AMERICAN UNIVERSITY OF BEIRUT

THE DYNAMIC EFFECTS OF OIL PRICE SHOCKS ON OUTPUT AND DOMESTIC PRICES IN EGYPT: AN SVAR APPROACH

by
FARAH MOHAMAD JAMAL AL SHAMI

A thesis
submitted in partial fulfillment of the requirements
for the degree of Master of Arts in Economics
to the Department of Economics
of the Faculty of Arts and Sciences
at the American University of Beirut

Beirut, Lebanon
April 2017

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ACKNOWLEDGEMENTS

I am deeply grateful to my advisor Dr. Leila Dagher for her invaluable guidance, support and patience throughout my work on this thesis. I am also thankful to Dr. Martin Montero Kuscevic Casto and Dr. Pierre Mouganie for their insightful comments and assistance.

I extend my thanks to my friend and former colleague Nyanzi Sulaiman for his continuous help and encouragement and, more importantly, for authorizing me to replicate and extend his thesis after the verbal approval of our dear professor Dr. Peter Pedroni.

I also thank my friend Dr. Ekkehard Ernst for his very kind and useful feedback.

AN ABSTRACT OF THE THESIS OF

Farah Mohamad Jamal Al Shami for Master of Arts
Major: Economics

Title: The dynamic effects of oil price shocks on output and domestic prices in Egypt: an SVAR approach

This paper analyzes the dynamic effects of oil price shocks on Egypt's economy, represented by real output and the price level, using a Structural Vector Auto-regressive (SVAR) analysis based on an identification strategy developed by Blanchard and Quah (1989). The main findings of the study are twofold: First, an oil shock operates through the supply channel and thus has stagflationary effects on the economy. Second, while the oil shock is relatively more important in explaining the fluctuations in output compared to the movements in the consumer price level, its impacts on both variables is weak. Consequently, the policy implications drawn from these results go beyond merely suggesting the development of efficient alternative energy sources to enhance substitutability, the reduction of oil-intensity, and trade diversification as ways to mitigate the long-run impacts but also emphasize the need to adopt countercyclical monetary policies, especially for the purpose of short-run output stabilization. The results also invite for fiscal expansion in the case of an increase in the commodity's prices while taking into consideration that output is mainly affected by supply-side policies whereas the price level is mostly affected by the demand-side ones. Policy responses should, however, place less weight on oil and focus on the goods, services and commodities that are found to be the most influential in Egypt's consumer price basket and to dominate the household consumption patterns and the industry's raw and intermediate inputs.

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CHAPTER I

INTRODUCTION

Oil is an important commodity with a strategic nature and a crucial role that makes it significantly affect the world economies. There has been an increasing interest in analyzing the effects of the oil price dynamics on the macro-economy since the end of the 20th century when we started to experience volatility in the crude oil price and observe the resulting fluctuations at the level of the financial markets, real, and overall economies in both oil-importing an oil-exporting countries. Major post-World-War-II oil disturbances can be summarized by the Suez Crisis of 1956-57, followed by the OPEC oil embargo of 1973-1974, the Iranian revolution of 1978-1979 and the Iran-Iraq War that started in 1980, after which happened the first Persian Gulf War in 1990-91, the oil price spike of 2007-2008, and finally the most recent dive in the international price of oil as it fell by almost 44% between June and December 2014, halved by March 2015, and scored a total decrease of almost 70% beginning of 2016[1]. Although the oil usage was very different and substantially of a less economic importance in the 19th century than it currently is, many similar implications and developments have arisen from the oil price shocks in both eras (Hamilton, 2011). The latter oil price shock which was mainly due to increased oil supply in the US and elsewhere and to reductions in the global demand has reintroduced the debate on the nature, magnitude, symmetry and evolution of the impacts of such a shock and more importantly on the transmission channel through which these impacts happen. Attempts to understand these phenomena have been mostly done on industrial economies but are found to be fewer on emerging

[1] Information gathered from Hamilton, 2011 and Kilian, 2015.

and even more developing markets. Nonetheless, answers to these questions strictly depend on the employed empirical strategy, the extent to which it disentangles the oil shocks from other simultaneous or resulting shocks, and the different country-specific factors.

The aim of this paper is to study in a dynamic framework the nature and size of the oil shocks' effects on Egypt's economy, particularly on the country's output and price level, using a Structural Vector Auto-regression Analysis (SVAR) based on an identification strategy that was developed by Blanchard and Quah (1989). Starting 2010, it became rational to treat Egypt as a small open net-oil importing country compared to the international oil market as a benchmark. While Egypt's objective was to satisfy its increasing oil demand over the last decade since total oil consumption grew by an annual average of 3%, its oil production has been declining as well as its oil refining capacity which declined by over 28% leading to an outpace by the consumption level and inducing an urge to import petroleum products and make up for the shortfall (EIA-Beta, 2015). Oil shocks influence fiscal, monetary and supply-side policy-making processes across the globe and are perceived to have an even greater burden on emerging net-oil-importers such as Egypt where similar shocks ought to be considered as external and thus exogenous. Economists' perceptions on this bearing are very different and heterogeneous across the macroeconomic variables: they disagree on whether the effects happen in the long or short-run for most of these variables and consequently on whether they occur through the supply or the demand channel. By referring to the related literature and theoretical framework, we argue that a global shock such as an unanticipated and permanent decrease in the international oil price will initially cause a right-ward shift in the aggregate supply curve of a net oil-importing

economy like Egypt as a result of a lower cost of production, leading to an increase in real output and a fall in the price level. Affecting our chosen variables in opposite directions, oil shocks must be of a supply nature and can therefore affect output and even prices in the long-run, which is inconsistent with the dominant views prior to the 1970s' oil price shocks and that were then contradicted by the consistent stagflationary behavior of some industrialized countries at a slightly later stage (Nyanzi, 2016).

The brunt of the oil price volatilities on the macro-economy has been considerably addressed for various markets in previous literature. What is distinct in our paper is that it merely and independently studies the Egyptian market, focuses on two chosen and very representative macro-economic variables (output and prices), and ultimately uses an identification strategy that allows us to isolate the oil price shock from any possible concurrent shocks or any other shocks that may emanate from the policy responses of large leading economies and that could bias the true effect of the unique shock of interest. This means that our study provides us with the privilege to conclude a real causal relationship between the oil shock and the variables in question while taking into account the special structure of the Egyptian market and the turmoil it has been facing lately. Though, one of the drawbacks of this study is that we admit that the international oil price shocks must also have substantial effects on other fundamentals such as the employment level, public expenditures, interest rates, exchange rates, etc. However, the unavailability of data corresponding to these elements on a quarterly basis and for the selected and largest obtainable time span (2002Q1-2016Q1) prevented us from considering them in our research question, which adds to the fact that only 57 observations determined by the mentioned range would not permit the presence of more than three variables in Blanchard and Quah's technique without

causing an overestimation in the results due to the excessive number of parameters. Furthermore, data limitations rendered it impossible to study the symmetry of the effects and their propagation as it needs more forecasting tools and a wider sample that is split at the 1970Q1's data point, knowing that it could still be inferred from previous research (Blanchard and Gali, 2010).

Understanding the nature and magnitude of the macroeconomic consequences of the oil price shocks in Egypt is keen for healthy and proportional fiscal and monetary policy reforms in the country. It plays a major role in determining the pro or counter-cyclical monetary actions to be taken in this fragile market that has quite recently switched to an inflation-targeting regime with an "implicit nominal anchor" given that the Central Bank of Egypt announces neither the prospected target nor the success achieved (CBE-MPD, 2015)[2]. Similarly, our study helps the government decide on its spending behavior. Even though the impact of oil disturbances tends to lie at the level of public expenditures mainly in oil-exporting and oil-dependent countries (Ahmad and Massan, 2015), an expansionary fiscal policy is needed in the scenario of a fall in the commodity's prices in every economy as government spending appears to be the main source of economic growth in the long-run due to the job opportunities it creates, especially in the public sector, and the increase in income it stimulates (Villafuerte and Lopez-Murphy, 2010). Enhancing the reliability of these policies and adjusting them according to the prevalent situation is the key to appeasing the negative effects of the oil shocks.

Subsequently, the rest of this quest is organized as follows: Chapter 2 goes over an extensive review of the empirical literature related to the subject; Chapter 3 gives a

[2] Taken from a report that has been prepared by the Central Bank of Egypt's Monetary Policy Department in 2015 in response to a request by the COMESA Monetary Institute.

background on the Macro-economic fundamentals in Egypt with an in-depth overview of the country's oil-subsector; Chapter 4 provides a thorough explanation of the research methodology starting from the theoretical framework and the data analysis to the empirical strategy used and its product being the identification of the structural shocks; Chapter 5 analyzes and interprets the empirical results in the light of our objective; and Chapter 6 concludes and opens the doors to policy recommendations and potential extensions.

CHAPTER II

LITERATURE REVIEW

The literature revolving around the macroeconomic effects of the oil price shocks is very wide yet not generous enough with emerging and developing economies on one hand and not rich enough in applying appropriate and innovative econometric techniques for advanced , more credible and accurate conclusions on the other hand. Most of the previous investigations on this topic lead to inconsistent and non-causal results because of the different approaches adopted by the researchers and that did not always ensure that the oil price shock is the only exact factor altering the macro variables in question by making the necessary valid assumptions. The divergence in the featured results also stems from the considered sample periods for the studies and the economic structures of the specific countries addressed. The literature comprises opposing views about the nature, the transmission channels and even the magnitude of the macroeconomic effects of oil socks while there seems to be an agreement on the evolution pattern of the size of these effects across time. While many of the findings are backed by economic theory and intuition to help defining the shocks and respective restrictions, a considerable number of them build on reduced-form relationships and rigorous econometric techniques. This paper's strength point is that it uses Blanchard and Quah's identification strategy which combines both approaches. However, the literature is still found to be very diverse and highly important in shaping our holistic understanding of the subject, nourishing our thoughts and complementing our results especially since our data limitations and research constraints hinder us from questing within many of the related dimensions.

A. General literature review around the subject with a particular focus on the transmission mechanisms

This research area has been the concern of Hamilton, J. since 1983 and until 2011. In 1983, he provides evidence that "all but one of the US recessions since World War II have been preceded by a dramatic increase in the price of crude petroleum" and concludes a negative relationship between the international oil price and the US real output while admitting that this is a statistically significant correlation but not a causal relationship before mentioning that oil shocks can be finally thought of as a major contributing factor for post war recessions. However, he uses an extensive methodology with many attempts to show that the correlation between oil price increases and real output cannot be explained as just a coincidence or simply as a correlation between endogenous macro variables. He mainly uses Granger causality tests and a dynamic OLS model with lagged variables in order to ensure the validity of his stated conclusion in the year 2005 when he also studies the effects on the US inflation rate. Due to the substantial disruptions of consumers and firms' spending by the oil shocks, he also concludes in 2005 that the oil shock operates through the demand channel; after he proved in 1988 that the technological costs of adjusting capital or labor can magnify the disruptive effects of oil shocks, in general. More importantly, Hamilton (2000) questions the instability in this relationship over time as no proportionate increase in output constantly exists as a result of oil price decline. By estimating a flexible regression, considering the different components of oil price (i.e. GARCH model), and using exogenous shocks in oil supply due to war as an instrumental variable, he concludes that the effects are not symmetric and that the relationship is non-linear with aggregate demand being the transmission channel again. In 2011, he complements his work at this level by surveying the different oil shocks throughout History, focusing on

every post-war event and claiming that it would become possible within the next decade to infer a general understanding of the oil shocks' consequences given the similarities that have been observed in them over a long period of time despite the changes in the usage of oil.

Concerning the transmission mechanisms, Ushie, Adeniyi and Akongwale (2012) argue that they come through the systemic response to monetary policy, which is related to the interest rate structure, since an oil shock tends to modify the inflationary expectations of the public thus rotating the treasury securities' yield curve, changing the demand for governments' fund rate and ultimately influencing the level of economic growth. This view is also adopted by Adjemian and Darracq Paries (2008) who estimate a two-country Dynamic Stochastic General Equilibrium Model (DSGE) for the ROW[3] and the euro area, providing satisfying data coherence corresponding to the euro region and using the simulations to present recommendations for an optimal monetary policy. Their prescriptions include an urge to tolerate the direct short-run inflationary effects of an exogenous oil shock while expecting a simultaneous muted wage response. Moreover, Mehrara and Mohaghegh (2011), based on their Panel Vector Auto-regression (PVAR) analysis involving twelve OPEC members and eight non-OPEC oil producers, affirm that, especially in oil-exporting countries, the monetary policy is the channel through which the important indirect impacts of oil shocks transmit while other researchers give particular attention to prices, interest rates and exchange rates to be the very specific channels. For instance, Omojolaibi and Egwaikhide (2013) find the main transmission channel to be gross investment as it responds rapidly to oil price volatilities. However, Algarhi (2015) states that fiscal policy response is the major

[3] ROW refers to the Rest of the World.

medium through which changes in international oil prices affect economic growth in developing economies and particularly in Egypt where the government spent an average of LE[4] 134 billion in 2013-2014, on fuel subsidies only[5], for example.

The view that oil prices affect real output through the supply side channel is the most common though and is what we tend to agree with since, for our studied net-oil importing country, we concede with the notion that oil shocks can affect output in the long-run. This stand is embraced in numerous research papers including Tatom (1987), Roubini and Setser (2004), Estrada and Hernandez de Cos (2009), DePratto, Deresende, and Maier (2009), Ahmed and Khan (2014), etc. We find it more convincing since the corresponding authors do not only explain it by the movement in output as a result of oil price changes but also by the movement in prices due to the same phenomenon in order to show how both variables deviate in opposite directions in response to this same shock, which is therefore in line with the supply nature. Additionally, the argument of the chief supporter of the "demand channel" hypothesis, Hamilton (2000), does not have any empirical evidence since none of the regressions estimated by the author show the effects of the shock on firms and consumers' expenditures neither the fall in these expenditures is sufficient to justify the hypothesis. An alternative justification could be that the contraction in firms' expenditures is due to the substitution of oil-intensive capital with non-oil intensive capital while for consumers' expenditures, it is the resulting fall in employment as a secondary effect (Nyanzi, 2016). Lee and Ni (2002) use industry level data and impulse responses of Vector Auto-regression Analysis (VAR) models to materialize this dilemma at a micro level. Kilian (2009) mentions that the effects of the oil shock on the fluctuations of the macro-economy differ depending

[4] Egyptian Pounds.
[5] This has an adverse impact since the subsidy increase due to the rise in oil prices means more public expenditures.

on the cause of the shock and the structure of the economy itself. This explanation cannot but be considered logical as per the various previous assessments of the relationship in question and is the basis for the theoretical framework we present to back up our identification of the intermediation as supply in nature.

