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TRENDS IN OIL AND GAS-RELATED INDUSTRIES' GROWTH: A PANEL DATA ANALYSIS

Dr. MOODHI RAID*
Assistant Professor, Economics, College of Business Administration, Al Yamamah University, Riyadh, (Kingdom of Saudi Arabia).
*Corresponding Author Email: Mo Raid@yu.edu.sa, ORCID: 0009-0009-5100-4216

Abstract

This study empirically investigates the Growth Trends in Oil and Gas-Related Industries impact of foreign trade, specifically exports and imports, on the growth of Saudi Arabia's manufacturing sub-sectors. Using panel data covering 23 industrial sectors from 2000 to 2017, several estimation methods are applied to examine how the composition of foreign trade and other determinants influence industrial growth. By analyzing industries across different technological classifications (high-, medium-, and low-technology), the study provides insights into whether foreign trade has contributed to enhancing or reducing growth within Saudi manufacturing. Furthermore, the research places special emphasis on oil and gas-related industries as a key strategic sector under Saudi Arabia's National Transformation Program (NTP) 2030. The findings are expected to support policymakers and government entities in designing effective industrialization policies, selecting appropriate trade tools, and strengthening the development and competitiveness of these critical industries within the broader structural transformation of the Saudi economy.

1. THE OLS TEST AND ALTERNATIVE FIXED EFFECT / FE-IV TESTS

The main econometric results from the baseline specifications 45 will present based on the hypotheses and the regression equation[1]. The dependent variable is the log of manufacturing output at time t for each industry (i) in growth form, and it is measured by total output for each industry during the period. The basic regression includes the core variables, exports and imports, pooled with all other determinants for growth.

The regression analysis begins with the application of the pooled OLS models. Nevertheless, we should consider that simple linear regression methodology applied in panel data fails to address the possible correlation between the unobserved effect and the independent variables producing biased and inconsistent results. To overcome this issue, we employ as a second methodology the fixed effects models. Doing so, although we address the problem of unobserved heterogeneity, within estimator models fail to support strict exogeneity condition which is necessary to produce robust results.

Thus, we need to employ a methodology that can treat all aforementioned problems in the same time. Following Wooldridge (2002) suggestion and since the empirical specification is introduced in panel form, this study chooses to employ the Arellano and Bond (1998) GMM models to address endogeneity issues provided. This approach is a much fixable method because it allows special method to be used Instrumental Variables (IV). IV is used to correct the causality problem between manufacturing growth and foreign trade composition (import and export), and also to test the impact of imports and exports on manufacturing growth.

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A. Instrumental Variables (IVs) Identification Strategy

The method of instrumental variables (IVs) is a general approach to the estimation of causal relations using observational data. The central idea is to use a third, 'instrumental' variable to extract variation in the variable of interest that is unrelated to these problems, and to use this variation to estimate its causal effect on an outcome measure. This part describes IV estimators, discusses the conditions for a valid instrument. Endogeneity, which occurs when there is a correlation between an independent variable and the error term, comes from three primary sources: omitted variables, model misspecification, and simultaneous causality (Bascle, 2008). It creates biased estimates in ordinary least squares (OLS) which might lead researchers to make incorrect causal inferences from data (Stock, 2001). When there is simultaneous causality, (Xi) and (ui) are correlated and OLS estimation picks up both forwards and backwards effects, thereby leading to biased and inconsistent coefficients. This implies that different sources of endogeneity will affect the regression, predicting the direction of the OLS estimates' bias. Thus, given our usage of observational data, as well as our quest to answer questions related to causality, we have considered the issue of endogeneity in our model and by using the instrumental variables methods as the suitable option to adequately address these sources of endogeneity. While the goal of instrumental variable estimation is to reduce or remove the bias resulting from unobserved differences in the industries, we should identify one or more variables, known as the instrumental variables or instruments that meet two requirements. First, the instrumental variables should be uncorrelated with the error of the equation. Secondly, instrumental variables are sufficiently correlated with the problematic explanatory variables that correlate with the error. Statistically, instrumental variable method can be used when the model has endogenous X's as we can identification is a concept in causal statistics for estimating the counterfactual effect of D on output Y controlling for covariates X using observational data. Even when measurements of (Y, D) are confounded, the effect can nonetheless be identified if an instrumental variable Z is available, which is independent of (Y, D) conditional on X and the unmeasured confounder. IV can thus be used to address the following important threats to internal validity as following:

1. Omitted variable bias from a variable that is correlated with X but is unobserved, so cannot be included in the regression
2. Errors-in-variables bias (X is measured with error)
3. Simultaneous causality bias (endogenous explanatory variables; X causes Y, Y causes X).

Therefore, instrumental variables can eliminate bias from these three sources: of reverse causality, selection bias, measurement error, or the presence of unmeasured confounding effects. In this estimation, the major cause of endogeneity is that foreign trade is usually changed by the manufacturing growth. This dual causality makes the error term correlated with the dependent variable, causing endogeneity $e_i \neq 0$. In order to overcome the issue, our approaches entailed instrumental-variable identification strategy.

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One relied on exports and imports data to identify the effect of trade on growth, which in turn correct for reverse causality bias. Hence, panel and instrumental variable methods are used to control industry heterogeneity and endogeneity as well as to correct the causality problem between manufacturing growth and foreign trade.

B. Properties of Instrumental Variables

Now that we understand what an instrument is, the next question is how to use it or how do instruments work? discusses the conditions for a valid instrument?

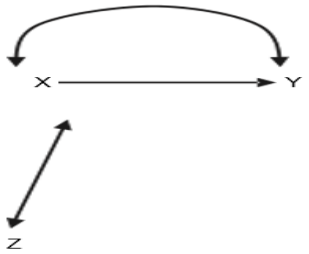
Although Instrumental variables seem to be well developed for panel data model as well as are suitable to deal with potential endogeneity problems in regressors, it is one of the most mystical concepts in causal inference. For some reason, most of the existing explanations are complicated and focus on specific nuanced aspects of generating IV estimates. Finding an appropriate instrumental variable of trade is a major problem for empirical studies of this nature as well as the difficulty of dealing with the issues of sectoral dynamics within the framework of analytical models. Furthermore, since this approach implies a well-developed theory and the methodological challenges, it perhaps requires a sustained program or body of research, which takes time and funding to develop and sustain in particular for industrial-level. Therefore, IV methods are becoming a hot topic in applied economic work.

