435,974	232,839,091
Adjusted Very Unskilled Labor Wages	5,872,454	14,557,777	18,242,271	18,119,809	5,443,512	15,681,336	23,796,428	36,111,079	54,798,562	83,156,818
Adjusted Unskilled Labor Wages	42,281,666	104,815,994	131,344,354	130,462,626	39,193,284	112,905,620	171,334,279	259,999,768	394,549,648	598,729,091
Adjusted Salaries and Wages	**83,388,842**	**206,720,432**	**259,040,254**	**257,301,290**	**77,297,865**	**222,674,973**	**337,909,272**	**512,777,320**	**778,139,584**	**1,180,826,818**

b. Cost of Consumables

The imported cost of consumables will be adjusted to remove tariffs and account for the annual derived shadow exchange rate.

Adjustments in Cost of Consumables										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Consumables	**419,460,976**	**1,039,841,206**	**1,303,019,384**	**1,294,272,085**	**388,822,257**	**1,288,109,755**	**1,954,706,554**	**2,966,267,195**	**4,501,310,469**	**6,830,738,636**
Domestic Consumables Cost (40%)	251,676,586	623,904,724	781,811,631	776,563,251	233,293,354	772,865,853	1,172,823,932	1,779,760,317	2,700,786,281	4,098,443,182
Imported Consumables Cost (60%)	167,784,391	415,936,482	521,207,754	517,708,834	155,528,903	515,243,902	781,882,621	1,186,506,878	1,800,524,187	2,732,295,455
Adjustment (5%)	8,389,220	20,796,824	26,060,388	25,885,442	7,776,445	25,762,195	39,094,131	59,325,344	90,026,209	136,614,773
Adjusted Imported Consumables Cost	243,287,366	603,107,899	755,751,243	750,677,809	225,516,909	747,103,658	1,133,729,801	1,720,434,973	2,610,760,072	3,961,828,409
Adjusted Imported Consumables Cost in USD	40,547,894	100,517,983	125,958,540	125,112,968	37,586,152	124,517,276	188,954,967	286,739,162	435,126,679	660,304,735
Adjusted Imported Consumables Cost in EGP	276,347,455	670,357,896	842,926,878	862,552,527	266,899,838	910,725,059	1,423,486,035	2,224,944,260	3,477,643,503	5,435,643,736
Adjusted Cost of Consumables	**444,131,846**	**1,086,294,378**	**1,364,134,632**	**1,380,261,361**	**422,428,741**	**1,425,968,961**	**2,205,368,657**	**3,411,451,138**	**5,278,167,690**	**8,167,939,190**

c. Cost of Electricity, Fuel, and Water

The cost of electricity, fuel, and water will be adjusted to account for their subsidy rates which are 44%, 50%, and 60% respectively.

Adjustments in Cost of Electricity, Fuel, and Water										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Electricity, Water, and Fuel	23,708,664	58,773,633	73,648,922	73,154,509	21,976,910	72,806,204	110,483,414	167,658,581	254,421,896	386,085,227
Electricity Cost	16,596,065	41,141,543	51,554,245	51,208,156	15,383,837	50,964,342	77,338,390	117,361,006	178,095,327	270,259,659
Fuel Cost	1,185,433	2,938,682	3,682,446	3,657,725	1,098,846	3,640,310	5,524,171	8,382,929	12,721,095	19,304,261
Water Cost	5,927,166	14,693,408	18,412,230	18,288,627	5,494,228	18,201,551	27,620,853	41,914,645	63,605,474	96,521,307
Adjustments in Electricity (44%)	7,302,268	18,102,279	22,683,868	22,531,589	6,768,888	22,424,311	34,028,891	51,638,843	78,361,944	118,914,250
Adjustments in Fuel (50%)	592,717	1,469,341	1,841,223	1,828,863	549,423	1,820,155	2,762,085	4,191,465	6,360,547	9,652,131
Adjustments in Water (60%)	5,690,079	14,105,672	17,675,741	17,557,082	5,274,458	17,473,489	26,516,019	40,238,059	61,061,255	92,660,455
Adjusted Electricity Cost	23,898,333	59,243,822	74,238,113	73,739,745	22,152,725	73,388,653	111,367,281	168,999,849	256,457,271	389,173,909
Adjusted Fuel Cost	5,927,166	14,693,408	18,412,230	18,288,627	5,494,228	18,201,551	27,620,853	41,914,645	63,605,474	96,521,307
Adjusted Water Cost	3,556,300	8,816,045	11,047,338	10,973,176	3,296,537	10,920,931	16,572,512	25,148,787	38,163,284	57,912,784
Adjusted Cost of Electricity, Water, and Fuel	**35,159,949**	**87,161,298**	**109,221,351**	**108,488,137**	**32,591,758**	**107,971,600**	**163,846,903**	**248,637,675**	**377,307,672**	**572,564,392**