B. Studies addressing advanced economies

Advanced economies occupy a large share of the literature in concern. The abovementioned tripartite, DePratto, Deresende, and Maier (2009), also estimate a New Keynesian open economy General Equilibrium Model for Canada, the United States and the United Kingdom which is not a fully-fledged DSGE model but one that uses an empirical structure that is similar to Gali (2008)'s as a basis. The authors impose the conditions capturing the exogenous determinants of growth (technology, labor productivity, physical and human capital accumulation, etc.) and study the explicit endogenous shocks moving the IS-LM-Phillips Curve Model: money supply, money demand, IS and aggregate supply fluctuations. This allowed them to examine the different transmission channels before confirming that the supply-side is the primary medium for the substantial effects of energy prices, as previously cited. They also claim that higher energy prices have temporary, negative, and statistically but not economically significant effects on both the output gap and the trend growth, "which translates into a permanent reduction in the level of potential and actual output". In this couple of studies, the US is identified and treated as an exception for its domestic output is relatively large enough to influence oil prices. Of the other major papers about developed economies, we also present Lorusso and Pieroni (2015) who use a Structural Vector Auto-regression Analysis (SVAR) that adopts a two-stage method which begins

by decomposing the oil price changes from the underlying cause of the shock before assessing the effects of the different revealed types of oil shocks on a set of UK macroeconomic aggregates such as output growth, inflation, nominal interest rate and government deficit. Their method permits to further prove the dependence of the consequences of oil price changes on the cause of the oil shock itself and to unveil the fact that, since the mid-1970s, oil price movements have been mainly due to shocks in oil demand rather than oil supply. They show that shortfalls in crude oil supply result in an immediate fall in UK's GDP growth and that the rise in real oil price leads to domestic inflation but to a decrease in the public budget deficit.

Furthermore, in 2007, Balanchard and Gali analyze the macroeconomic performance of the United States, Germany, France, the United Kingdom, Italy and Japan in the aftermath of two oil price shocks, the 1970's and the last decade's, while focusing on the differences in the nature and size of these effects across episodes. They use a six-variable VAR which considers the unexpected variations in the nominal oil price shocks as exogenous with respect to the contemporaneous values of the other macroeconomic fundamentals in these countries, bearing in mind that an oil shock may happen with other concurrent shocks in the economy. Then, they employ a battery of bivariate rolling VARs for a deeper analysis of the US case. Their conclusion affirms that the latest increase in oil price had milder effects on inflation and economic activity due to the unusual lack of parallel adverse shocks, the reduced oil-intensity at the production and consumption levels, the increased flexibility of labor markets and the enhanced credibility of monetary policy. These effects include a contraction of real output and employment in face of resulting higher prices. The smaller magnitude of the oil shock effects are approved by many researchers such as Roubini and Setser (2004),

Barsky and Kilian (2004), and Peersman and Van Robays (2012). In turn, Peersman and Van Robays (2012) do not only explain the asymmetries of these effects across time but also across countries by conducting a cross-country analysis on a set of industrialized nations with a wide structural diversity with respect to the economic role of oil. They find that this role can explain the effects of exogenous oil supply but not oil demand shocks, which further emphasizes the crucial dependence on the source of the oil price shift in addition to showing a greater resilience of net-energy exporting countries and those that have improved there net-energy position over time compared to others.

Experts did not refrain from tracing the impacts of oil price shocks on many specific macroeconomic variables of interest so as to get a holistic comprehension of the subject and propose the necessary solutions and reforms accordingly. Estrada and Hernandez de Cos (2009) analyze the effects of oil price fluctuations on productivity, capital stock and structural employment before clarifying how the permanent increase in oil prices can significantly reduce potential output in the long-run. In order to alleviate these negative impacts on economic growth, they suggest reforms that aim to raise competition and improve wage-setting mechanisms. Within this context, another - less visited - aspect is the oil price shocks' implications on trade. A major component of Hou at al. (2014)'s investigation on the implications of the latest "fracking revolution" is the effects of the recent drop in international oil prices through and on global trade. Conclusions rest, on average, at the following end: higher oil prices increase the national incomes of oil-exporting countries and are accompanied by a growing consumption of traded and non-traded goods, thus altering the countries' terms of trade and leading to the migration of a large number of skilled and unskilled workers from the South neighborhood to oil-rich countries (Mehrara and Mohaghegh, 2011).

Consequently, knowing the restrictive immigration policies of fortunate states, the migrant workers are always keen to send their money back home, which creates large flows of remittances. Morshed and Pitafi (2008), by constructing an inter-temporal dynamic optimizing model of a small open oil-importing and labor-exporting country, demonstrate that this increase in remittances from the expatriated labor helps mitigating the domestic fall in output due to the oil shock. Clarida and Gali (1994) remain the pioneers in identifying the sources of real exchange-rate (relative to the dollar) fluctuations after the collapse of the Bretton Woods. They remarkably use Blanchard and Quah's identification strategy for four developed countries and find that demand shocks are the most substantial sources without relating to any oil disturbances.

C. Studies addressing developing and emerging economies

More attempts to answer our research question for developing countries have lately matured. These include studies of individual cases such as Eryigit (2012)'s empirical study on the dynamic relationships among the energy sector variables and other economic variables in Turkey, mainly including the Istanbul Stock Exchange Market Index, the exchange rate and the interest rate. The researcher uses a VAR analysis after performing the necessary unit root and co-integration tests and verifies the existence of the anticipated relationship between oil price shocks and the three stated elements. The same approach is used by Ahmad and Masan (2015) who, with Johansen multivariate co-integration techniques and a stationary VAR for the period of 1971-2013, exhibit the short-run and long-run relationships between real GDP, real government expenditure and real oil revenues in Oman. They deduce that public expenditure reforms and the diversification of the small Arab oil-exporting country's

income sources in face of the volatility in oil revenues enhance its economic stability and growth. Diversifying income sources is also among the final recommendations presented by Yusuf (2015) who addresses the case of the Nigerian economy and uses the same techniques as the latter study before applying an SVAR method to look at the impacts of oil price shocks on economic growth while controlling for the unrest in the international oil market, the exchange rate and the agriculture output. The impulse response functions (IRFs) and variance decompositions (VDCs) provide evidence that long-run impacts on economic growth, whose future path can be predicted with the help of the controlled parameters[6], exist.

For Pakistan, a comprehensive research paper by Ahmed and Khan (2014) estimates a seven-variable structural VAR using monthly instead of quarterly data for the 1990-2011 era to track the impacts of food and oil price shocks on the country's inflation rate, output, money balances, interest rate and real effective exchange rate. The General IRFs and VDCs uncover two major conclusions: First, oil price shocks negatively affect industrial production, which is a proxy of output, cause an appreciation in the real effective exchange rate, and increase the inflation and interest rates. Second, the real effective exchange rate is, in the case of Pakistan, the most dominant source of variations after either oil price or food price shocks, indicating that external demand/supply shocks form the major reason of stagflation in this country. The authors carefully impose 21 zero restrictions – following the information-based approach of a series of researchers[7] – to just identify the model. However, they unfortunately do not explain the possibility of having idiosyncratic shocks to such a small economy affect the international price of oil at any point in time. Earlier in 2010, Tan, Wu and Zhanga were

[6] The prediction is revealed by the Forecast Error Variance Decompositions (FEVDs).
[7] This includes "Sims (1999), Gordon and Leeper (1994), Sims and Zha (1998), Kim and Roubini (2000), Kim (2001) and Lee and Ni (2002)" (Ahmed and Khan, 2014).

the first to initiate a thorough analysis of the case of China's large developing economy and to use a partial equilibrium analysis of the transmission channels in the country to emphasize the price mechanism transmitting the oil shock, though very indirectly and lagged, as the producer price index (PPI) was found to have a true impact on the consumer price index (CPI). In their paper, they reach a conclusion that is similar to Ahmed and Khan (2014)'s, stating that an oil price increase negatively affects output and investment but positively affects the inflation and interest rates. They derive this inference from a five variable SVAR model using zero restrictions on the impact matrix to understand the short-run and long-run effects while assuming that this oil shock is the only one that can affect the international price of the commodity. The second pillar of their conclusion admits that the impact on the real economic variables (namely output and investment) lasts much longer than that to monetary variables and not only dominates and persists, but also ascends over time. It is worth mentioning that this long-run impact of oil shocks is reduced-form instead of causal since it is deduced from a co-integration between oil price, investment and an output proxy, which cannot be interpreted as causality. Again, like their peers Ahmed and Khan (2014), their identification strategy suffers from uncertainty in the timing of the impacts and due to the presence of both stationary and non-stationary variables in their VAR model, which may lead to inconsistent IRFs. Moreover, the other four shocks they estimated in their model can be identified as "unanticipated" changes only since no economic intuition to define them is presented (Nyanzi, 2016).

D. Studies addressing Egypt

Egypt, in particular, started to receive more attention in the framework of this research question since 2010. Studies specific to this country vary in terms of their narrower objectives and the complexity of their methodologies. El Anshasy and Bradley (2011) use a dynamic heterogeneous panel data model for 16 oil- producing countries, including Egypt, with three sets of explanatory variables that affect the size and growth of government expenditures. The first introduces country-specific effects; the second captures the effects of the growth in the non-oil private sector; and the third comprises three different mediums through which oil prices affect fiscal policies: oil price shocks, the volatility of oil prices, and the skewness of oil price shocks. The results show an increasing prudence of fiscal policies in these countries in the short-run despite the increase in their oil revenues; whereas, in the long-run, higher oil prices enlarge the fiscal space. Although we do not agree with considering Egypt as an oil-exporting country because it surely does not affect the international oil prices given the insignificance of its oil market at the global scale, we believe the authors' opposing approach is not problematic in the case of their correlation-oriented econometric methodology. To assess the oil and natural gas sector in Egypt and discover the effect of oil prices on the country's real GDP, Algarhi (2015) conduct a SWOT[8] analysis with the support of an Autoregressive Distributed Lag (ARDL) model while also taking oil prices as endogenous but controlling for a set of variables, namely lagged GDP, CPI, government expenditure, capital and labor. The author also inserts in the OLS equation a dummy for economic reforms and an interaction between oil price and government

[8] SWOT: Strengths, Weaknesses, Opportunities and Threats.

expenditure to account for fiscal policy responses to oil price changes which finally are proven to have an adverse impact on economic growth.

The literature includes three deeper studies on Egypt that must be emphasized as well, especially since they are also closer to ours. Nonetheless, presenting them and dissecting their methodology and results is the key to highlighting the added value of our study and our innovative approach which makes it more accurate and distinct. In 2010, Berument et al. implement several individual four-variable SVAR models as suggested by Cushman and Zha (1997) for each of the 16 selected MENA[9] countries, including Egypt, over the general period 1952-2005. They look at the impact of the international oil prices on real exchange rate, inflation, and output growth and assume that none of these three indicators of economic performance can affect the international price of oil that is exogenous, and that they cannot affect each other either. Their impulse responses advocate that, in most net oil-exporters, significant positive effects of the world oil price on GDP exist. However, for Bahrain, Egypt, Lebanon, Morocco, Tunisia and Yemen (all are net-importers except for Bahrain) there is absolutely no significant impact on outputs. A further decomposition of positive oil shocks into oil demand and oil supply for the second set of countries indicates, though, that "oil supply shocks are associated with lower output growth but the effect of oil demand shocks on output remains positive".

Similarly, Cashin et al. (2012), in an attempt to study the impact of oil price shocks on the economy[10] in general, use a Global SVAR setting for a variety of 38 countries from OPEC members to OECD importers and a number of other major importers, from MENA countries (including Egypt) to Latin American and emerging

[9] MENA refers to the Middle East and North Africa Region.
[10] The economic performance is represented in their paper by the following variables: GDP, inflation, interest rate, equity, and real effective exchange rate.

Asian countries, and a set of countries identified as the ROW[11]. For this purpose, they estimate 38 individual VARX* models[12] covering 1979Q2 to 2011Q2 to build the GVAR framework while discriminating between supply driven and demand driven oil shocks and conclude that the economic consequences differ depending on the two different types of shocks and on whether the country is an energy exporter or importer. They close by asserting that, for oil-importers, one should expect a fall in economic activity due to a supply-driven oil shock unlike the oil-exporters that flourish in such a circumstance with the help of their great oil reserves. Conversely, in the case of an oil demand disturbance, almost all countries experience a short-run increase in real output but an inflationary pressure in the long-run. However, the authors' choice to deal with a large global scope made them obliged to refer very often to the interpolation tactic in order to fill in the encountered data gaps, which raises questions about the nonalignment of their results. Finally, Omojolaibi and Egwaikhide (2013) also apply a Panel VAR technique to examine the effects of oil price dynamics on five African economies, together with Egypt, for the 1990Q1-2010Q4 time frame. The construction of such a rigorous system that is almost new to developing countries led them to a beneficial detailed end: While the policy lesson from the individual country effect is that fiscal deficit and GDP should be used as potent instruments of macroeconomic stabilization in the five chosen economies, the cross country analysis recommends the use of gross investment instead as it appears to be -on the whole- the most responsive variable to oil price volatility, with careful attention to its multiplier effects. The macroeconomic performance of Egypt, indeed, is affected by oil price volatility mainly through the

[11] OECD refers to the Organization for Economic Cooperation and Development and OPEC to the Organization of the Petroleum Exporting Countries.
[12] VARX*: the X indicates an individual VAR model whereas the * indicates the presence of foreign variables.

monetary policy, as proxied by money supply, though with a low magnitude of around 11.96%.