C. Instrumental Variables Set Up

In this case, the assumption is the data required to estimate the causal links is missing. In the context of internal validity of a causal estimate, the objective in modeling a causal relationship between variable Y (output) and its causal antecedent X (e.g., exports), is to isolate the part of the association that is strictly the result of X acting on Y (i.e., having exports promoting output), and not the result of reverse causal effects (Y causing X; e.g., output obtain exports) or common correlates (a third variable z, which causes both X and Y).

Requirements for instruments z:

- z is correlated with the regressors x, (z predicts or causes x),
- z is uncorrelated with the error term u, (z is not endogenous),
- z is not a direct cause of the dependent variable y, (z is not in the y equation).



Source: Hernan and Robins (2006) Instruments for Causal Inference, Harvard School 677 Huntington Ave. 02115 Boston, MA

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To obtain this, we experimented with a number of specifications that included choosing between multiple proposed instruments (are direct correlated with X, and are correlated Y but do not cause the Y themselves) such as, domestic demand variable, trade openness variable and variable of output per capita. Where the domestic demand is calculated as the output minus exports plus imports i.e. [D = Y-X+M)]. Trade openness is the sum of imports (M) and exports (X) normalized by output (Y). The output per capita is calculated as industrial-level output divided by Saudi Arabi's population. However, the results are ambivalent. For some variables and the results are expected for others, they are the complete opposite.

D. Lagged Time

Major changes in the areas of foreign trade and industrial performance need time before their impact can be discerned. Such possibilities point to the need for incorporating a suitable lag structure in the econometric model specification to assess the impact of the foreign trade on industrial growth. Some authors (Brückner and Lederman, 2012[2]; Ferrarini,2010[3]; Alakayleh, 2014[4]) employ the lagged variables or earlier periods of variables as instrumented variable to estimate the IV regression, which will also be used in this study. These variables are used in lagged periods for two reasons, firstly, to avoid the endogeneity problem. Secondly, to ensure that each variable has started influencing the other, which the foreign trade needs time to affect the manufacturing growth, and vice versa. The regression is performed under the assumption that the one and two-year lagged values of the instrumented variables using the lagged value of the dependent variable (log of output) at time (t) in sub-industry (i). This solution is better suited for foreign trade, which can change rapidly in time.

After a certain time, lag is the time waiting for imports and exports. For example, the time necessary to comply with all procedures required to export goods. The waiting time between procedures, during unloading of the cargo is included in the measure as well as the time spent waiting for imports that often distributed after receipt it. Economic theory suggests that economic conditions affect the timing of foreign trade and their reversals (Bagwell and Staiger-2003). These predictions are supported by abundant empirical evidence Hummels (2001), Hausman et al. (2005), Evans and Harrigan (2005), Portugal-Perez and Wilson (2009), Djankov, Freund and Pham (2010), and Freund and Rocha (2010). Therefore, time has been found an important determinant of foreign trade.

While foreign trade composition import and export ratio affect output growth with a time lag, the using of lagged dependent variable based on many theoretical considerations as follows: 1- The lags required to achieve the effect of foreign trade on acquired domestic industries or the established foreign industries. One can assume that building a new plant and achieving a desired level of production takes time, Girma et al. (2007). In addition, to detect the relationship between foreign trade and manufacturing growth should allow for the presence of adjustment costs, since neither (exports/imports) nor industries react immediately. This conformed the importance of (time lag) after a period of time from the start the import or export. For example, the scientific may not impact imports in the product of the manufacturing sector right now, but after an appropriate period (six months or a

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year) sufficient access for imports to industrial installations and used in the production process. Moreover, some of the information becomes available only with a lag (needs time to be available), e.g., statistics, Bevan and Estrin (2004). Therefore, the time lag has made for one year in this estimation and this will capture clearly that the effect of trade on industrial-level output.

E. The IV Specification

In the IV specification, we include Yt-1 as an instrument to estimate the foreign trade effect of within-industry level growth. we interconnect these equations and include the lagged variables basing on the theory, which, states that foreign trade explain manufacturing growth, and vice versa; which means the trade and the industry learn from each other's; and to detect the relationship between them. The prediction method used to generate the instruments for trade in this regression depend on the lagged variables themselves regardless of whether the outcome measure is ordered or categorical (a time-series or industry-level dataset). The lag selection test not only applies to time series data, but also panel data. For example, we tested for the lag selection in this part automatically by putting y output for each industrial sub-sector (i) at time (t), then we obtained on possibility of model is well specified.

2. THE RESULTS OF OLS, FE AND IV TESTS

Findings of three models OLS, fixed effect, and fixed effect within instrumented variables IV, respectively are illustrated in Table 4.6.

Table 4.6: Impact of import and export on sub-sectors manufacturing industry

	Yearly		
Variable	**OLS (1)**	**FE (2)**	**FE-IV (3)**
Log labor	0.212 (0.000) ***	0.083 (0.000) ***	-0.176 (0.007) ***
Log capital	0.712 (0.000) ***	0.491 (0.000) ***	0.761 (0.000) ***
Log imports	- 0.327 (0.000) ***	0.191 (0.042) ***	-0.858 (0.000) ***
Log exports	0.299 (0.000) ***	0.135 (0.007) ***	1.052 (0.000) ***
Constant	7.576 (0.000) ***	2.818 (0.011) ***	8.183 (0.000) ***
Observation	414	414	391
R-squared	0.855	0.697	0.512

Note: *** denote statistically significant at the 1 per cent level

OLS regression shows that exports are positive and significantly associated with manufacturing growth. The coefficient of imports of foreign trade is negative, but not significantly at the conventional level. This result confirms that exports and imports have no homogenous effect on manufacturing growth. All other independent variables are compatible with growth theory in which they hold the same expected relationship with growth. Moreover, they are statistically significant. (As we will discuss in greater detail in next part of tech groups.

On the other hand, Table 4.6 column (2) fixed-effect regression shows that the main variables export and import became significant, the coefficients estimated for log exports

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on manufacturing growth and log imports growth are statistically significant and positive at 1%. The imports coefficient is 0.191 (0.042). The level effect is that 1% increases in import is associated with 19.1% increases in manufacturing growth. Meanwhile, the exports coefficient is 0.135 (0.007). The level effect is that 1% increases in exports is associated with 13.5% increases in manufacturing growth. The positive and significant coefficients imply that the foreign trade through exports and imports allow higher manufacturing.