III. Economic Capital Requirements

The capital requirements formula is:

$$\boldsymbol{Capital\ Requriments} = Fixed\ Assets + Net\ Working\ Capital$$

The formula for the net working capital is presented below.

$$\boldsymbol{Net\ Working\ Capital} = Accounts\ Receivable + Inventory\ of\ Final\ Goods + Inventory\ of\ Raw\ Material - Accounts\ Receivable$$

$$\boldsymbol{Accounts\ Receivable} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}\ ,\ \boldsymbol{Inventory\ of\ Final\ Goods} = \frac{Cost\ of\ Operations}{Turnover\ Coefficient}\ ,$$

$$\textbf{\textit{Inventory of Raw Material}} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$$, and $$\textbf{\textit{Accounts Payable}} = \frac{Cost\ of\ Raw\ Material}{Turnover\ Coefficient}$$

The following table presents the calculations of the economic capital requirements after the adjustments in the machinery and means of transportation to exclude the 5% tariff rate.

Fixed Capital	
Year	**2007**
Tangible Fixed Assets	
Land	2,887,500,000
Machinery and Equipments	1,182,500,000
Buildings and Construction	4,157,489,148
Means of Transportation	831,497,830
Furniture and Fixtures	118,250,000
Total Tangible Fixed Assets	**9,177,236,978**
Total Intangible Fixed Assets	-
Total Fixed Capital after Contingency	**9,177,236,978**

Working Capital	
Year	**2007**
Accounts Receivable	271,638,715
Inventory of Final Product	181,092,477
Inventory of Raw Material	30,395,723
Gross Working Capital	**483,126,915**
Accounts Payable	30,395,723
Net Working Capital	**452,731,192**
Investment Cost	**9,629,968,170**

In addition to the initial investment cost of the marble processing base, in order to meet the increasing future demand of marble, re investments are needed in fixed capital by 2013:

Fixed Capital	
Year	**2013**
Tangible Fixed Assets	
Machinery and Equipments	59,789,422
Total Tangible Fixed Assets	**59,789,422**

IV. Quantifying Indirect Costs

In this section the calculations of the indirect costs will be presented.

a. Opportunity Cost of Wasted Marble Material

The table below shows the calculations of the opportunity cost of wasted marble.

Opportunity Cost of Wasted Marble Material										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Amount Creating Waste (Tons)	787,971	700,081	1,496,427	1,954,517	816,700	2,514,305	3,142,881	3,928,601	4,910,752	6,138,440
Wasted Amount (Tons)	157,594	140,016	299,285	390,903	163,340	502,861	628,576	785,720	982,150	1,227,688
Price of Wasted Marble (EGP/Ton)	237	646	380	298	220	276	345	431	539	674
Opportunity Cost of Wasted Marble (EGP)	**37,288,262**	**90,453,089**	**113,738,259**	**116,386,398**	**36,013,471**	**138,633,026**	**216,682,218**	**338,672,429**	**529,342,072**	**827,357,070**

b. Mitigation Cost of Air Pollution

The mitigation cost of air pollution is divided to the cost of air pollution on the workers and on the external environment.