E. Conclusion

This broad literature uncovers two main divergent views on the nature of oil shocks: the first arguing that they operate through the aggregate demand channel and the other that they operate through the supply one. Our methodology is advantageous in that it does not require a prior decision about the transmission mechanism but rather infers it from the results. Another conclusion which can be drawn at this stage is that the effects of the oil shocks may be non-linear and that, overall, the impacts of oil shocks on the macro-economy have diminished in magnitude over time but our study neither attempts to analyze the linearity nor pursues the evolution and symmetry of the impacts due to data limitations. Nevertheless, what makes our study constructive and different from others that delve into the same area and address Egypt is that it identifies its SVAR model using Blanchard and Quah (1989)'s strategy while all the others use the Cholesky decomposition. Blanchard and Quah (1989) is based on economic intuition imposed through the assumptions, as previously stated, and decomposes the shock into a temporary and a permanent one by assuming that the effect of the demand shock on output is temporary (i.e. it does not persist in the long-run and is just transitory on output) while the effect of the supply shock is permanent; whereas the Cholesky method is purely statistical and has no economic interpretation but is just a decomposition of a lower triangular matrix in an attempt to uncover the impulse responses. Moreover, the Cholesky decomposition only works in the short-run with no restrictions on dynamics but just on the contemporaneous coefficients and has to be treated recursively since the

ordering of the variables in the VAR model matters for the results. Hence, it only generates a reduced form model unless we can associate economic theory and pragmatic meaning to the ordering of the variables. Therefore, this explains why the identification strategies employed by the presented studies suffer from lack of transparency in the economic definition of some shocks and uncertainty regarding the timing of the impacts while our approach focuses on long-run restrictions that offer transparency and clarity. This advantage is further reinforced with the Granger non-causal restrictions we use to ensure that our small open economy does not influence the international oil price, which adds meticulousness to our structural method.

CHAPTER III

MACROECONOMIC FUNDAMENTALS

A. Overview on the Egyptian economy

Our choice for Egypt is not random. Besides its own specific properties that appeal for an in-depth research on oil and energy, Egypt is the second largest Arab economy after Saudi Arabia playing a central role in Middle Eastern politics and economic dynamics in modern times, which makes it a fertile soil for investigations around our subject. Egypt is a lower middle income country that heavily depends on agriculture, tourism and cash remittances from its citizens working abroad, mainly in Saudi Arabia and the Gulf. Egypt's History is rich with key political-economic upturns and down turns. Recently, the 2011 revolution was accompanied by significant negative economic shocks followed by a relatively fast recovery which shaped the current culmination of the political, economic, and social changes that have been taking place over the last couple of years. This was not surprising knowing how the country erupted in large-scale anti-regime demonstrations resulting in the resignation of President Mubarak and the collapse of his regime that has been in power for 30 consecutive years. Since the presidential elections of July 2014, Egypt became due to complete its political transition and the economic outlook became optimistic in spite of the immediate and short-run interruptions following many of the latest changes. Despite the political unrest and the brunt of the large turmoil faced by the neighboring Arab and European countries, Egypt's government began to set different challenges for the purpose of fiscal consolidation, economic stabilization and human development. This includes correcting

the public budget deficit by widening the tax base, undertaking subsidy reforms, and cutting wage bills, especially for public sector employees; solving the public debt issues; and regulating the country's balance of payments by increasing exports and bringing back tourists through a floating exchange rate as well as by attracting foreign direct investments (FDIs) through higher interest rates. It also includes reducing high inflation, bringing down youth unemployment which currently amounts to 33.36% of the total labor force[13], improving energy management; etc. (Amr et al., 2015). According to the African Development Bank (2014), the country's Economic Development Conference of that year was successful as it secured USD 60 billion worth of investments, loan agreements and grants, thus reinforcing the government's commitment to continue its structural reforms that were expected to persist and evolve in the coming three years.

In the fourth quarter of 2016, the International Monetary Fund approved a USD 12 billion dollar loan for Egypt to support the implementation of the abovementioned structural reforms while seeking to protect the poor, compensate the shortages of staple foods and control for the multiple factors that put the country on the edge of a financial crisis last summer. The Monetary Fund claimed that this is the only way to restore back investors' confidence; regenerate the country's business environment and financial integration; counter the issues of current account deficit and low foreign exchange reserves; sustain the fiscal path; and promote inclusive growth while overcoming the moderate centralization in Cairo and a few major cities (e.g. Alexandria, Ismailia, Port Said and Suez) as well as the perpetual disparities of all types. Accordingly, the country proceeded with the program and the whole package of measures it involves. As a result,

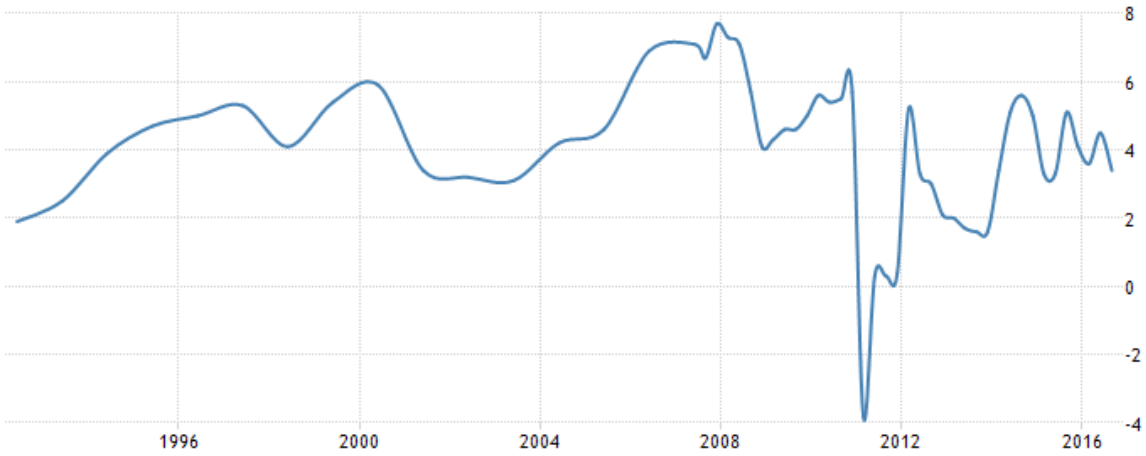
[13] The general unemployment rate is 12.6% and the source of data on unemployment is the World Bank, 2016.

while some improvement can be noticed in certain areas, many other macro imbalances still exist. For instance, Egypt's gross domestic product (GDP), which represents around 0.53% of the world's economy according to the World Bank, has been gradually improving since 2004. With an average of USD 68.54 billion between 1960 and 2015, Egypt's GDP level became worth USD 330.78 billion at the end of 2015, which is its highest record ever reached and which is estimated to have kept escalating until now (Figure 3.1 below). In other terms and as per Figure 3.2 below, Egypt has been experiencing, since the 90s, a constantly positive GDP growth rate with a remarkable volatility and an average of approximately 2%. This is except for the critical period around 2011 when Egypt joined the Arab Spring and suffered a very severe plunge in its annual rates of GDP growth until -4%. This plunge rapidly recovered within less than one year and kept improving until reaching 4% in the beginning of 2016. However, given the measures taken at the end of this year, the economy is expected to react and face a short slowdown in its growth level until it adjusts again. The IMF's ongoing project is to raise the country's growth rate to 5-6% and ensure more jobs are created, particularly for the youth.

Figure 3.1. Egypt's gross domestic product in billions of current US dollars

Source: The World Bank Data, 2016 (retrieved from Trading Economics)

Figure 3.2. Egypt's GDP growth rate (annual percentage)



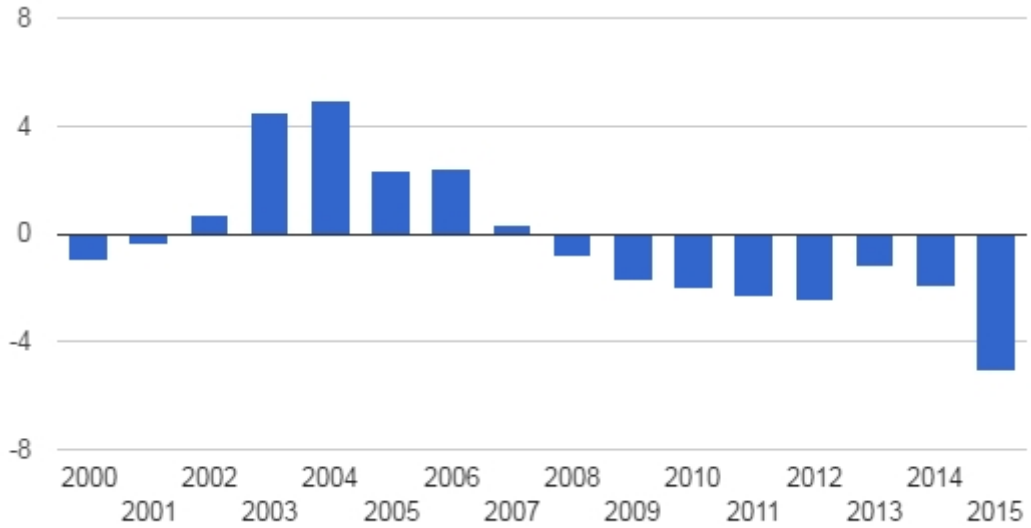
Source: Central Bank of Egypt, 2016 (retrieved from Trading Economics)

Since 2006, Egypt has been encountering a negative current account balance with an average of -1.5% of GDP and the deficit was increasing with time, with a slight break in 2013-2014. Though, 2015 scored the highest current account deficit - around -6% of GDP - sending a signal about the weakness of the adopted trade strategy and more specifically about the affected exporting activity whether at the level of goods and services, primary or secondary income. Although Egypt is the 61st largest export economy in the world and the 74th most complex economy according to the Economic Complexity Index (ECI), it has lost its comparative advantage to produce and export many of the elements it ever specialized with in the past, including crude and refined petroleum, insulated wire, gold, and many agricultural products such as wheat and cotton. This is because of the political-economic chaos that has been infecting Egypt's importers, namely the Arab and European economies, and affecting their currencies in recent History[14]. When Egypt lost its competitiveness in front of its former importers, the latters could find their own means to satisfy their domestic needs of the mentioned

[14] The data about Egypt's exports and imports and the country's export and import destinations is derived from the Atlas of Economic Complexity, 2017.

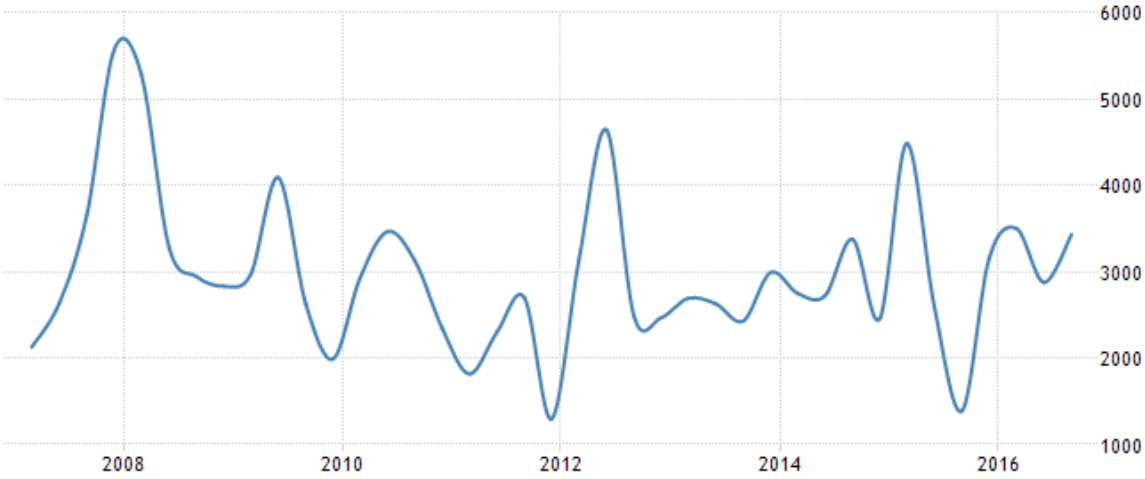
goods while seeking cost-effectiveness and quality. This urged the country to import in order to make up for the shortfalls and worsened the country's negative trade balance (Figure 3.3). On the other hand, Egypt foreign direct investments FDIs (in net inflows), which have been oscillating around a mean of USD 2358.59 million since 2002, have stagnated over the last two years before we observe a significant and alarming drop in their level at the beginning of 2015 until around USD 1400 million. The trend has mean-reverted at the beginning of the next year before it stagnated again (Figure 3.4). This reflects the lack of confidence in the Egyptian economy and financial stability, which also stems from the country's poor foreign exchange reserve, and incarnates the national problems such as the bad infrastructure, the unpleasant investment environment, corruption, and the absence of sufficient ease to do business.

Figure 3.3. Egypt's current account balance (percentage of GDP)



Source: The World Bank Data, 2016

Figure 3.4. Foreign direct investment, net inflows (in millions of USD)



Source: Central Bank of Egypt, 2017 (retrieved from Trading Economics)

As a reaction and as part of the latest IMF loan's conditions, the government decided to float its exchange rate in November, 2016. By looking at Figure 3.5, we can realize how Egypt's national currency depreciated by more than 50% (from less than 9 EGP/USD to more than 18 EGP/USD) after it has been stable around its original value for considerably long. Even though the object of this devaluation was to boost the country's exports and tourism sector and enhance its capital account balance; and although signs of success automatically appeared, this was accompanied by soaring inflation and an increase in the interest rates by the central bank as a result of higher demand. Both effects are visualized in Figures 3.6 and 3.7 respectively as both variables jump up to an outlying level compared to their previous corresponding trends, starting mid-2016. The increase in the interest rates is a wise action as it encourages investments by promising higher yields, recuperates the country's emerging stock market, and therefore responds to the policy makers' objective. However, the direct increase in the consumer price level accentuated poverty, especially for it affected the primary goods and services, including staple food, health, education and residential energy in a country

with rapid population growth and limited resources. Other actions designed to correct for the public budget deficit and compensate the level of public debt without having to issue more treasury bonds include the government's austerity measures which were adopted once the IMF loan was approved. As Figure 3.8 shows, Egypt has suffered a wide deficit in its public budget since 2002 and the budget averaged -9.66% of GDP afterwards. The deficit attained -13.3% of GDP in 2013, which is the worst over the last 15 years, and recorded a level of -9.8% of GDP in 2016. It is also worth noting that the country's debt to GDP ratio has grown at a relatively fast pace from 75% in 2010 till 85% in 2015 and is projected to trend around 105% in 2020; partly because of the IMF loan and similar anticipated plans. Most of Egypt's debt is external - which makes it more complicated to service it without having to bear side effects on the economic cycle - and the average external debt in the country between 1997 and 2014 was equal to USD 31984 million (Figure 3.9).