The Table 4.6 column (3) fixed-effect regression within IV also shows that exports are positive and significantly associated with manufacturing growth. the coefficient estimated for log exports on manufacturing growth is statistically significant and positive at 1%. The coefficient is 1.052 (0.000). Although imports have statistically significant, it is negatively associated with growth in manufacturing. The coefficient is -0.858 and it is significant at 1%. While the results indicate that foreign trade promotes manufacturing growth, exports have a stronger effect than imports. This is due that as a part of the national transformation plan the Saudi government has established the "Saudi Export Program" under the umbrella of the Saudi Fund for Development, in order to develop national non-oil exports and encourage diversification, this program provides financial incentives and credit to exporters on the one hand, and on the other provides competitive credit terms for buyers abroad or for funding institutions working in this area. This program indirectly assisted the improvement of Saudi manufacturing product and export development.

Although imports have statistically significant, OLS and FE-IV generated negative results while FE generated positive results. This finding that the effect of imports is positive or negative in the growth of manufacturing industries according to economic theory, comes with several interpretations are behind this attitude: Negatively, imports displace or crowd out domestic production (Edwards and Jenkins 2013). Rising imports may cause local industries to lose market shares to imported goods, thus reducing growth and impacting negatively on manufacturing growth. second, Imports are frequently perceived to be a cost, while exports are generally considered a revenue (Van Berg et.al, 2018). Moreover, this finding reflects to essential fact which is the weakness of the combined contribution of intermediate materials to manufacturing productivity growth-those produced domestically and those imported from foreign sources.

Positively, imports on the contrary can improve manufacturing growth through within-industry and across-industry effects. Rising import forces industry to cut costs, and use inputs more efficiently in order to survive (Holmes and Schmitz, 2010). further, Imports can also improve local industry productivity through the technological effect mechanism, where local industry can learn or imitate imported more-advanced technological and knowledge products (Acharya and Keller 2009).

Similarity, the impact of imports in Saudi Arabia has no homogeneous effect on manufacturing growth, according to the circumstances of each of the industries stages and technology level groups that make effects vary across industries. For example, in mid-tech industries, the negative impact of imports is mainly due to the local economic availability some of industries and the country's lack of need for most of these products

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as inputs into the national industry in that period and thus lack of need for imports of the external market. This will be very clear when we discuss this with more details in impact imports of mid and low-tech Saudi industry in following section. Generally, these different effects could be due to the decline in oil revenues as one of the most important sources of financing imports during the time, such as the global financial crisis in 2008 and oil prices fluctuations crisis 2015. Therefore, the rate of growth of domestic industrial output significantly exceeded the growth rate of imports, which led to the low impact of imports in the growth of manufacturing industries in Saudi Arabia.

Concerning to the other determinants for growth, the labor log is negatively associated with growth in manufacturing. The coefficient is -0.176 and it is significant at 1%. The coefficient of log labor is -0.176, which implies that for each 1% increase in employment, manufacturing will decrease by 17.6%. This result shows that while labor have statistically significant, it is negatively associated with growth in manufacturing. This negative effect reflects the fact of that as the employee rate in a single project increase, the industry growth in that projects decreases. One explanation may be that the composition of the manufacturing sector shifted away from labor-intensive manufacturing industries to resource-based and capital-intensive sectors, especially between 2005 and 2010. Second, labor intensity within industries declined during the 2000s. This is because of new technology as well as a high capital is used which causes the low labor demand and employment. However, the national transformation program in the Kingdom of Saudi Arabia offers great opportunities for job creation and facilitates structural transformation and the threshold level of employment is frequently adjusted to a higher level.

The Saudi government also encourages manufacturing firms which have a developed industrial base, for example, the manufacturing industries and firms that make the greatest contribution to trade deficit reduction are also those that have the greatest potential to maintain or expand employment in Saudi Arabia such as, computers and electron, chemicals (including pharmaceuticals), transportation equipment (including aerospace and motor vehicles and parts), and machinery are especially important. These industries, in turn, would create jobs, higher competition among industries, competitive labor skills, economic growth, and higher productivity. From one year to the next, these rates will increase, allowing economic growth and growth in manufacturing to occur.

There is another variable that impact positively on manufacturing growth, such as log capital accumulation. The coefficient is significant at 1%. This coefficient is 0.761 (0.000). The level effect is that 1% increases in capital accumulation is associated with 76.1% increases in manufacturing growth.

This imply that higher capital accumulation in the manufacturing sector helps to raise productivity and facilitate overall growth and structural transformation as a part of Saudi national transformation plan. Furthermore, manufacturing industries tend to attract more capital accumulation that can accelerate the transformation from low-productivity to high-productivity activities. As a result, capital accumulation can be realized more easily in manufacturing compared with other sectors in Saudi economy.

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Again, all other determinants in FE regression show logical associations and importance toward manufacturing growth. On the other hand, the negative response of labor to manufacturing growth is an important empirical result: and implies that when estimating the within-industry effect that import-induced job losses are higher in the more capital-intensive medium and high technology industries. This reconfirms our finding that there is an approximately negative relationship between labor and growth in manufacturing.

Similar to the OLS regression results, the RE test reflects equivalent results for all parameters of the regression. Based on the Hausman test with the full set of control variables, Chi- squared statistics is 127.38 (p- value= 0.000) which means that the null hypotheses (that a random-effects model is appropriate) is rejected and the alternative (that fixed-effect IV regression is appropriate) is accepted. So, we decided to continue working with fixed effects in analyzing the effects through different industry classifications and then we compared fixed effects results and the basic OLS results. Additionally, the Fixed effects within IV results have, so far identical results with the ones obtained by OLS.

3. THE EFFECTS BY THE DEGREE OF TECHNOLOGY

A. Impact of Exports and Imports on High-Technology Industries

The Table 4.8 fixed-effect regression within IV for high-technology industries shows that the primary variables (exports and imports) are significant. The impact of exports on the growth of manufacturing output during the study period in the seven sub-industries is relatively strong. These sub-industries are 1- chemicals; 2-pharmaceuticals medicinal chemical and botanical products; 3- computer, electronic and optical products; 4-electrical equipment; 5- machinery and equipment; 6- motor vehicles, trailers and semi-trailers; and 7- other transport equipment. The coefficient is positive at 1.840 (0.000), with a statistical significance of 1%. The level effect is that a 1% increase in exports is associated with a 1.840% increase in manufacturing growth.