Mitigation Cost of Air Pollution										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Amount of Workers	35,750	39,325	43,258	47,583	52,342	57,576	63,333	69,667	76,633	84,297
Cost of Masks (EGP/Worker)	30	30	30	30	30	30	30	30	30	30
Mitigation Cost of Air Pollution of Workers (EGP)	**1,072,500**	**1,179,750**	**1,297,725**	**1,427,498**	**1,570,247**	**1,727,272**	**1,899,999**	**2,089,999**	**2,298,999**	**2,528,899**

The air pollution cost on the environment is as follows:

Cost of Air Pollution on The Environment										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Air Pollution on the Environment	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Net Income	**202,953,753**	**124,746,380**	**308,695,293**	**482,319,443**	**90,125,069**	**1,129,798,284**	**1,762,939,857**	**2,641,000,975**	**3,891,555,257**	**5,645,484,301**
Cost of Air Pollution on the Environment	**4,262,029**	**13,134,960**	**28,443,331**	**34,575,421**	**14,357,721**	**57,443,196**	**79,981,196**	**110,992,719**	**155,160,022**	**206,767,245**

c. Mitigation Cost of Safety

The safety cost is calculated as follows:

Mitigation Cost of Safety										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Amount of Workers	35,750	39,325	43,258	47,583	52,342	57,576	63,333	69,667	76,633	84,297
Cost of Safety Tools (EGP/Worker)	400	400	400	400	400	400	400	400	400	400
Cost of Training (EGP/Worker)	100	100	100	100	100	100	100	100	100	100
Mitigation Cost of Safety (EGP)	**17,875,000**	**19,662,500**	**21,628,750**	**23,791,625**	**26,170,788**	**28,787,866**	**31,666,653**	**34,833,318**	**38,316,650**	**42,148,315**

d. Total Indirect Cost

The total indirect cost per year is:

Total Indirect Cost										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total indirect Cost (EGP)	60,497,791	124,430,299	165,108,066	176,180,941	78,112,228	226,591,361	330,230,067	486,588,465	725,117,743	1,089,139,891

V. Economic Income Statement (2007-2016)

\	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Prices (EGP/Ton)										
Export Current Price (EGP/Ton)	1,577	4,307	2,534	1,985	1,470	1,838	2,298	2,874	3,593	4,493
Domestic Current Price (EGP/Ton)	1,577	4,307	2,534	1,985	1,470	1,838	2,298	2,874	3,593	4,493
Quantities (Tons)										
Exported Quantity (Tons)	90,013	88,006	131,189	285,968	380,846	476,058	595,072	743,840	929,800	1,162,250
Domestic Quantity (Tons)	1,223,272	1,078,796	2,362,856	2,971,561	980,321	3,714,451	4,643,063	5,803,829	7,254,787	9,068,483
Gross Revenue (EGP)										
Export Revenue	141,986,131	379,023,459	332,374,193	567,621,613	559,796,707	874,957,402	1,367,550,836	2,137,470,105	3,340,847,249	5,221,715,295
Domestic Revenue	1,929,584,000	4,646,148,173	5,986,417,996	5,898,289,388	1,440,951,702	6,826,877,379	10,670,350,177	16,677,664,848	26,067,045,615	40,742,566,379
Export Subsidy	-	-	-	-	-	-	-	-	-	-
Gross Revenue	**2,071,570,131**	**5,025,171,633**	**6,318,792,189**	**6,465,911,001**	**2,000,748,409**	**7,701,834,781**	**12,037,901,013**	**18,815,134,953**	**29,407,892,864**	**45,964,281,674**
Cost of Operations (EGP)										
Cost of Consumables	407,476,377	1,010,131,457	1,265,790,259	1,257,292,882	377,713,050	1,251,306,619	1,898,857,795	2,881,516,704	4,372,701,598	6,635,574,675
Salaries and Wages	83,388,842	206,720,432	259,040,254	257,301,290	77,297,865	222,674,973	337,909,272	512,777,320	778,139,584	1,180,826,818
Cost of Raw Material	364,748,675	904,209,744	1,133,060,334	1,125,453,987	338,106,311	1,120,095,439	1,699,744,829	2,579,362,778	3,914,183,016	5,939,772,727
Cost of Maintenance	49,241,071	122,068,315	152,963,145	151,936,288	45,644,352	151,212,884	229,465,552	348,213,975	528,414,707	801,869,318
Cost of Management, Marketing, and Administration	25,532,407	63,294,682	79,314,223	78,781,779	23,667,442	78,406,681	118,982,138	180,555,394	273,992,811	415,784,091
Cost of Energy, Fuel, and Water	35,159,949	87,161,298	109,221,351	108,488,137	32,591,758	107,971,600	163,846,903	248,637,675	377,307,672	572,564,392
Miscellaneous	18,237,434	45,210,487	56,653,017	56,272,699	16,905,316	56,004,772	84,987,241	128,968,139	195,709,151	296,988,636
Indirect Cost	60,497,791	124,430,299	165,108,066	176,180,941	78,112,228	226,591,361	330,230,067	486,588,465	725,117,743	1,089,139,891
Total Cost of Operations	**1,080,938,015**	**2,639,389,636**	**3,319,495,022**	**3,334,676,484**	**1,034,754,011**	**3,388,926,671**	**5,170,534,659**	**7,896,554,886**	**12,071,032,374**	**18,464,885,064**
Gross Operating Profit (EGP)										
Gross Operating Profits	**990,632,116**	**2,385,781,996**	**2,999,297,167**	**3,131,234,517**	**965,994,398**	**4,312,908,110**	**6,867,366,354**	**10,918,580,067**	**17,336,860,490**	**27,499,396,610**
Taxes (20%)	-	-	-	-	-	-	-	-	-	-
Net Profit after Taxes	**990,632,116**	**2,385,781,996**	**2,999,297,167**	**3,131,234,517**	**965,994,398**	**4,312,908,110**	**6,867,366,354**	**10,918,580,067**	**17,336,860,490**	**27,499,396,610**