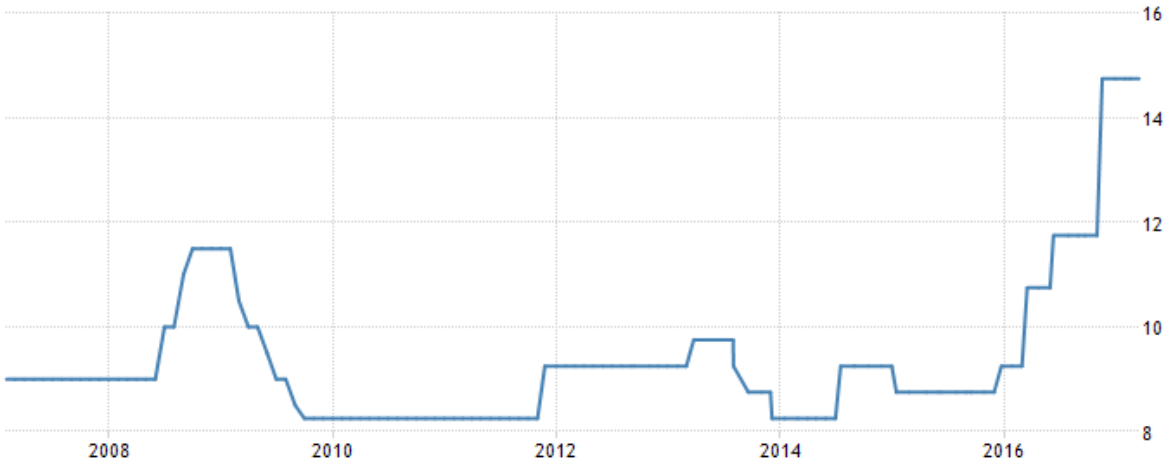
Figure 3.5. Exchange rate (USD-EGP)

Source: Central Bank of Egypt, 2017(retrieved from Trading Economics)

Figure 3.6. Inflation rate, consumer prices (annual percentage)

Source: Central Bank of Egypt, 2017(retrieved from Trading Economics)

Figure 3.7. Real interest rate (percentage)

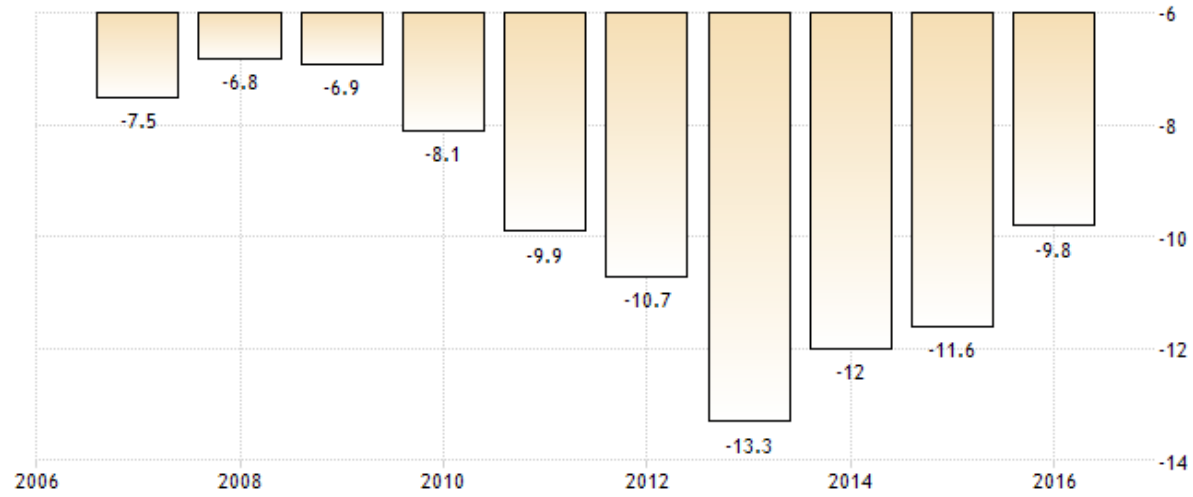


Source: Central Bank of Egypt, 2017(retrieved from Trading Economics)

Henceforth, the value added taxes VATs were introduced for the first time in the country, a ceiling was imposed on the income tax bracket so as not to exceed 22.5% for the richest social class, civil servants' wage bills were controlled, and subsidy reforms dominated the negotiations' agendas. The latter measure focuses on reducing subsidies

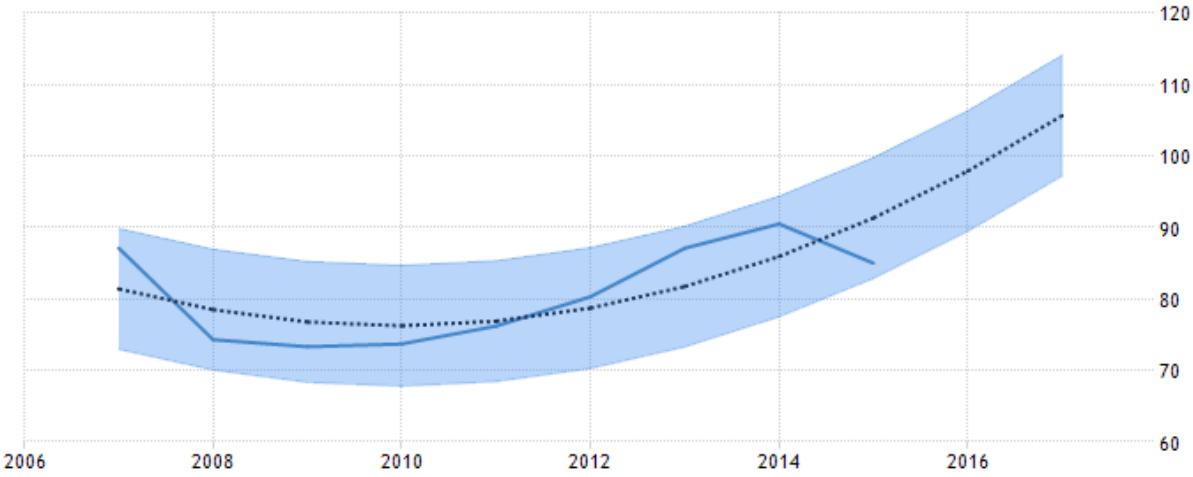
and especially removing energy subsidies for three main reasons: first, there is a need to diminish oil domestic consumption and to rely on the available alternatives such as the domestically produced natural gas and the hydro energy; second, a country hosting a considerable influx of refugees like Egypt should expect these refugees to be the major beneficiaries of any executed subsidies; and thirdly, a recent study by the World Bank affirms that oil subsidies are mostly beneficent for the middle to high social class. The counterfactual used by the social activists, though, is that all of these measures that shrink the fiscal space for the purpose of debt servicing in addition to the prevailing inflation and currency depreciation would further contribute to the impoverishment of the Egyptians and will hinder their human development by making the external world unaffordable and inaccessible to them. Nevertheless, the IMF argues that fiscal consolidation is the key to achieving inclusive growth and social justice and that the replacement of a certain provision by another, such as shifting public spending from commodity subsidies to targeted cash transfer programs, should be taken into consideration while assessing the project. Furthermore, to support this project, the IMF also states that GDP growth in the short-to-medium term is expected to be slightly lower (by 0.1 - 0.7%) compared to the case where subsidies are not removed and the output of the energy sector would significantly decline; which depicts one of the implicit short-run benefits of the projects as the long-run advantages are clear enough.

Figure 3.8. Egypt's government budget as a percentage of GDP



Source: Egypt's Ministry of Finance (retrieved from Trading Economics)

Figure 3.9. Egypt's debt to GDP ratio (in percentage)



Source: *Central Bank of Egypt, 2017 (retrieved from Trading Economics)*

B. Basic facts on Egypt's oil sub-sector

In 2015, the EIA[15] named Egypt as "the largest non-OPEC oil producer in Africa and the second-largest dry natural gas producer in the continent" despite the economic consequences of the political turmoil following the 2011 revolution. According to the Atlas of Economic Complexity's observatory for Egypt, the country's exports have decreased at an annualized rate of 3.6% during the last 5 years (from USD 34 billion in 2010 to USD 27.7 billion in 2015). In 2008, although the exports were still led by crude petroleum which represented 16.5% of Egypt's total exports followed by refined petroleum which accounted for 3.66%, the country witnessed a transition from having a surplus to having a shortage in its oil market and from being a petroleum exporter to being a petroleum importer, as illustrated in Figures 3.10 and 3.11 below. Since the bearish trend of oil prices starting mid-June 2014, the annual growth rate of Egypt's crude oil production became negative and decreasing (Figure 3.12), indicating that Egypt became unable neither to satisfy its own needs of the commodity nor to export it and thus justifying the current identification of Egypt as a net oil-importing country while keeping in mind the exception of the existing share of non-crude oil products in its exports. Egypt imported 145,000 barrels per day of petroleum products in 2014 and its most recent imports are led by refined petroleum which represents 7.84% of the total imports followed by wheat which accounts for 4.03%.

Even though Egypt occupies a strategic location and enjoys the privilege of the Suez Canal allowing it to serve as a major transit route for oil from the Persian Gulf to Europe and to the United States, Egypt's current economic situation proves that the country still depends on the Gulf due to oil as well as remittances. "While supplies of

[15] EIA: United States Energy Information Administration.

oil have for the most part not been disrupted, and even if the Suez Canal was compromised only 2-3 million barrels of oil per day flow through the canal. World oil supply is around 88 million barrels per day, so temporarily rerouting the oil around the Horn of Africa would represent a viable solution"[16]. The global weakening of the commodity's prices, the ongoing depreciation of the Euro currency, the Brexit, and the political chaos that the US recently passed through, further harmed Egypt's exporting activities as its top exporting destinations are Saudi Arabia (USD 2.42 billion), Italy (USD 2.29 billion), Germany (USD 1.87 billion), the United States (USD 1.65 billion) and Turkey(USD 1.42 billion)[17]. In fact, this 47.4% recent drop in global oil prices barely eased Egypt's external bill (BLOM Bank-Invest, 2010). In parallel, Egypt's economic growth is mainly driven by the manufacturing sector, despite the energy shortages and the changes to the energy-subsidy scheme but the Purchasing Managers' Index (PMI) revealed a contraction in the country's non-oil manufacturing, construction and mining sectors at the end of the 2015-16 FY (African Economic Outlook, 2015). Nonetheless, the primary energy consumption in the country by fuel was lately reported by the EIA to be distributed as follows: 53% of natural gas, 41% of oil, 3% of hydroelectric energy, 2% of coal and 1% of renewable sources. Undefined sources claim that 45% of Egypt's petroleum production serves the national military forces and the military institution itself admits that petroleum is the lifeblood of its forces and discloses the following numbers: while oil consumption values 770,000 barrels per day, the oil reserve amounts to 4.4 billion barrels. This should have strict implications on the reforms at the level of the country's management of its oil sub-sector, particularly when attempting to fairly distribute the petroleum resources to satisfy the domestic demand.

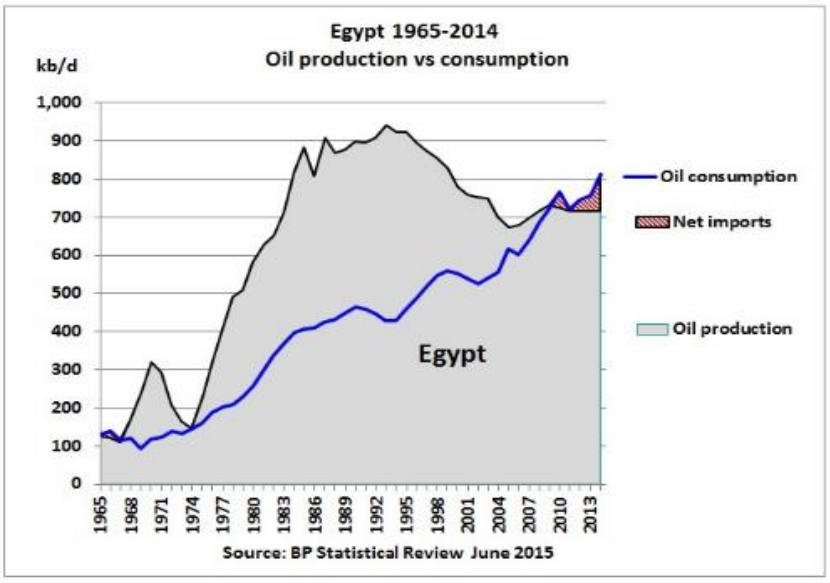
[16] Source: Wealth Artisan Magazine, 2016 - https://wealthartisan.com/the-economic-impact-of-the-egyptian-political-crisis/
[17] Source: the Atlas of Economic Complexity- Egypt, 2016.