This is largely due to government encouragement of export industries, through various financial incentives and supportive national policies in line with the national transformation program intended to reduce the economy’s oil dependency. At the heart of this drive, highly technological which used and diversification into non-oil-based industries. For example, the chemical industry achieved the highest manufacturing export value, with 58% of total non-oil exports. The Saudi chemical market is today one of the fastest growing markets, with strong export potential in MENA and the region as a whole. Specifically, the most of chemical products has been occupying the leading position of manufacturing industries composition, such as construction chemicals, natural gas treatment chemicals, lube oil additives, medical and pharma related products, personal care products, human and animal nutrition additive. Moreover, increase exports of Saudi Arabia’s this group industries might be attributed to the kingdom's economic and strategic importance to the industrialized world as a pioneering power in the region. The significant rise comes with the Saudi Arabia's accession to the WTO in 2005 and G20 member country 2008. The production of tech-high industries grew substantially in Saudi Arabia which is driven by ease of transportation to Europe, Africa, India, GCC countries and

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other export markets. Therefore, provided a great opportunity to develop and competition and thus will strengthen the kingdom position as a foreign trade hub.

Table 4.7: Impact of import and export on high technology sub-sectors manufacturing

	High Technology	
Variable	**FE**	**FE-IV**
Log Labor	-0.025 (0.366) ***	-0.166 (0.081) ***
Log capital	0.767 (0.000) ***	0.245 (0.473) ***
Log imports	0.503 (0.005) ***	0.859 (0.004) ***
Log exports	0.106 (0.315) ***	1.840 (0.000) ***
Constant	-5.552 (0.015) ***	-4.842 (0.404) ***
Observation	126	119
R-squared	0.817	0.214

Note: *** denote statistically significant at the 1 per cent level

Dependent variable: Output levels by sub-industries

On the other hand, imports in the high-tech group played a key role in industrial growth. The estimated coefficient of log imports and manufacturing growth for high-technology industries is statistically significant and positive at 1%. The coefficient is 0.859 (0.004). The level effect is that a 1% increase in imports is associated with an 85.9% increase in manufacturing growth. The positive and significant import coefficient indicates that the high-technology industries experienced greater manufacturing growth than others due to technology transfer through imports of the intermediate and capital goods used in the industrial processes.

These results align with those of the analysis; namely that, for many reasons, the country depends entirely on imports of products in these industries. First, there is strong and growing local and regional demand for these products due to increasing population growth and high levels of income due to increased oil revenue[5], such as, products of electrical, machinery, transport and medical equipment, machines and equipment industry ,office and accounting terminals as well as computers electric machines and terminals, radio, TV and telecommunication equipment and terminals medical terminals, optic tools and all types of engines, trailer motors and transportation equipment. Although industrial output increased in absolute terms, its contribution to meeting local need was low because the rates of increase were not consistent with increases in domestic consumption as well as the local supply of these industries was limited, thus encouraging imports.

One explanation may be that the manufacturing base remained weak in these high-tech industries due to a failure to develop productive forces and the imbalance of the sectoral structure of industrial production. However, increasing imports of these intermediate goods and some capital goods led to manufacturing growth through transfer technology by imports, as one of the most important channels to carry technology. In other words, technology can be generated are linked to imports of intermediate products and capital

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equipment embodying foreign knowledge. As rates of import increase, participation in global production networks facilitates technology transfers. Technology transfers, in turn, typically lead to increased productivity and growth, as well as an increase in demand for domestic inputs.

For instance, through various financial incentives and a supportive national policy, the government encouraged industrial joint ventures in high technology. Several major projects have been implemented. In the eastern province, Isuzu Motors began operations in late 2012, aiming for an annual capacity of 25,000 trucks by 2022 and 40% export of production at peak volumes. In this context, Saudi Aramco, the National Shipping Company of Saudi Arabia (Bahri) and Hyundai Heavy Industries (HHI) are signing of an agreement to jointly create, develop manufacture ships and giant tankers on the eastern coast of Saudi Arabia.

Today, Bahri has a fleet of 90 vessels, of which 43 are Very Large Crude Carriers (VLCCs). This makes Bahri the world's largest owner and operator of VLCCs, with a total of 11.6m of deadweight tonnage (DWT). Therefore, foreign trade has assisted to build Saudi's local industrial capabilities which led rebound this sector, in particular between both of South Korea, the world's largest shipbuilding nation, and Saudi Arabia, the world's largest oil-exporting nation.

With increased imports, technological know-how and developing productive capabilities, the vehicles[6] industry has undergone a major diversification, from basic to sophisticated products. For example, it could turn its focus to the worldwide tire industry. The Gulf Cooperation Council (GCC)[7] is one of the fastest growing tire markets, at approximately 6% CAGR, and it is forecasted to reach annual sales of 41 million by 2022. A tire plant in Saudi Arabia would be the first in the region, gaining competitive access to the GCC, GAFTA, and Near East and African markets.

In summary, the imports evidently had a larger and more significant for high-tech industries, indicating that foreign trade facilitates imports of capital and intermediate goods embodying superior technology, which helps to reduce costs and increase manufacturing growth in the sectors that use these products.

This is due to the fact that Saudi Arabia as developing countries is mostly capital and investment goods importers while developed countries are capital exporters. The import evidently promotes technology transfer and indigenization, upgrade the technological capacity of local industry, aids export development, strengthens commercial relations, and represents an essential component in achieving the objectives of national transformation then overall economic development.

For example, if enough industrial capabilities are in place, the technology can be a powerful driver of industrial development through the imports in order to take advantage of the technical development of products and to improve production, thereby enhancing the competitiveness of local products in foreign markets. Hence, foreign trade is critical for manufacturing growth then achieve to long-term prosperity, particularly through imports to transfer technological progress and developing productive capabilities.

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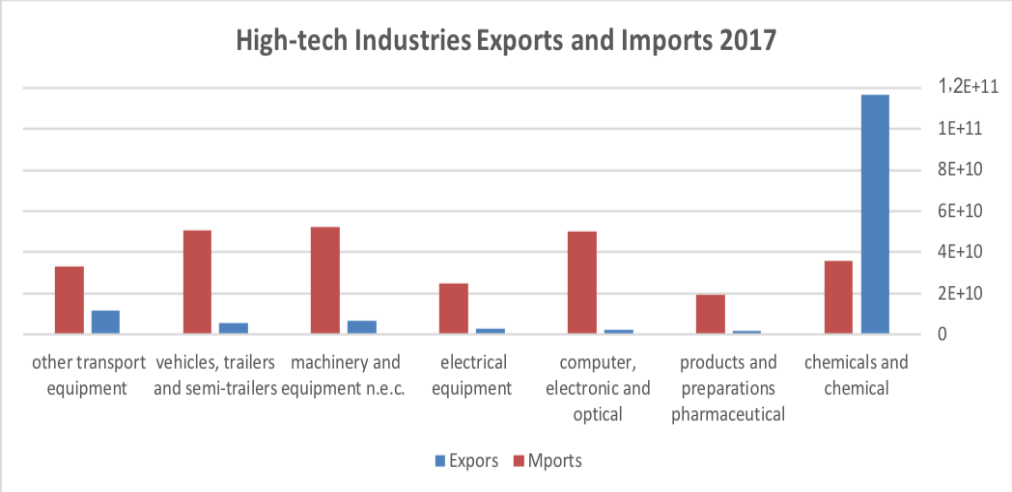