VI. Net Economic Present Value of The Marble Production Base (2007-2016)

a. Present Value of Economic Benefit and Cost discounted at SDR

The calculations of present value of the marble extraction base economic benefit as well as costs are based on the discounted cash flow method for the ten studied years discounted at the SDR which is denoted by P. The net benefit for the ten studied years is as follows:

Economic Benefit										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Export Revenue	141,986,131	379,023,459	332,374,193	567,621,613	559,796,707	874,957,402	1,367,550,836	2,137,470,105	3,340,847,249	5,221,715,295
Domestic Revenue	1,929,584,000	4,646,148,173	5,986,417,996	5,898,289,388	1,440,951,702	6,826,877,379	10,670,350,177	16,677,664,848	26,067,045,615	40,742,566,379
Export Subsidy	-	-	-	-	-	-	-	-	-	-
Total Economic Benefit	**2,071,570,131**	**5,025,171,633**	**6,318,792,189**	**6,465,911,001**	**2,000,748,409**	**7,701,834,781**	**12,037,901,013**	**18,815,134,953**	**29,407,892,864**	**45,964,281,674**

The discounted net benefit formula used is the following:

$$\text{Present Value of Economic Benefit} = \frac{\text{EB}_1}{(1+\text{P})^1} + \frac{\text{EB}_2}{(1+\text{P})^2} + \frac{\text{EB}_3}{(1+\text{P})^3} + \frac{\text{EB}_4}{(1+\text{P})^4} + \frac{\text{EB}_5}{(1+\text{P})^5} + \frac{\text{EB}_6}{(1+\text{P})^6} + \frac{\text{EB}_7}{(1+\text{P})^7} \frac{\text{EB}_8}{(1+\text{P})^8} + \frac{\text{EB}_9}{(1+\text{P})^9} + \frac{\text{EB}_{10}}{(1+\text{P})^{10}} + \frac{\text{Residual}}{(1+\text{P})^{11}}$$