Similarly, the country's production and surplus of the domestically produced natural gas, which fulfills more than half of the country's energy consumption, have been shrinking since 2009 leading to a progressive reduction in Egypt's exports of the commodity (Figure 3.13). These exports reached a minimum but positive level at the end of 2015 before the ministry of petroleum initiated a new strategy to revitalize the oil and natural gas sector in order to, at least, respond to the country's domestic needs. A major impediment to increasing natural gas output is the substantial debt that Egypt owes foreign operators (e.g. Egypt was recently described as one of the biggest EBRD[18] borrowers); turning down the drilling activity and delaying the project investments that are expected to heal up this sector. The government latest reforms include supporting and facilitating the operation of the national petroleum refineries especially the main ones installed in Cairo, Alexandria, and the Suez. At the same time, the ministry of electricity and energy is planning to fuel 14% of its electricity production which values 19% of the world's production by hydroelectricity. In brief, three main pillars are disclosed within the government's new energy strategy, including: "security, by boosting, diversifying and improving energy efficiency; sustainability, by addressing debt build-up and phasing out of subsidies in a socially responsible manner; and governance, by improving and modernizing the oil and gas sector's governance and encouraging private sector investment" or the downstream integration of the oil and gas industry in the private sector. Furthermore, the government is updating its energy pricing strategy[19] that was launched in 2009 and negotiated thereafter and again, as part of the IMF local structural reforms, it is considering a serious energy subsidy removal which, despite all its aforementioned advantages, is expected to drive up the

[18] EBRD: the European Bank for Reconstruction and Development.
[19] Egypt's energy pricing strategy, 2009 can be access through this link: https://www.esmap.org/sites/esmap.org/files/Egypt_An_Energy_Pricing_Strategy.pdf.

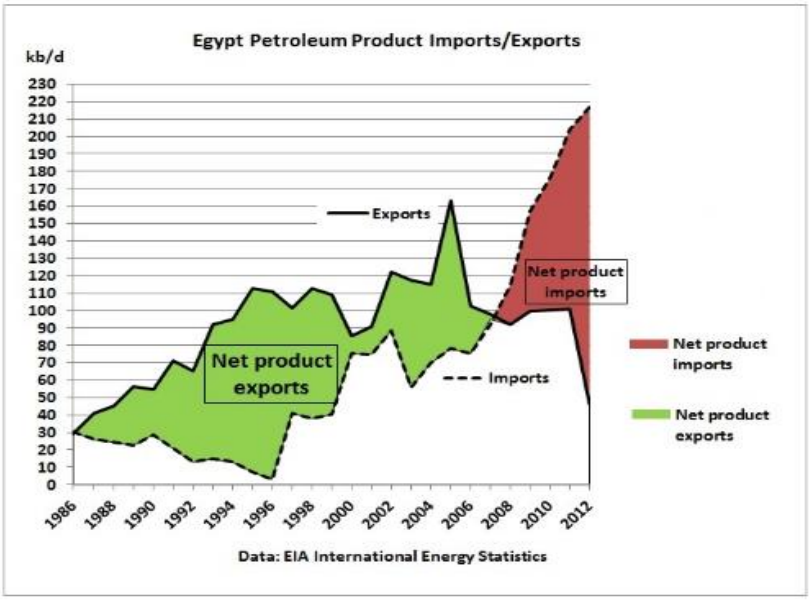
transportation cost and have some undesired implication as it is concurrent with the latest rise in crude oil price to over USD 100 per barrel.

Figure 3.10. The evolution of Egypt's oil production versus oil consumption (1965-2014)



Source: Retrieved from the EIA's report for Egypt, 2015

Figure 3.11. Evolution of Egypt's petroleum product imports and exports (1986-2012)



Source: Retrieved from the EIA's report for Egypt, 2015

Figure 3.12. The annual growth rate of Egypt's crude oil production (1980-2015)

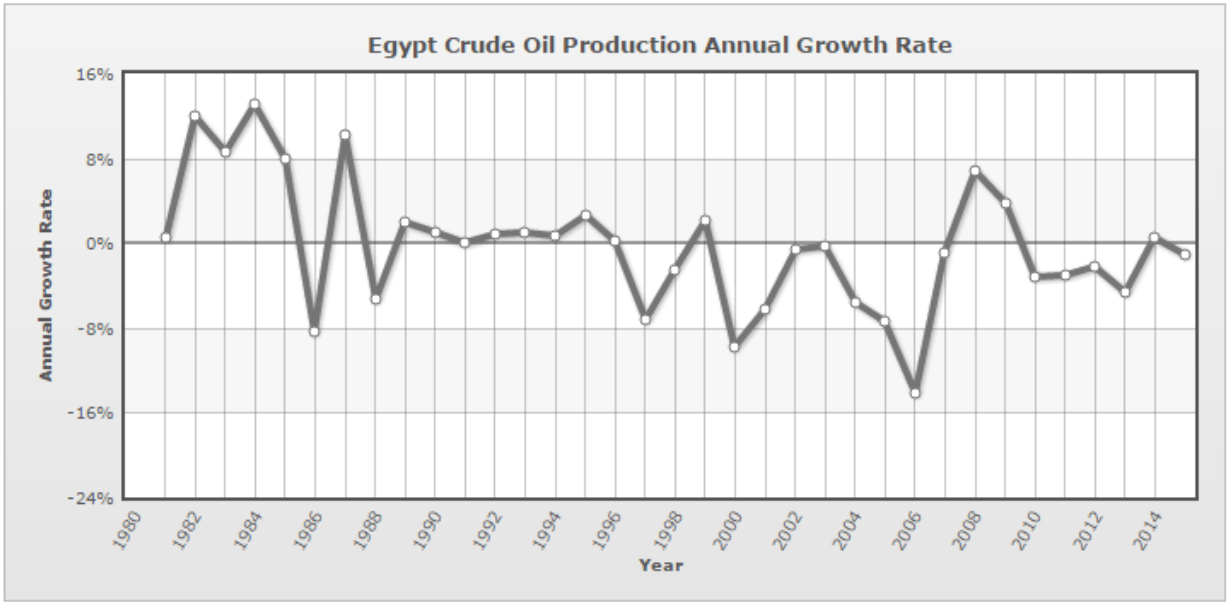
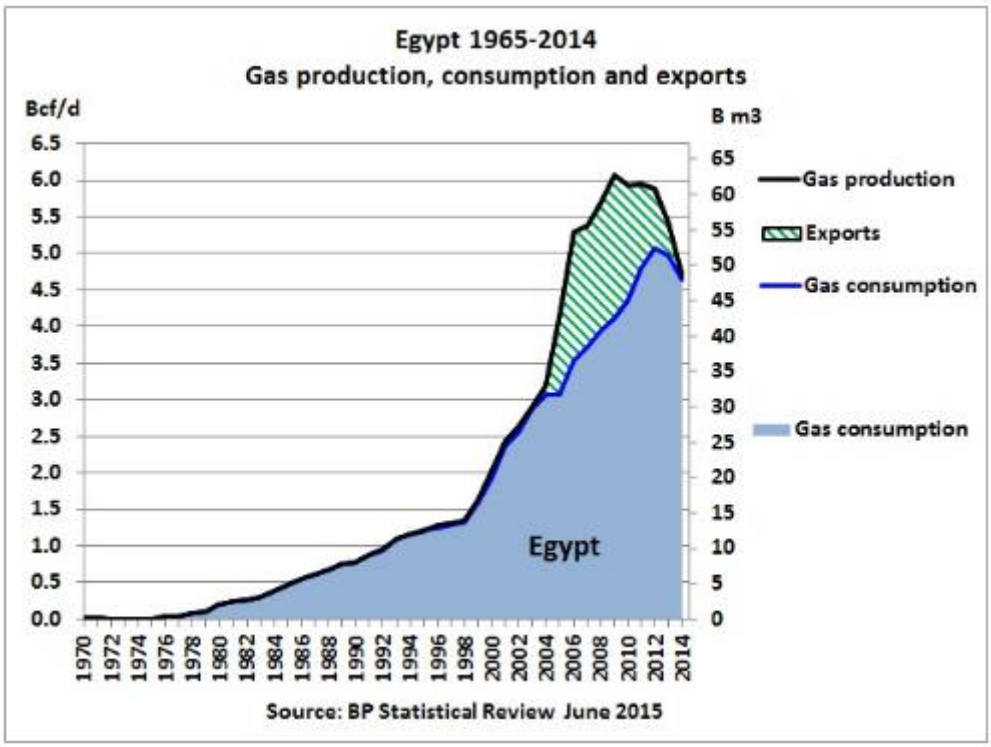


Figure 3.13. Evolution of Egypt's natural gas production and consumption (1970-2014)



Source: Retrieved from the EIA's report for Egypt, 2015

CHAPTER IV

RESEARCH METHODOLOGY

A. Theoretical framework

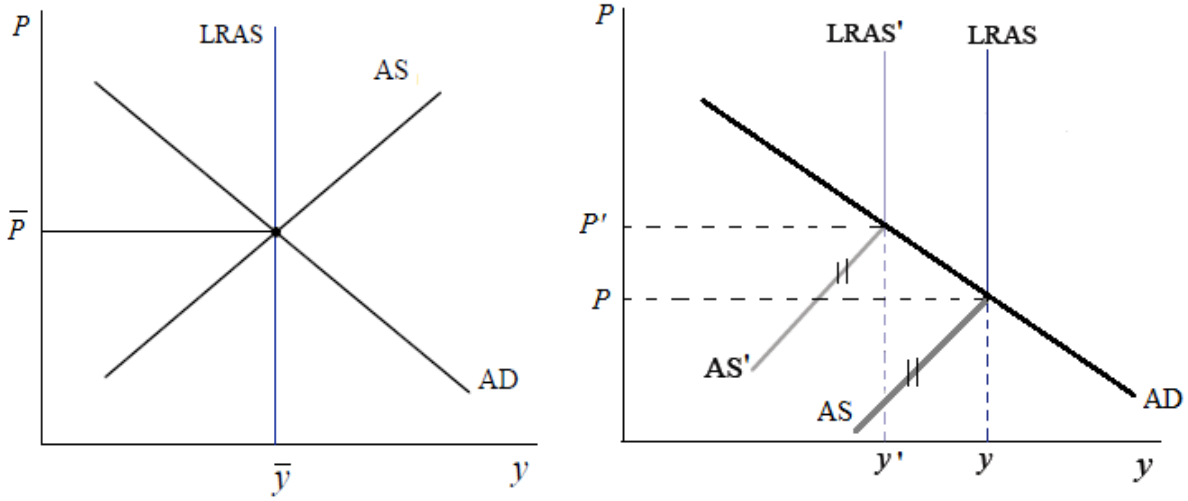
As our literature review demonstrates, many VAR based analyses such as Tatom (1987), Roubini and Setser (2004), Blanchard and Gali (2007), Estrada and Hernandez de Cos (2009), DePratto, Deresende, and Maier (2009), etc. prove that oil shocks are transmitted through the supply side mechanism and can therefore affect output in the long-run. Since this is also in alignment with Blanchard and Quah (1989), there is need to assume that aggregate supply (AS) shocks have permanent effects on output level, while aggregate demand (AD) shocks only affect output in the short run. As a result, the standard AD-AS model is a simple and straightforward configuration for our paper's theoretical framework which includes the understanding of the oil shocks' nature and transmission channels (Tatom, 1987). In a simple IS-AS model applied to a net oil-importing country, an unanticipated positive oil shock is translated into a negative supply shock but not into a demand shock since the latter would normally be followed with a fall in both output and prices, which is counterintuitive. In oil-importing economies, oil price shocks behave like technology shocks (one type of exogenous supply shocks): higher oil prices raise the production cost, induce the need to rearrange input resources, increase prices and reduce the GDP level.

In other words, as Figure 4.1 indicates, the AS curve is vertical in the long-run and intersects the AD curve with an equilibrium price level and a steady-state equilibrium real output level. This orientation of the AS curve is the result of an adjustment mechanism where the nominal wages (the cost of labor) respond to market

price changes until the full employment state in the economy is achieved. The vertical position of the AS curve means that a change in the market price and, more generally, in the monetary policy cannot affect output in the long-run, which is a common economic theory. However, an unanticipated increase in the international oil price shifts the AS curve of a net-oil importer upward and to the left (from AS to AS') in the short-run, keeps the AD curve unchanged and leads to a fall in output from y to y' but to an increase in the price level from P to P'. Then, as already explained, the equilibrium would be restored through wage adjustments and, if this oil price shock is permanent and large enough, the vertical long-run AS curve (LRAS) shifts to the left, affecting real output and the price level in the same fashion. Accordingly, this supports the view that a permanent oil shock has the nature of a supply shock to a net oil-importer as it affects price and output in opposite directions and in the long-run[20].

Figure 4.1. AS response to a permanent increase in the international oil price

a) Vertical Long-Run AS Curve (LR-AS) **b) How the AS Shifts in the SR and LR**



[20] Analysis and figures adapted from Peter J. Montiel's acadmic book on "Macroeconomics in emerging markets" (2011).

International oil price shocks do not only affect potential output of oil-importing countries through their negative impacts on productivity, capital stock utilization and structural employment but also have short-run impacts on the AD as they cause inflation and shift real income from oil-importing to oil-exporting countries, decrease the consumers' purchasing power, reduce the companies' profitability and lower the level of domestic demand. However, this effect is neutralized by the reacting monetary policies and does not persist. A totally opposite scenario can be witnessed in oil-exporting countries that have relatively large oil sectors, where an increase the international oil price boosts the national income through greater oil export revenues.

Nonetheless, comparable studies adopting methodologies that are similar to ours consider a more complicated explanation of their theoretical framework based on a modified AS-AD model. For example, Shah and Wang (2012) study the dynamic effects of oil price shocks on Indonesia, Malaysia, Pakistan and Thailand and use Blanchard and Quah (1989) to identify their SVAR model. As inspired by Romer (2006), they rely on the Lucas supply curve which takes into account the expectations based on past information and the productivity shock that is decomposed into supply and oil price shocks; they decompose the oil shock into shocks to oil demand/supply and other exogenous shocks (including the political situation, etc.); and they define the demand curve in terms of literal money, domestic price level and oil price in order to consider the short-run interventions of the monetary policy that cannot be the transmission channel, in our case, since it cannot have long-run impacts. We believe that their approach is rational and compatible with ours but that our approach is an easier way to support the intuition behind our model's structure and analysis.