Figure 4.1: High-tech industries for foreign trade in Saudi manufacturing 2017

Source: Author's Based on General Organization for Statistics (GaStar) 2017

B. Impact of Exports and Imports on Mid-Technology Industries

The Table 4.9 fixed-effect regression within IV for mid-technology industries shows that exports had a strong impact on the growth of manufacturing output in five sub-industries in Saudi Arabia, playing a key role in industrial growth. The coefficient is 0.549 (0.000) and significant, at 1%. The level effect is that a 1% increase in exports is associated with a 55% increase in manufacturing growth. The positive and significant export coefficient indicates that the medium-technology industries experienced greater manufacturing growth than others due to a strong impact of oil-related industries, which have substantial comparative advantages. These industries are petrochemical and coal, base metals, rubber and plastic products, fabricated metal products, and other non-metallic mineral products. The industrialization of the energy-intensive was encouraged, as it has a significant cost advantage due to the large reserves of oil and natural gas in Saudi Arabia.

This mainly reason, the effective support for the competitiveness linked by the availability of natural resources and basic industries which led to industries with added value that have potential for developing and competing with foreign rivals. Where the state has an advantage in access to the raw material of a commodity, this lowers costs by increasing availability, which leads to a growth in exports and a global increase in competition. Petrochemical, plastic, and rubber products, for example, have seen great success in international markets, gaining a positive image of the Saudi products for their quality and price. This sector represents 58% of the total non-oil export value, with sales estimated to reach 100 million tons by 2022. The petrochemical sector in Saudi Arabia is set to become the dominant player in the region by 2030.

To achieve this, the Saudi's government encourages manufacturing firms to export or find new industries that benefit from the availability of capital-intensive raw materials, enjoy low-cost infrastructure (electricity, telecoms, water, and transportation), have a developed

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industrial base, and offer quality products and internationally competitive prices. These elements assist the government in its policy of export-oriented industrialization. For example, the SABIC[8] company has specialized and obtained concession from the state to provide raw materials to companies in the petrochemical and plastics industries. This has assisted Saudi product manufacturing and export development, thus making the manufacturing industry more competitive in the area of domestic extractive exports.

On the other hand, there was an opportunity to explore some of modern industries of high value added, such as precious metals (Gold and Silver), base metals (Iron, Copper and Zinc), and other industrial minerals such as Kaolin, Gypsum, Limestone, Silica, Feldspar, and other minerals like Phosphate and Bauxite. Saudi Arabia explore a modern industry due to expand mining activities increasing the production of primary, intermediate and downstream metallurgical products for both local and export markets. more especially for emerging industries such as base metals sector comes second as exports represent 39% of the total non-oil export value.

In 2014, established a largest fully integrated aluminum complex globally in the eastern region of Saudi Arabia which is a Joint Venture between Ma'aden[9] and Alcoa[10], has an annual production capacity of (760)[11] thousand tons and include bauxite mining, alumina production, production of primary aluminum.

Moreover, during the past few years, geological studies indicated the availability of large tantalum, Niobium and Rare Earth prospects in the Kingdom which led to increasing exports of metal industry and thus exports of mid-tech industry.

As a result, exports contribute more than imports to medium-technology industries in in Saudi Arabia. This result aligns with the findings of the analysis. Since most exports are manufactured products that depend on oil and gas, it is reasonable to conclude that the health of the Saudi Arabia manufacturing sector depends, to a significant extent, on the advantages that makes the country a welcoming home and efficient springboard for energy-intensive industries, such as minerals, metal processing, plastic, rubber, and petrochemicals.

Table 4.9: Impact of import and export on middle technology sub-sectors manufacturing

	Middle Technology	
Variable	FE	FE-IV
Log Labor	0.083 (0.000) ***	0.113 (0.000) ***
Log capital	0.657 (0.000) ***	0.377 (0.000) ***
Log imports	0.204 (0.000) ***	0.021 (0.521) ***
Log exports	-0.115 (0.080) ***	0.549 (0.000) ***
Constant	7.138 (0.000) ***	-1.213 (0.000) ***
Observation	90	85
R-squared	0.877	0.828

Note: *** denote statistically significant at the 1 per cent level

Dependent variable: Output levels by sub-industries

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By contrast, the impact of imports on the growth of the mid-tech industries is positive but statistically insignificant. This is unsurprising because it is consistent with the results presented in Chapter 3, obtained from the aggregate analysis of the total manufacturing sector in Saudi. The coefficient is significant, at 1%, and 0.021 (0.521).

The level effect is that a 1% increase in imports is associated with a 2.1% increase in manufacturing growth. This implies a weak correlation between the growth rates of manufacturing and imports in this group of industries.

This is primarily due to the local economic availability of these industries and the lack of need for most of these products as inputs in national industry during that period and thus lack of need for imports of the external market of these industries such as petrochemical, plastic and rubber and basic metals. As a result, there is self-sufficiency in these industries productions are available throughout the year. In fact, Saudi Arabia's product industry has a contains important sectors with a medium to high-tech intensity, such as chemicals, equipment, rubber and plastics. An expanding manufacturing sector in Saudi Arabia would be beneficial to generate technological progress.

Building up local capabilities allows the manufacturing sector to take advantage of many opportunities for technological progress Industrial upgrading is associated with the production of higher value-added activities which depend on high tech, increasingly requires local tech capabilities. Therefore, the manufacturing sector has a large potential for technological progress and industrial upgrading.