Where,

$$\boldsymbol{Residual} = \frac{EB_{10}}{SDR}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Economic Benefit	2,071,570,131	5,025,171,633	6,318,792,189	6,465,911,001	2,000,748,409	7,701,834,781	12,037,901,013	18,815,134,953	29,407,892,864	45,964,281,674	
SDR	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Residual											459,642,816,736
$\frac{\boldsymbol{Residual}}{(\mathbf{1}+\boldsymbol{SDR})^{\mathbf{11}}}$											161,102,003,207
$\frac{\boldsymbol{EB_N}}{(\mathbf{1}+\boldsymbol{SDR})^{\boldsymbol{N}}}$	1,883,245,574	4,153,034,407	4,747,402,096	4,416,304,215	1,242,307,349	4,347,484,948	6,177,346,631	8,777,399,315	12,471,817,325	17,721,220,353	161,102,003,207
Present Value of EB											**227,039,565,419**

The economic cost for the ten studied years of the marble extraction base is:

Economic Cost										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Operations	1,080,938,015	2,639,389,636	3,319,495,022	3,334,676,484	1,034,754,011	3,388,926,671	5,170,534,659	7,896,554,886	12,071,032,374	1,080,938,015
Fixed Assets	9,177,236,978						59,789,422			9,177,236,978
Taxes on Profit (20%)	-	-	-	-	-	-	-	-	-	-
Change in Net Working Capital	450,390,840	649,354,842	283,377,244	6,325,609	(958,301,030)	980,905,275	742,336,662	1,135,841,761	1,739,365,620	2,664,105,288
Total Economic Cost	**10,708,565,833**	**3,288,744,479**	**3,602,872,266**	**3,341,002,093**	**76,452,981**	**4,369,831,946**	**5,972,660,742**	**9,032,396,647**	**13,810,397,994**	**21,128,990,352**

The present value formula of the economic cost is:

$$\boldsymbol{Present\ Value\ of\ Economic\ Cost} = \frac{EC_1}{(1+P)^1} + \frac{EC_2}{(1+P)^2} + \frac{EC_3}{(1+P)^3} + \frac{EC_4}{(1+P)^4} + \frac{EC_5}{(1+P)^5} + \frac{EC_6}{(1+P)^6} + \frac{EC_7}{(1+P)^7} \frac{EC_8}{(1+P)^8} + \frac{EC_9}{(1+P)^9} + \frac{EC_{10}}{(1+P)^{10}} + \frac{Residual}{(1+P)^{11}}$$

Where,

$$\boldsymbol{Residual} = \frac{EC_{10} + Depreciation}{SDR}$$

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	
Economic Cost	10,708,565,833	3,288,744,479	3,602,872,266	3,341,002,093	76,452,981	4,369,831,946	5,972,660,742	9,032,396,647	13,810,397,994	21,128,990,352	
SDR	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Depreciation											480,668,228
Residual											206,483,221,236
$\frac{Residual}{(1+SDR)^{11}}$											72,371,109,389
$\frac{NC_N}{(1+SDR)^N}$	9,735,059,848	2,717,970,643	2,706,891,259	2,281,949,384	47,471,286	2,466,656,212	3,064,919,347	4,213,679,697	5,856,956,898	8,146,140,442	72,371,109,389
Present Value of EC											**113,608,804,405**

The depreciation calculations of the marble quarries' assets in year 11 are provided in the table below.

Fixed Capital	2017	Depreciation Rate	Depreciation
Land	2,887,500,000	0%	
Building and Construction	1,182,500,000	2%	23,650,000
Machinery and Equipments	3,660,119,048	10%	366,011,905
Means of Transportation	732,023,810	10%	73,202,381
Furniture and Fixtures	118,250,000	10%	11,825,000
Re-investments in Machineries	59,789,422	10%	5,978,942
Depreciation Value			480,668,228

VII. Economic Contribution

The estimations of the value added, employment, and foreign exchange earnings are provided in this section.