B. Data analysis and properties

To able to estimate our three-variable VAR system depicting the impacts of the oil price shocks on Egypt's real output and domestic prices, we need to begin by defining the vector Z_t which comprises the three elements and can be written as $Z_t = [P_t^{op}, Y_t, P_t]'$ where P_t^{op} represents the real international oil price, Y_t represents Egypt's real gross domestic product (GDP), and P_t Egypt's domestic price level that is proxied by the country's consumer price index (CPI). The choice of these variables is based on the object of interest and the strategy employed, namely Blanchard and Quah (1989), which requires two of the three variables to be real and the third (the domestic price level in our case) to be nominal. The variables in Z_t are all included after executing the natural logarithmic transformation, denoted by the lower case "t", as a way to avoid outlying data from a positively skewed distribution and have the data normally distributed instead. The inclusion of these variables in the vector also follows conducting a seasonality adjustment and establishing their order of integration to guarantee the stability of the system. The data is used at a quarterly frequency and spans for the longer obtained period (2002Q1 to 2016Q1) so as to maximize the degrees of freedom, which gives us a total of 57 observations.

The real international oil price P_t^{op} is derived from Brent-Europe because it is known to be the most commonly used source for studies related to Arab countries. We keep the unit of the series as given in current US dollars per barrel since this is the currency used by Egypt during its predominant oil-importing activity and in order to avoid any contamination from the exchange rate adjustments. This series, in the first place, is deflated by the US producer price index for all commodities, derived from the Federal Reserve Economic Data and sourced from the Federal Reserve Bank of St.

Louis' database. The deflation is simply done by dividing the PPP by 100 and then the international oil price by what is obtained. As for Egypt's CPI (no unit; base year 2010) P_t and real GDP (Y_t) datasets, they are derived from the International Monetary Fund (IMF) International Financial Statistics database. The real GDP, in particular, is expressed in millions and in local currency unit (Egyptian pound) but was only available in the mentioned source until 2013Q4. Therefore, in order have a complete dataset for the whole studied period, we used the percentage change in real GDP at market prices from the same source to compute the missing values using simple math. The sources of the three datasets mention that the data is not seasonally adjusted. This can also inferred from checking the correlogram of each series since the three of them show wavy patterns of the autocorrelation level, which indicates the need to correct for the presence of seasonality or, in other words, adjusting for any possible seasonal cycles that can hinder us from understanding what underlying trends are in the economy. We do this adjustment using the most recent X-13ARIMA-SEATS Method developed by the U. S. Department of Commerce, U. S. Census Bureau of Statistics as a preliminary step to avoid this misleading component.

Table 4.1. Summary statistics

	Diff CPI	Diff REAL_GDP	Diff REAL_OIL_PRICE
Mean	0.022538	0.029042	0.002619
Median	0.01884	0.009753	0.027108
Maximum	0.070501	0.531226	0.213406
Minimum	0.003398	-0.050225	-0.531532
Std. Dev.	0.014313	0.092311	0.12767
Skewness	1.116647	4.51526	-1.633625
Kurtosis	4.172716	23.38528	7.126625
Observations	56		

Source: Author's calculations using Eviews8 statistical software

The logarithmic transformation and seasonal adjustment are then followed by checking the order of integration of each of the three variables which helps characterizing their long-run properties. To do this, we conduct both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (with trend and intercept) whose results are presented in Table 4.2 below. The outputs of both tests show that, for all tree variables, the absolute value of the t-statistic at the variable's level is lower than all three test critical values (corresponding to the 1%, 5% and 10% significance levels). This indicates that all three variables have a unit root and are non-stationary in levels. However, at the first difference level, the absolute value of the t-statistic is greater than all three critical values, which verifies that all the variables should be differenced since, at their respective first difference levels, they do not have a unit root and are stationary at the 1% significance level. This, in turn, means they have an I(1) order of integration. By looking at the graphs exposing the trends in our variables over the studied period (Figure 4.2), we can see that, in levels, real GDP and the CPI have constant and progressive upwards trends with no breaks. However, the real international oil price exhibits considerable fluctuations with an overall upward trend that starts to slow down in 2014. The graph makes obvious the oil price spike of 2008 and the shoot in 2014, among other smaller shocks. Concerning the first difference level, all three variables appear to be mean reverting with an undulation pattern. This does not only support the ADF and PP tests' results but also our choice to difference the series as a trend removal method instead of the Hodrick-Prescott and Brand-Pass de-trending filters that could be spurious as the choice should be backed by whether the trend is fixed or not.

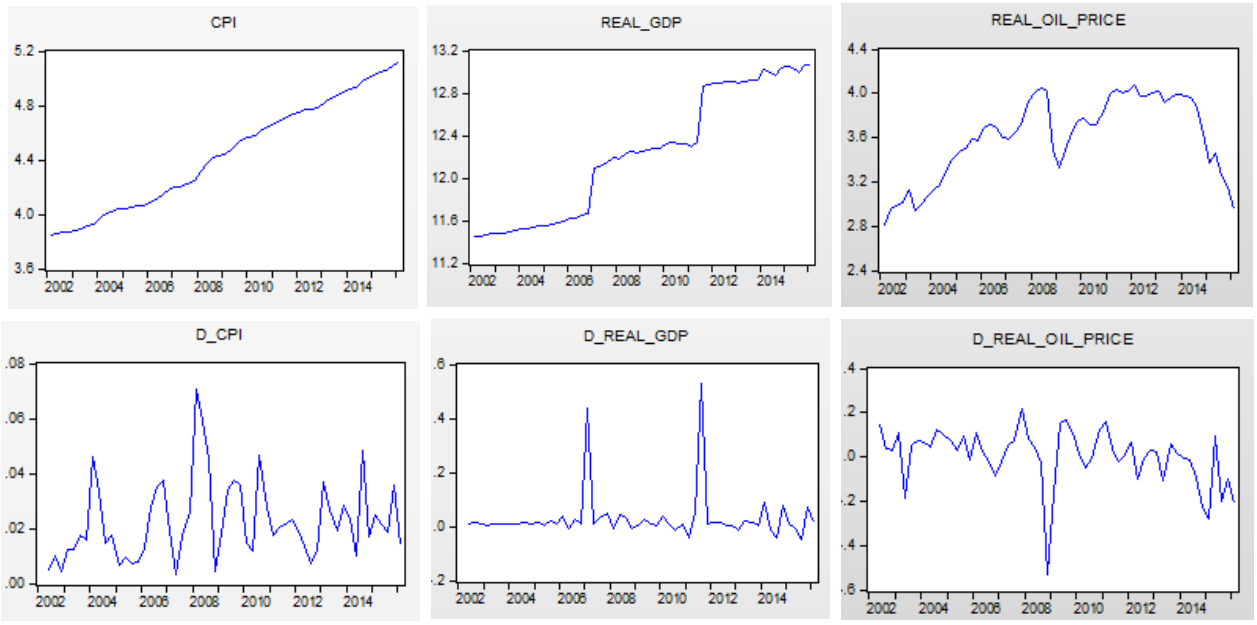
Table 4.2. Unit root tests at level and first difference specification

Variable	Augmented Dickey-Fuller		Phillips-Perron		Order of Integration
	Level	First Difference	Level	First Difference	
P^{op}	-0.498895	-5.59196***	0.216051	-5.354193***	I(1)
Y	-2.691656	-7.41383***	-2.76107	-7.416688***	I(1)
P	-2.764275	-4.976749***	-2.70657	-4.697781***	I(1)

*Significant at 10%, **Significant at 5%, ***Significant at 1%

Source: Derived from Eviews8 Statistical Output (Author's calculations)

Figure 4.2. Trends CPI (P), real GDP (Y) and real Oil Price (P^{op}) from 2002Q1 till 2016Q1



Source: Derived using Eviews8 Statistical Software (Author's calculations)

C. Empirical strategy

Before we proceed with identifying our VAR system, we run the Johansen System Co-integration Test for the three-variables in order to check their eligibility to be involved in a VAR model. Although our variables (P_t^{op}, Y_t, and P_t) should intuitively not be co-integrated – with a plausible exception for the international oil price and real GDP – undertaking this step is essential to ensure that our constructed VAR model is

correct since, in case of presence of any co-integration, it would be inappropriate to use the VAR method but the Vector Error Correction Model (VECM) instead; or else, we risk encountering a misspecification error. The results of both the Trace and the Maximum Eigenvalue tests of the Johansen System, as represented in Table 4.3 below, prove that there is no co-integration at the 5% significance level, which raises no doubts about the validity of the VAR method for our study.

Table 4.3. Johansen system co-integration test (trace and maximum Eigenvalue)

Series: CPI REAL_GDP REAL_OIL_PRICE
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (**Trace**)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.193539	17.83229	29.79707	0.5785
At most 1	0.090368	6.216893	15.49471	0.6699
At most 2	0.020205	1.102259	3.841466	0.2938

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (**Maximum Eigenvalue**)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.193539	11.61540	21.13162	0.5859
At most 1	0.090368	5.114633	14.26460	0.7273
At most 2	0.020205	1.102259	3.841466	0.2938

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Derived from Eviews8 Statistical Output (Author's calculations)

After ensuring that our variables do not have a unit root through the differencing method, we define the covariance stationary (1x3) vector $\Delta Z_t = [\Delta P_t^{op}, \Delta Y_t, \Delta P_t]'$ with Δ symbolizing the differencing parameter. The variables included in this vector are also annualized (by multiplying each series by 400) as we seek ease of interpretation when

analyzing our SVAR model's properties such as the impulse response functions and variance decomposition. The three-variable VAR system is represented by equation (1) below:

$$\Delta Z_t = c + \sum_{j=1}^{p} R_j \Delta Z_{t-j} + \mu_t \quad (1)$$

Where p is an optimal lag selected by a chosen lag length criterion. For this paper, we rely on two criteria being the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SC) as they are known to be the most precise. The former chooses an optimal lag of 2 while the latter chooses 1; however, after considering the captured level of residual autocorrelation in each, we decide to adopt 2 lags. This is therefore expected to turn μ_t (3x1) into white noise vector of structural shocks, as expressed at a later stage. On the other hand, R is a (3x3xp) matrix-valued polynomial in positive powers of lag operator L and c is a constant which can then be ignored. Accordingly, the reduced form VAR can be represented by the following:

$$\mu_t = -c - R_0 \Delta Z_{t-0} - R_1 \Delta Z_{t-1} - R_2 \Delta Z_{t-2} - R_3 \Delta Z_{t-3} - \cdots - R_p \Delta Z_{t-p} \quad (2)$$

$$\mu_t = -R_0 L^0 \Delta Z_t - R_1 L^1 \Delta Z_t - R_2 L^2 \Delta Z_t - R_3 L^3 \Delta Z_t - \cdots - R_p L^p \Delta Z_t \quad (3)$$

$$(-R_0 L^0 \Delta Z_t - R_1 L^1 \Delta Z_t - R_3 L^3 \Delta Z_t \ldots - R_p L^p) \Delta Z_t == R(L) \Delta Z_t = \mu_t \quad (4)$$

Additionally, given that ΔZ_t is a stationary covariance process, there should be at least one Vector Moving Average (VMA) representation according to the World Representation Theorem. Hence, the reduced form of this VMA can be specified using the operation below:

$$\Delta Z_t = R(L)^{-1} \mu_t = F(L) \mu_t \quad (5)$$

F is a (3x3) matrix in lag polynomial L and E (μ_t, μ_t') = $\Omega_\mu \neq I_3$ but F(0) = I_3.

D. Identification of the structural shocks

After specifying and estimating the reduced form VAR model, we need to identify the structural shocks that help us analyze the dynamic effects of international oil prices on Egypt's economy. We estimate our Structural Vector Autoregressive SVAR system in a way that disentangles the international oil shock from any other shocks that are idiosyncratic to the country of interest or even any other external shocks hitting the economy. In addition, we impose the needed Granger non-causal restrictions characterizing the behavior of our small open economy to ensure that it cannot affect the international oil prices given its insignificant size relative to the international oil market. For this, we adopt the standard identification strategy that was developed by Blanchard and Quah (1989) and later applied by Gali (1992), Clarida and Gali (1994), etc. This strategy focuses on long-run restrictions, which offers transparency and clarity, and is based on economic theory accompanying the statistical application and intervening in the determination of short-run as well as long-run restrictions. This, as previously mentioned, is unlike the Cholesky decomposition which only considers the short-run impacts and imposes no restrictions on dynamics but just on the contemporaneous coefficients, leading to recursive assumptions that suggest a specific ordering for the variables together with a lower triangular matrix. If no economic interpretation is associated to the Cholesky statistical method, it only produces a reduced form model that lacks transparency in the definition of the shocks and suffers from uncertainty regarding the timing of the impacts. In our linear methodology, we tend to replicate Nyanzi (2016) and Shah and Wang (2012) who apply an identical research question to Uganda and a set of four developing countries (Indonesia, Malaysia, Pakistan and

Thailand) respectively using the same Blanchard and Quah (1989) approach while we carry out this for Egypt.

Accordingly, the next step consists in specifying our structural VMA as:

$$\Delta Z_t = A(L)\varepsilon_t \quad (6)$$

Where A(L) is a (3x3) matrix of polynomial lags L whose estimation facilitates the re-expression of ΔZ_t in terms of past and current structural disturbances and ε_t is the vector of structural shocks which are normally distributed with a mean of zero and a constant variance, can be interpreted as white noise, and are uncorrelated with each other. This vector can be written as $\varepsilon_t = [\ \varepsilon_t^{oil}, \varepsilon_t^{AS}, \varepsilon_t^{AD}\ ]'$ where ε_t^{oil} represents the oil price shock, ε_t^{AS} represents Egypt's aggregate supply shock, and ε_t^{AD} Egypt's aggregate demand shock. As a first identifying restriction of the structural shocks, we assume that these structural disturbances are orthonormal, which implies that:

$$E(\varepsilon_t, \varepsilon_t') = \Omega_\varepsilon = I_3 \quad (7)$$

Therefore, by referring to equations (5) and (6), we get the following:

$$\Delta Z_t == F(L)\mu_t = A(L)\varepsilon_t \quad (8)$$

By evaluating equations (7) and (8) at L=0, we get equation (9) below:

$$A(0)A'(0) = \Omega_\mu \quad (9)$$

Equation (9) explains the relationship between the variance-covariance matrix Ω_μ and the initial impact matrix of structural disturbances, knowing that the variance-covariance matrix can be estimated from the reduced form VAR by: $\widehat{\Omega}_\mu = T^{-1}(\mu'\mu)$. Given that $\Omega_\mu$is symmetric, this yields to six non-redundant equations with nine unknowns, indicating the need for three additional restrictions to recover the structural disturbances in equation (6). Consequently, following our identification strategy, we construct our steady state (long-run) impact matrix of structural shocks. To do this, we

evaluate F(L) at L=1, take the assumptions related to equation (7) into account, get the long-run impact matrix corresponding to the reduced form VMA, and relate this matrix to A(L) after evaluating it at L=1 as well. The described process yields to:

$$\Omega_{\mu}(1) = F(1)\Omega_{\mu}F(1)' == A(1)A(1)' = \Omega_{\varepsilon}(1) \quad (10)$$

Where F(1) is a (3x3) long-run effects matrix corresponding to reduced form shocks, A(1) is a (3x3) long-run effects matrix corresponding to structural shocks, and $\Omega_{\mu}(1)$ and $\Omega_{\varepsilon}(1)$ are the respective long-run variance-covariance matrices.