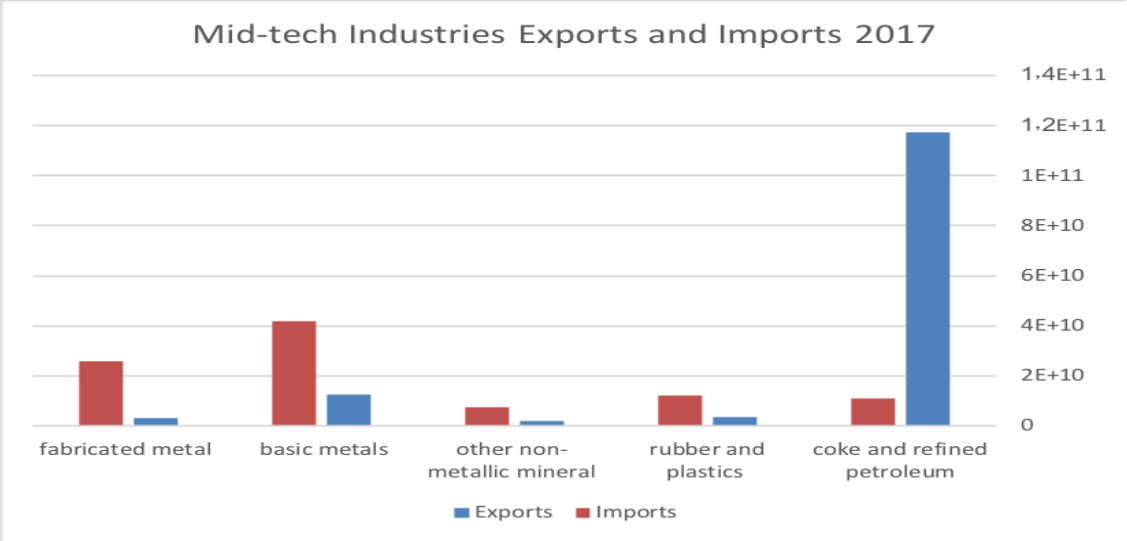

Figure 4.2: Mid-tech industries for foreign trade in Saudi manufacturing 2017

Source: Author's Based on General Organization for Statistics (GaStar) 2017

C. Impact of Exports and Imports on Low-Technology Industries

The Table 4.10 fixed-effect regression within IV for low technology industries shows that the primary variables (exports and imports) are significant for the 11 sub-industries in this

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group. These sub-industries are 1- food; 2- beverages; 3- tobacco; 4- textiles; 5-Wearing; 6-apparel; 7- leather; 8- wood; 9- paper printing and reproduction of recorded media; 10- furniture, and 11- other manufacturing. Growth rates of exports are positive and statistically significant. The coefficient is significant at 1% and 4.150 (0.020). The level effect is that a 1% increase in exports is associated with a 4.150% increase in manufacturing growth.

For instance, food substances accounted for up to 8.3% of the total non-oil export value, with growth that was 9% higher than that of the previous year. The positive effect of exports in this group may be attributed to the importance of these industries for meeting countries' basic requirements, as well as the simplicity of their technologies, except the printing and recorded media.[12] Indeed, Saudi Arabia's product industry also has a comparative advantage in low-tech intensity sectors, such as food. This is due to large exports of dates, dairy, and seafood products. For example, the Arabian Gulf Sea is rich in fish, leading to further seafood-industry growth as well as development efforts being undertaken by Ministry of Environment Water and Agriculture. In addition, the country has developed expertise in the dairy industry over many years, giving a strong competitive advantage. With many years of experience in the sector, Almarai was ranked by Forbes in 2019 as among the world's best regarded companies, coming sixth among food businesses.

Table 4.10: Impact of import and export on low technology sub-sectors manufacturing

	Low Technology	
Variable	**FE**	**FE-IV**
Log Labor	0.525 (0.001) ***	-2.003 (0.136) ***
Log capital	0.708 (0.000) ***	1.596 (0.000) ***
Log imports	-0.217 (0.155) ***	-4.067 (0.0026) ***
Log exports	0.013 (0.862) ***	4.150 (0.020) ***
Constant	10.265 (0.000) ***	31.750 (0.020) ***
Observation	198	187
R-squared	0.836	0.855

Note: *** denote statistically significant at the 1 per cent level

Dependent variable: Output levels by sub-industries

Although imports are statistically significant, they are negatively associated with manufacturing growth. The coefficient is significant at 1% and -4.067 (0.0026). The level effect is that a 1% increase in imports is associated with a -4.067% decrease in manufacturing growth. The negative import coefficient indicates an inverse relationship between the growth rates of manufacturing and imports in this group. This is largely due to the high cost of imported inputs for use in production. Thus, the growth rate for domestic industrial output significantly exceeded that of imports, hence the low impact of low-tech imports on manufacturing industry growth in Saudi Arabia.

Since industry success depends on the ability to obtain imported inputs at low prices, this group of industries in Saudi suffered due to the high costs of both imported raw materials

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and foreign workers. This particularly affected the wood and textile industries. The weakest export performance was reported for textiles and wood, making up 7.2% of the total non-oil export value and amounting to a decrease of 2.8% for the period of 2000-2017 in both sectors. Saudi Arabia imports wood and cotton in large quantities because its climatic nature means there are no forests and very few trees. Similarly, in the textile industry, the country depends on foreign labor[13], which increases the foreign labor intensity in low-tech industries increase, which causes high costs relative to industrial output. When rates of imports increase, this creates demand for imported raw materials and foreign labor to facilitate the production process, which increases the cost of output and thus restricts growth.