a. Value Added

The value added is calculated is calculated as follows:

$$\boldsymbol{Value\ added} = Gross\ Output - Material\ Inputs$$

The value added of the marble extraction base per year is as follows:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Output	2,071,570,131	5,025,171,633	6,318,792,189	6,465,911,001	2,000,748,409	7,701,834,781	12,037,901,013	18,815,134,953	29,407,892,864	45,964,281,674
Material Inputs	364,748,675	904,209,744	1,133,060,334	1,125,453,987	364,748,675	1,120,095,439	1,699,744,829	2,579,362,778	3,914,183,016	5,939,772,727
Value Added	**1,706,821,456**	**4,120,961,888**	**5,185,731,855**	**5,340,457,014**	**1,662,642,099**	**6,581,739,342**	**10,338,156,184**	**16,235,772,174**	**25,493,709,848**	**40,024,508,946**

The absolute efficiency test (AET) is the difference between the present value of value added and the present value of investment discounted at the SDR, for the marble quarries, the AET is estimated in the table below.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Value Added	1,706,821,456	4,120,961,888	5,185,731,855	5,340,457,014	1,662,642,099	6,581,739,342	10,338,156,184	16,235,772,174	25,493,709,848	40,024,508,946	
$\frac{VA_N}{(1+SDR)^N}$	1,551,655,869	3,405,753,627	3,896,117,096	3,647,603,998	1,032,369,932	3,715,220,273	5,305,108,773	7,574,107,543	10,811,821,630	15,431,180,837	**56,370,939,577**
Investment	9,627,627,817	649,354,842	283,377,244	6,325,609	(958,301,030)	980,905,275	802,126,083	1,135,841,761	1,739,365,620	2,664,105,288	
$\frac{I_N}{(1+SDR)^N}$	8,752,388,925	536,656,894	212,905,518	4,320,476	(595,029,544)	553,695,456	411,617,512	529,878,564	737,660,817	1,027,127,916	**12,171,222,534**
Net Present Value of Value Added											**44,199,717,043**

The relative efficiency test (RET) is:

$$\boldsymbol{RET} = \frac{Present\ Value\ of\ Value\ Added}{Present\ Value\ of\ Investment} = 4.63$$

b. Employment Effect

The estimation of the jobs created per capital investment is:

$$\boldsymbol{Jobs\ Created\ per\ Captial} = \frac{Labor}{Present\ Value\ of\ Investment} = 0.0000039095$$

The cost of creating a job is calculated as follows:

$$\boldsymbol{Jobs\ Created\ per\ Captial} = \frac{Present\ Value\ of\ Investment}{Labor} = 255{,}787\ \text{EGP}$$

c. Foreign Exchange Earnings

The foreign exchange earnings effect is calculated as follows:

$$\boldsymbol{Foregin\ Exchange\ Earnings\ Effect} = \frac{Present\ Value\ of\ Foregin\ Exchange\ Earnings}{Present\ Value\ of\ Investment} = 0.24$$

Where the foreign exchange earnings and their present value are obtained as follows:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Foreign Revenue Generated	141,986,131	379,023,459	332,374,193	567,621,613	559,796,707	874,957,402	1,367,550,836	2,137,470,105	3,340,847,249	5,221,715,295	
Foreign Exchange Payments	4,988,986,978						59,789,422				
Foreign Exchange Earnings	(1,514,862,942)	1,041,692,162	790,213,908	855,436,411	670,928,979	801,330,472	935,027,531	1,119,859,427	1,323,852,002	1,565,003,680	
$\frac{FEE_N}{(1+SDR)^N}$	(4,406,364,406)	313,242,528	249,717,651	387,693,199	347,589,712	493,890,643	671,088,387	997,145,579	1,416,845,361	2,013,197,291	**2,484,045,946**
Investment	9,627,627,817	649,354,842	283,377,244	6,325,609	(958,301,030)	980,905,275	802,126,083	1,135,841,761	1,739,365,620	2,664,105,288	
$\frac{I_N}{(1+SDR)^N}$	8,752,388,925	536,656,894	212,905,518	4,320,476	(595,029,544)	553,695,456	411,617,512	529,878,564	737,660,817	1,027,127,916	**12,171,222,534**