The three additional identifying restrictions are necessary and emanate from the following economic rationale: an oil price shock (ε^{oil}) can affect Egypt's domestic prices and output in the short-run and in the long-run if permanent since this is a global shock to a net oil-importing country, regardless of what the source of this shock is (whether supply or demand). On the other hand, the aggregate supply AS shock (ε^{AS}) can affect Egypt's real GDP in the short and long-run and the country's domestic price level, though not at the long horizon. However, the AS shock and the aggregate demand AD shock (ε^{AD}) are specific to Egypt's small economy and cannot affect the international oil price at any horizon. Concerning the AD shock, while it may affect the country's price level in the long-run, it can only affect its output (Y) in the short-run as our theoretical background shows no possible permanent effect of AD shocks on output. These assumptions result in three 0 restrictions [$A_{12}(1)= A_{13}(1)=A_{23}(1)=0$]. The number of restrictions can be checked using the simple operation of [k(k-1)/2] where k is the number of variables and has a value of 3, in our case, thus specifying the need for these three restrictions that can be summarized in the vector equation below:

$$\begin{bmatrix} P^{op\ ss} \\ Y^{\ \ ss} \\ P^{\ \ ss} \end{bmatrix} = \begin{bmatrix} A_{11}(1) & 0 & 0 \\ A_{21}(1) & A_{22}(1) & 0 \\ A_{31}(1) & A_{32}(1) & A_{33}(1) \end{bmatrix} . \begin{bmatrix} \varepsilon^{\text{oil}} \\ \varepsilon^{\text{AS}} \\ \varepsilon^{\text{AD}} \end{bmatrix} \quad (11)$$

Where (^{SS}) denotes the steady state level of the variables that is reached in the long-run.

Besides these three additional zero restrictions which are crucial to recover the structural shocks, we need to impose two more necessary over-identifying restrictions to ensure that the international oil price is exogenous to Egypt as it cannot be influenced neither by the AS nor by the AD. Here stem the Granger non-causal restrictions expressed in the vector equation (12) below and reflecting the small country assumption that requires the ε^{AS} and the ε^{AD} not to Granger cause the international oil price.

$$\begin{bmatrix} \Delta P_t^{op} \\ \Delta Y_t \\ \Delta P_t \end{bmatrix} = \begin{bmatrix} . & 0 & 0 \\ . & . & . \\ . & . & . \end{bmatrix} . \begin{bmatrix} \varepsilon^{oil} \\ \varepsilon^{AS} \\ \varepsilon^{AD} \end{bmatrix} \quad (12)$$

It is worth noting that, decomposing Egypt's real shock into supply and demand is an important technique in characterizing the nature of the oil shock and making sure through which transmission channel it operates to consolidate our related previously detailed expectations. Moreover, the inclusion of additional variables representing the Egyptian economy such as the exchange rate, public expenditures, etc. is not possible because of the lack of available quarterly data which constrains us with only 57 observations that cannot handle more than 3 variables without resulting in an overestimation due to the excessive number of parameters. This understanding is based on this equation [k x k x 2 + k] (where k is the number of variables again and 2 is the number of lags) that gives a relatively large number when k=4, for example, but an appropriate one when k=3.

The above detailed procedure can be partly and differently translated in three equations (knowing that our chosen lag =2), such that:

Equation (I): $\Delta P_t^{op} = B_0 + B_1 \Delta P^{op}_{t-1} + B_2 \Delta P^{op}_{t-2} + B_3 \Delta Y_t + B_4 \Delta Y_{t-1} + B_5 \Delta Y_{t-2} + B_6 \Delta P_t + B_7 \Delta P_{t-1} + B_8 \Delta P_{t-2} + e_t$

Equation (II): $\Delta Y_t = a_0 + a_1 \Delta P_t^{op} + a_2 \Delta P^{op}_{t-1} + a_3 \Delta P^{op}_{t-2} + a_4 \Delta Y_{t-1} + a_5 \Delta Y_{t-2} + a_6 \Delta P_t + a_7 \Delta P_{t-1} + a_8 \Delta P_{t-2} + \Delta e_t'$

Equation (III): $\Delta P_t = \lambda_0 + \lambda_1 \Delta P_t^{op} + \lambda_2 \Delta P^{op}_{t-1} + \lambda_3 \Delta P^{op}_{t-2} + \lambda_4 \Delta Y_t + \lambda_5 \Delta Y_{t-1} + \lambda_6 \Delta Y_{t-2} + \lambda_7 \Delta P_{t-1} + \lambda_8 \Delta P_{t-2} + \Delta e_t''$

Where B_0, a_0, and λ_0 are constants; the other Bs, as, and λs are impact coefficients; and e_t, e_t', and e_t'' represent the error terms. However, Equations (I), (II) and (III) do not incarnate our model's object and properties if not complemented by the aforementioned restrictions. For instance, in equation (I), we should impose the Granger non-causal restrictions making the impacts of output and the price level on the international oil prices null (i.e. $B_3 = B_4 = B_5 = B_6 = B_7 = B_8 = 0$). Therefore, the whole preceding procedure is an easier and more applicable method to define and express our model.

CHAPTER V

EMPIRICAL RESULTS

We execute the SVAR model we identified in the previous section using the WinRATS Pro 9.1 statistical package. The output of the elaborated econometric technique allows us to study the model's properties accomplished by the impulse response functions and variance decomposition analyses that we need to understand in order to answer our research question. This section provides the structural evidence on the macroeconomic effects of oil price shocks on Egypt's real GDP and consumer price level and uncovers the dynamic effects of the country's supply and demand shocks, providing a holistic view of the structural identification and particularly the nature of the oil price disturbances. The impulse responses unveil the size of the effects of interest and the shocks' propagation in the first place, while the variance decompositions emphasize the weight of the oil shock's influence over time.

A. Impulse response functions

The impulse response functions (IRFs) are represented in Figure 5.1 below and visualize rational and convincing results. The horizontal axis refers to the time horizon (in quarters) after the shock hits the economy while the vertical axis shows the accumulated responses of the variables in levels and on an annualized basis. The first graph shows how and at what pace a positive international oil shock behaves through the commodity's price; whereas the second two graphs are obviously consistent with our identification restrictions, including the Granger non-causal ones preventing Egypt's supply and demand shocks from affecting the international oil price. The

impulse responses also show that a permanent increase in the international price of oil is associated with a direct fall in real output which starts once the commodity's price begins to rise and reaches a minimum value when the commodity's price peaks in the second quarter from the time the shock hits. Thereafter, the decline in output subsides rapidly until the variable attains a significantly higher level two quarters after its minimum, followed by a new steady state level that is also higher than its initial stage. The maximum effect of an oil shock on real output is worth more than double the initial effect. Specifically, an oil shock that permanently increases the international oil price by 47.4% leads to a 0.8% fall in real output in the first quarter. This fall in real output persists until it finds its bottom at 5.8% after the second quarter. In the long-run, real output is 3% higher relative to the level before the shock impacted. In growth terms, an oil shock of the corresponding size drives output growth to fall by about 0.86 percentage points at the end of the one-year horizon since the time the shock impacted, which is consistent with the estimates of Roubini and Setser (2004) for the US and G7's GDP growth varying between 0.3 and 1 percentage points[21].

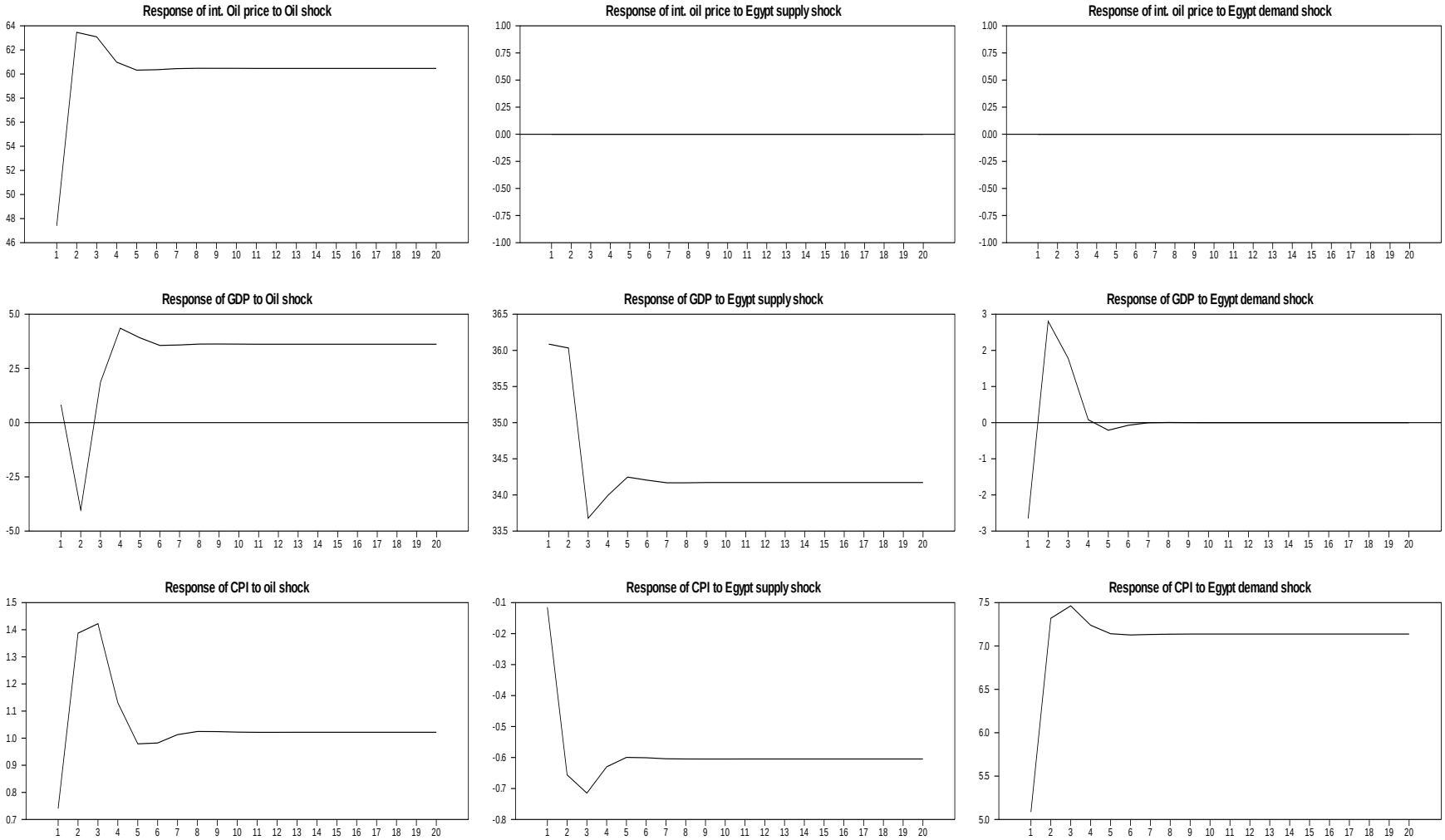
On the other hand, following an increase in the international oil price, consumer prices rise initially, persist and peak after three quarters from the beginning of the shock, with the peak effect being over double the initial effect. Thereafter, the impact diminishes until the CPI level reaches its new higher steady state level. This is similarly consistent with the conventional wisdom as an oil shock of the same size, leading to a 47.4% annualized increase in the international price of oil, engenders a 0.74% initial increase in the consumer price level. The impact peaks at 1.45% before finding a new long-run equilibrium price level that is 0.46% higher than the level of the CPI prior to

[21] As cited in Nyanzi (2016).

the impact of the shock. The magnitude of these impacts are likewise in line with Nyanzi (2016)'s estimates for Uganda, Blanchard and Gali (2010)'s results for the United States, and Shah and Wang (2012) conclusion for the set of four countries they addressed in their study.

The results are also compatible with our hypothesis on the dynamic effects of aggregate supply and demand on real output and the price level originating from the conventional theory as well. They show that aggregate supply shocks have a more powerful effect on real output while aggregate demand shocks have a more powerful effect on consumer prices, which is consistent with the common understanding of the effects of an increase in international oil price on a net-oil importing country. The estimates indicate that a supply shock which increases the steady state level of real GDP by 36.08% leads to a 0.12% initial reduction in the price level, with a maximum impact of 0.55% on the price level realized after two quarters. When real output is at its new higher steady state level, the price level is almost 5% lower than the level preceding the impact of the shock. Conversely, an aggregate demand shock that increases the consumer price level by 5.8% in a one-year horizon and in the long-run leads to a 2.06% initial short-run increase in real output. Apart from observing how both variables move in the same direction in response to a demand shock, we can see how the positive impact of the shock on real output wanes thereafter, before the variable reaches its original steady state level on the 5^{th} quarter. This indicates that the aggregate demand shock has a temporary effect on real output, reflecting and supporting our previously emphasized identification restriction.

Figure 5.1. Accumulated impulse responses (quarterly annualized and un-scaled)



To end with, these results prove that oil shocks are transmitted through the supply channel and thus confirm the conclusions made by Tatom (1987), DePratto, Deresende, and Maier (2009), Estrada and Hernandez de Cos (2009), Ahmed and Khan (2014), and other featured studies in out literature; unlike what is revealed in Hamilton (2000)'s findings, for instance.