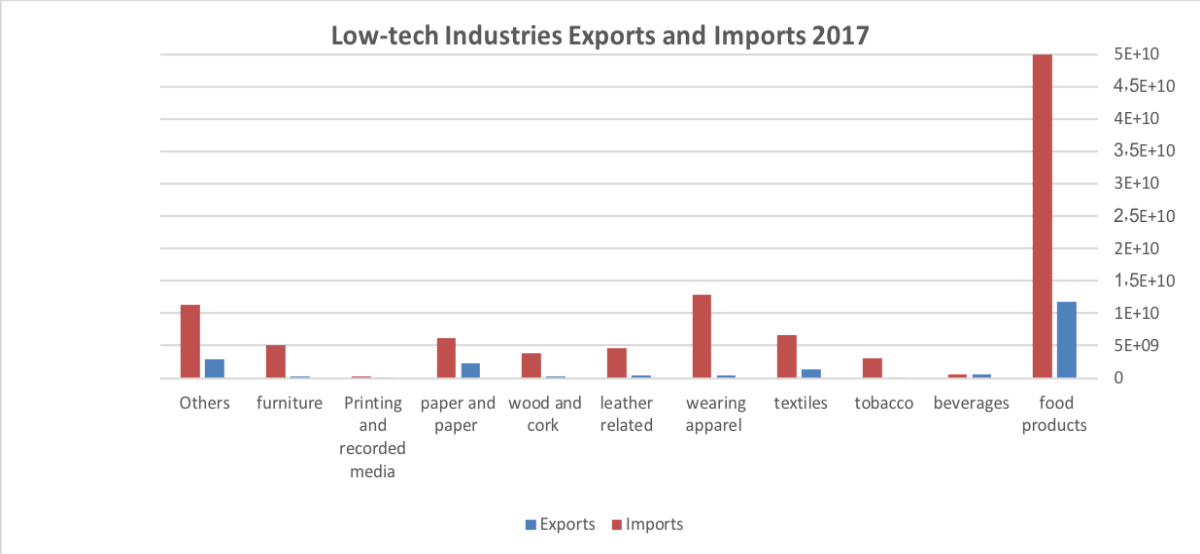

Figure 4.3: Low-tech industries for foreign trade in Saudi manufacturing 2017

Source: Author's Based on General Organization for Statistics (GaStar) 2017

4. JUSTIFICATIONS FOR THE VARIOUS EFFECTS ACROSS INDUSTRIES

The divergent growth paths between sub-industries indicate that within difference effects have to be considered by the different inputs that industries need in production process. As we observed that industries have different productive capabilities, thereby implying that different dimensions of foreign trade may have divergent effects on growth. Clearly, these analyses also depend critically on the level of sector or industry detail used which should be interpreted with care[14].

Since the effects significantly vary across industries depending on the sector itself, and foreign trade composition (import and export), and thus were importantly determined by the level-technology of the industry. We used our calibrated model to perform a variety of counter factual exercises including of the aggregate and disaggregate effects of trade to manufacturing growth. The specific episodes we studied include the boom in Saudi Arabia

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mid- tech industry associated with the oil/ gas, the increase imports of high- tech industries during the study period as well as the effect of the low - tech industries.

The discussion of causality on the empirical specification had been made in Dao (2014) and Mazen (2015) which is derived from Esfahani (1991) which proves the method and the problem. This framework assumed that trade theory actually points to various channels through which foreign trade can affect manufacturing growth, although there is no clear-cut answer as to whether the effect on manufacturing growth should be always positive, or as to whether there should be a clear cause-effect relationship between foreign trade and manufacturing growth (either in tech-levels or in total growth rates). These channels include growth of production inputs, access to better and cheaper technology and exports effects.

As mentioned in the hypotheses section, industries that industries that involved with foreign trade can have exposure to foreign technology and may learn about the newest and best production techniques through imports. the growth in industrial output depends on the growth of production inputs (capital, labor, intermediate goods used in production). Industries that export their production have access to other, by providing the material resources necessary to improve the quality which may allow these industries to produce at a more efficient as a result of exposure to international competition and effect on export promotion.

Although the available empirical evidence on the impact of trade on growth of the industrial sectors is far from unambiguous, our review for levels of technology industries showed either a positive or negative effect. It is interesting to note that the positive exports had high effect in all technology levels within 23 sub- industries (high-tech, mid-tech and low-tech) during study time. The manufacturing had enjoyed a fairly robust recovery, exports have been a key factor fueling this strong recovery in sub- sectors manufacturing. Particularly, some evidence has suggested that increasing exports in mid-tech industries which related to oil and gas.

Similarly, exports have also increase in high-tech. Low-tech industries also points towards a significant role of exports and therefore the presence of a positive association between trade and manufacturing growth. These results are consistent with the economic logic of the export promotion hypothesis. Accordingly, many policymakers have advanced the idea that exports are one of the best mechanisms for promoting industrialization in Saudi Arabia.

Contrarily, high impact of imports is just in single industrial group which high technology-dependent that have high domestic demand such as automobiles, construction equipment, airplanes, electrical appliances and medicine or pharmaceutical industries. This evidence indicates that manufacturing growth might be occurs through the enhancement of technology that is mainly made by imports in industrial development process. At the same time, the analysis highlights that technology transfer varies importantly across industries and sub sectors as well as provides empirical support for the positive role of high- tech industries import in boosting manufacturing output.

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These results are consistent with the reality of the manufacturing sector in Saudi Arabia, which is influenced by an imbalance in the productive structure of the industrial sector. For low-tech and mid-tech groups, we however find mixed evidence while low-tech industries are the only group where the impact of imports turns out to be negative.

While the source for divergent effects lies in the differences in technologies or industrial productive capabilities, the main challenge for Saudi Arabia is to find a way to deliberately change or develop those capabilities related to two factors: The first is focusing on improving foreign trade and the kingdom's competitiveness (promote industries that comparative advantage).

The second is related to the challenges across sub-sectors, such as the importance and value of each sector or productive capabilities and its value added that would ultimately determine leading and promising industries (promote infant industries which boomed and foreign trade dependent industries). Selecting these industries that are expected to grow exponentially depends on identifying and developing certain industries according to specific criteria.

Consequently, Saudi Arabia should take comparative advantages hold taken seriously, by using industrial policy which assist to promote industries that have comparative advantage. This could still be a useful guide for industrial policy makers in figuring out what is the Saudi's current comparative advantage not only in the factors of production that it may have someday, but also in the factors of production that it has now. The theory of comparative advantage is like a compass, it is useful in being able to tell you where you are at the moment, but it does not tell you where to go or how to get there.

For example, when a country tries to develop a number of comparative-advantage, the bulk of its export earnings and jobs have to come from comparative advantage conforming industries, so industrial policy makers need to take those industries seriously. In Saudi, export earned provide the bulk of the foreign exchanges with which to buy advanced technologies.

The notion of comparative advantage was first systematically developed by the Classical economist, David Ricardo. However, the Classical version of the theory of comparative advantage is very different from the modern neoclassical version, known as the HOS (Heckscher-Ohlin-Samuelson).

Further, we emphasize that measures to promote manufacturing growth should not only be focused on comparative advantage industries, yet also should encourage the promising or infant industries. Today, the majority developed countries use the theory of infant industry promotion to develop their economies. They refused to accept that they should stick to their comparative advantage and actively promoted industries in which they had no business of specializing (according to the theory of comparative advantage).

This implies that if the new industry’s technological requirements and factor requirements are very different from those used for the industries in which the country currently has comparative advantage, the gains from succeeding will be large. This is in line with the

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modified neoclassical theory of comparative advantage, developed by Lin (2012) and others. They have suggested that developing countries should not follow their current comparative advantages but should anticipate their future comparative advantage by deliberately developing industries that have comparative advantages in other countries that are more developed themselves.

For both leading and promising industries, the growing-up process requires that government and private sector efforts through increase productive capabilities by imports physical equipment, worker training, the development of management skills, R&D, and so on and public policy intervention especially industrial policy to improve physical infrastructure or reducing supports for industries that are not delivering growth.