B. Variance decomposition

The forecast error variance decompositions of Egypt's output and CPI are reported in Table 5.1 below. The variance decomposition is a statistical method to analyze the impacts of the different shocks on the fluctuations observed in the chosen variables by decomposing each variable's forecast error variance of the q quarter ahead into different shocks. In other terms, it is based on a structural decomposition (orthogonalization) estimated in the factorization matrices of the identified VAR model and it is used to measure the proportion of fluctuations in output and prices, in our case, caused by the oil price, AS, and AD shocks, respectively. The Granger non-causal restrictions we imposed when identifying our model to take into account the small country assumption and control for the fact that the international oil prices cannot be affected by Egypt's supply or demand shocks at any horizon led to merely zeros and ones in the variance decomposition results for the ΔZ_1 series, as expected. Given that we drove these results to be as such with our imposed restrictions and that they are not interesting to show, we omit the percentages of variance in international oil price due to the different shocks from Table 5.1. The table also does not show the long-run identifying restrictions making the percentage variance in Egypt's output due to the

country's demand shock tend to zero as the horizon approaches the long-run. Besides this, all unrestrained features in the model are included.

Table 5.1. Variance decomposition of output and CPI in Egypt

Horizon (Quarters)	Percentage of Variance in Output due to			Percentage of Variance in CPI due to		
	Oil Shock	Egypt Supply Shock	Egypt Demand Shock	Oil Shock	Egypt Supply Shock	Egypt Demand Shock
1	0.053	99.41	0.538	2.074	0.05	97.876
2	1.779	95.517	2.704	3.009	0.952	96.039
3	4.195	93.105	2.7	3.01	0.962	96.028
4	4.607	92.507	2.886	3.26	0.98	95.76
5	4.62	92.489	2.892	3.328	0.982	95.69
6	4.628	92.48	2.893	3.328	0.982	95.69
7	4.628	92.479	2.893	3.331	0.982	95.687
10	4.628	92.479	2.893	3.331	0.982	95.687
20	4.628	92.479	2.893	3.331	0.982	95.687
30	4.628	92.479	2.893	3.331	0.982	95.687
40	4.628	92.479	2.893	3.331	0.982	95.687

The estimates indicate that oil price shocks are not an important determinant of output fluctuations in the short, medium and long-run since, over the 40 quarters following these shocks, their relative contribution to output movements ranges only between 0.053 and 4.628%. These results are not unexpected given Egypt's economic structure and are consistent with Berument et al. (2010)'s results claiming that there is absolutely no significant impact of oil shocks on the outputs of Bahrain, Egypt, Lebanon, Morocco, Tunisia and Yemen. Although Egypt's crude oil production has been remarkably decreasing since 1996, shrinking the country's oil-exporting activity and obliging it to further import crude oil and especially non-crude oil products, Egypt's production of crude oil still valued 511 thousand barrels per day at the end of 2015

when it was lastly reported[22]. This indicates the existence of a crude oil domestic supply which partly explains the obtained results. Additionally, according to EIA Beta's report on Egypt (2015), natural gas constitutes 53% of the country's primary energy consumption and about 70% of Egypt's electricity is fueled by natural gas, as encouraged by the government, with the remainder being fueled by petroleum and renewable energy (mostly hydroelectricity). Egypt's natural gas needs are domestically satisfied as well since the country still enjoys a surplus in the natural gas market that allows it to even export the commodity and induces a considerable substitution effect on oil despite the increasing domestic consumption and declining production of natural gas that narrowed down this positive balance lately. This, in addition to it the fact that Egypt's economy strongly relies on tourism, agriculture with rudimentary technology, and labor-intensive economic activities, provides a solid justification of the small extent to which oil price shocks explain the changes in Egypt's output level.

Similarly, the estimates suggest a weak role of oil disturbances in explaining the fluctuations in Egypt's consumer price level in the short to long-run as well. The oil disturbances' relative contribution to domestic price movements ranges between 2.074 and 3.331% only over the 40 quarters ahead. This surely reflects the small weight of oil in the country's CPI basket (unlike the PPI basket) given that the weight of fuel and electricity constitutes 3.3% of the 2000-based CPI basket as recorded in 2009[23]. This is not surprising knowing that 56.86% of Egypt's population lives in rural areas where biomass energy (wood, crops, etc.) is the most commonly used (World Bank Data, 2016). However, national fiscal and monetary policies, trade conditions, natural circumstances (weather, etc.) and other factors affecting the prices of food products are

[22] Source: the United States Energy Information Administration, 2016.
[23] This weight was retrieved from the Egyptian Center for Economic Studies- American University in Cairo (2009)'s calculations based on monthly data from CAMPAS.

expected to be the main source of volatility in Egypt's CPI level. Moreover, energy prices in Egypt are artificial due to the enormous government subsidies that intend to keep them low and affordable by the poor class (a similar intervention to setting a price ceiling), which prevents their fluctuations due to international oil shocks to be fully reflected in the country's CPI level. These subsidies do not only lead to a large household and intermediate industry consumption of energy products but also to a relatively dilated purchasing power and thus to a demand-driven market price level. This therefore lies behind the very high responsiveness of the CPI level to Egypt's demand shocks as depicted by the estimates of Table 5.1 where the percentage of variance in CPI due to a demand shock ranges between 97.876 and 95.687% all over the 40 quarter horizon. This conclusion should be considered during the government's decisions like the introduction or the increase of value-added taxes (VATs) and the subsidy removals on consumption goods, especially if tackling inflation is a priority. It also explains the weak contribution of Egypt's supply shocks to the variance in CPI as portrayed by the percentages in Table 5.1 that are ranging only between 0.05 and 0.982% over the 40 quarter horizon.

However, the estimates show an insignificant contribution of Egypt's demand shocks to changes in the country's output, even in the short-run, but a significantly large contribution of the country's supply shocks to output variations. While the percentage of variance in output due to a demand shock ranges between 0.538 and 2.893% only, this percentage of variance due to a supply shock ranges between 92.479 and 99.41% over the whole considered horizon. The minimal effect of demand shocks is expected in the long-run when aggregate demand cannot affect output, as previously explained. As for this minimal effect in the short-run and the prominence of the aggregate supply

shocks in determining the variations in output at all horizons, they can be explained by several facts. To begin with, Egypt's economy depends on the dominant agriculture sector that is sensitive to natural dynamics, climate change, and increasing population as well as on other labor-intensive sectors such as tourism, construction, and the service and banking industry. It is a transition economy experiencing recent shifts in the key economic activities and it is subject to the spillovers of 5 million refugees and immigrants, out of which 500 thousands flowed in from Syria since the conflict started in 2011 - according to President El-Sisi's statement in the G-20 meeting of September, 2016 – modifying the labor supply and the cost of labor. Moreover, Egypt's economy relies on remittances from its citizens working abroad, which makes it also subject to the surrounding conflicts in the MENA region, changes the expectations of business owners, and stagnates investments. However, those remittances contributed lately to increasing the capital influx, particularly the foreign direct investments (FDIs) designed to purchase local assets and associated with technology improvement, after the currency float and the IMF loan that boosted the confidence in the nation's economy (Bloomberg Markets, 2017). These factors and the government's recent strategy and structural reforms make Egypt more susceptible to labor, productivity and technology shocks and therefore support the dominant role of supply shocks in explaining the fluctuations in output.

The conclusion drawn from these results is that policy makers should not prioritize the development of oil related policies when planning to mitigate the sluggishness in Egypt's economic growth or target the country's inflation rate given the weak role of oil shocks in explaining the changes in the country's output level and its consumer price index. Nonetheless, the supply side is the channel through which the

government should address economic growth while the demand side is the channel for the price level. In other words, monetary policy should place rather less weight on international oil price in the inflation equation and this weight should be between 3 and 4%, as informed by the variance decomposition analysis. Furthermore, output stabilization in case of an oil shock should be achieved through alternative fiscal or monetary tools that mainly have a direct impact on the supply side of the economy. This does not deny the fact that supporting the production and usage of alternate energy sources such as the nationally produced natural gas and the renewable, cost-effective and eco-friendly hydro energy would improve the substitutability and alleviate the impact of any potential energy shock on the economy, especially in the long-run. This could also be done through reducing oil intensity in the market, which is a strategy that has been lately followed by many countries suffering from high oil prices, such as Jordan, in an attempt to save the impacted sectors (transportation, etc.).

On the other hand, it is worth mentioning that, by applying the same econometric technique and properties on the three variables in question while only substituting the Brent's data on international oil price with the West Texas Intermediate (WTI)'s data (derived from the US Energy Information Administration), the empirical results remained unchanged or presented few insignificant differences. This could be considered as a positive robustness check which further fosters the authenticity of our results, knowing the difference in the benchmarks of the two data sources, in their definition of crude oil and in the way they calculate its price. Again, our choice for Brent was not random but based on the standard criterion of considering this source when addressing countries from the MENA regional and particularly from the Arab world.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

This study examines the dynamic effects of oil price shocks on Egypt's economy and particularly on the country's output and price level using a Structural Vector Auto-regressive analysis based on Blanchard and Quah (1989)'s identification strategy which focuses on long-run identifying restrictions that offer transparency and clarity, combines the economic intuition with the statistical approach, and disentangles the international oil price shock from any other concurrent shocks affecting the economy or any potential shocks arising as a response to this oil shock of interest. This methodology ensures that the inferred relationships are causal and that the true effects are not biased by any external factors which are not related to the unique shock of interest. This study is important and timely since it is the first to specifically address the Egyptian economy with the exact adopted methodology while taking into account the country's structure and characteristics and, more importantly, the turmoil and economic reforms it has been recently experiencing, knowing that a major part of them concerns the energy sector in terms of pricing and production. Furthermore, this study delves into the question of the transmission channel through which the oil shock affects the economy - which has been the concern and the center of disagreement of many researchers - without requiring any prior decisions about it.

Our model generates very convincing results that match closely with the conventional wisdom related to the effects of oil shocks on output and prices for a net oil-importing country. They suggest that an increase in the international price of oil exerts negative short-run and long-run impacts on output and an inflationary effect on

consumer prices. Subsequently, oil shocks are discovered to be transmitted through the supply channel, given the opposite directions in the movements of the country's real GDP and CPI level. The standard theoretical framework of aggregate supply and demand is therefore well reflected in the impulse response functions since oil price shocks are slightly more important in explaining the fluctuations in the output level which is strongly determined by the supply shocks in the short to long run. As for the consumer price level, it is mostly explained by the demand shocks which have a relatively lower impact on the output level that is also only limited to the short-run. The modest effects of oil price shocks on Egypt's output and CPI are elaborately explained in our paper by several fact including the small weight of oil products in the consumer price basket, the dominance of non-oil intensive sectors (agriculture and tourism), and the substitution of oil by the domestically produced natural gas and the hydro energy in many demand and supply side activities. We yet admit that these effects can get stronger in case of the enlargement of oil-intensive sectors and the absence of sufficient alternative energy sources for household and industry usage.

Accordingly, the policy implications go beyond just inviting for the development of alternative non-oil energy sources, the reduction of oil intensity, and trade diversification as a way to alleviate the impacts of oil shocks on the economic activity in the long-run. Given the weak role of oil shocks in explaining the changes in the country's output level and its consumer price index, the policy implications should rather involve alternative fiscal and monetary policy reforms that do not relate to the oil sector for the purpose of stabilizing the country's output and adjusting its price level. While the reforms targeting output should be oriented towards the supply side, those targeting the price level should be demand-oriented. For instance, monetary policies

should place less weight on inflation but play a role in output stabilization in the short-run in case of an oil shock. On the other side, financial and budgetary instruments should be counter-cyclically put in place to smooth the effects of an oil price fall, for example, and this includes the reduction of oil price subsidies or the increase of taxes on oil products. However, in case of an increase in the international oil price, expansionary fiscal policies would be needed knowing that public expenditures are the major determinant of output growth, as previously mentioned. Similarly, less monetary tightening policies would be needed in this case. In general, Egypt is invited to nurture its cooperation with the GCC neighborhood and the countries importing its natural gas, and previously its crude oil, such as Jordan to foster a joint management of the upturns and downturns in the international oil market. This conclusion is the key for the decision makers to make necessary, accurate, credible, and proportionate policies whether at the fiscal, monetary, or trade levels.

However, while this paper analyzes the nature and magnitude of the effects, it does not attempt to study their linearity, symmetry, and evolution across time as this needs more specialized econometric tools and a wider number of observations. The shortcomings of our study also include the exclusion of additional interesting macroeconomic variables such as the exchange rate, the interest rate, public expenditures, etc. due to the risk of overestimation associated with the inclusion of more than three variables when using Blanchard and Quah's strategy and having only 57 observations. The absence of quarterly data corresponding to these variables in Egypt and for the adopted time span also impeded our attempt to think through these additional dimensions. Additionally, the short time span we could obtain and consider can probably conceal the credibility of our conclusion and our ability to generalize it

and to further decompose any shock as needed, which fades the attractive properties of our estimated model and our advisable results. These points wrap up a list of potential extensions for this paper which could be achieved by finding the appropriate respective remedies such as employing non-linear specifications to our SVAR system in order to address the asymmetry of the responses, for example. Another substantial extension and effective remedy to improve the estimates, add more variables and enhance the shocks' further decomposition would be trying to scale up to new countries – preferably of a similar economic structure – by applying the panel SVAR technique developed by Pedroni (2013) which takes into account responses to both idiosyncratic and common structural shocks while permitting full cross member heterogeneity of the response dynamics. This method would help us explore different shocks as well, such as the monetary, fiscal and international food price shocks that were deliberated in Ahmed and Khan (2014). Moreover, to overcome the incompleteness of the datasets over a more stretched time range, the lack of needed datasets and the problem of missing data points, we could refer to the tactic of interpolation or even replicate the methodology implemented by BLOM Bank-Invest (2010) to estimate the quarterly data of real GDP growth in Lebanon by using a bottom up approach from the demand side, employing the Chow-Lin disaggregation method, and deriving a vector autoregressive model with exogenous variables (VARX).

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