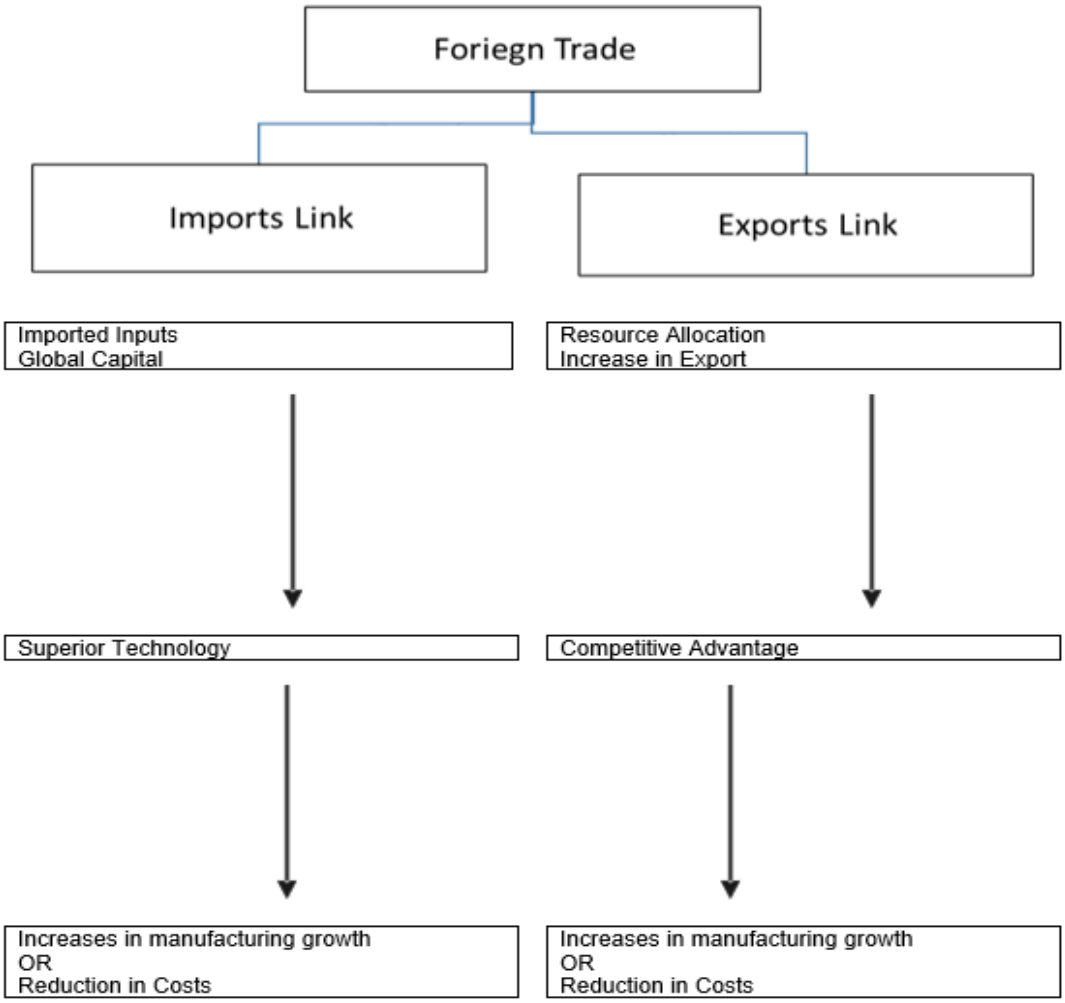

Figure 4.4: Foreign trade and manufacturing growth: Theoretical Links

Source: Author's Based on foreign trade theories, and the economic views that emphasize on importance of the role of exports & imports in the economies of developing countries.

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5. SUMMING UP

In the light of the findings of this study, we strongly recommend that the Saudi Arabia's government to continue subsidizing to priority manufacturing sectors to achieve inclusive development of the industrial sector in several ways. First, adopting vigorous growth policy to stimulate the manufactured exports by focusing on a diversified portfolio of sectors that are based on a sustainable competitive advantage and leveraging natural resources by expanding oil and gas related industries and exploiting of basic locally produced materials or product. For example, the export policies in the petrochemical, mining, plastic and chemicals sectors will enable a faster development in the country's economy. Simultaneously, those industries that support the national goals identified in the National Transformation program are also itself that have the greatest potential to maintain or expand employment in the Saudi Arabia.

Second, promoting promising and competitive industries and increasing their share of the GDP and job market. Selecting these industries depends on the level of technology within the Saudi's fields of high demand. For instance, is the only country among the top 20 (with the highest demand on vehicles) which does not have a regional production center. Moreover, there is a great opportunity in the Kingdom to localize medical supplies given its great dependence on imports (90%). Thus, must leveraging of high-tech level on those sub-sectors as well as must leveraging of fast growing local and regional demand on those industries, pharmaceutical, equipment and machinery, medical supplies and automotive industries. Hence, if aim from foreign trade is transferring technologies to Saudi Arabia, the import of capital and intermediate goods which embody superior technology will success which will help to define and fund new industries in specific technology sectors ensuring sustainable manufacturing growth.

Foot Notes

1) The first specification of the equations is mentioned in the previous chapter Ch#3.
2) (Brückner and Lederman: 2012) Trade Causes Growth the World Bank Paper.
3) (Ferrarini,2010) Trade and Income in Asia: Panel Data Evidence from Instrumental Variable Regression Benno No. 234 | November 2010 ADB Economics, Working Paper Series.
4) (Alakayleh: 2014) Impact of trade openness on economic growth in a small, open, and developing economy: new instrumental variables for trade openness Article (PDF Available) in International Journal of Sustainable Economy 6(2):142 - 170.
5) Saudi Arabia's population of around 30 million and is increasing by 2.3% a year. The number of households is rising by 3.7% a year. KSA's consumers are relatively affluent, having an GDP per capita of $24,252. The country's GDP is rising by 5% - 6% a year, much faster than in Europe and North America.
6) Vehicles include wagons, bicycles, motor vehicles (motorcycles, cars, trucks, buses), railed vehicles (trains, trams), watercraft (ships, boats), amphibious vehicles (screw-propelled vehicle, hovercraft), aircraft (airplanes, helicopters) and spacecraft.
7) (GCC) is a regional intergovernmental political and economic union consisting of six Arab states which includes Saudi Arabia, Bahrain, Kuwait, Oman, Qatar and the United Arab Emirates.

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8) SABIC (Saudi Basic Industries Corporation) is a Saudi multinational chemical manufacturing company which is a subsidiary of Saudi Aramco. In 2017, SABIC was ranked fourth in the world among chemical companies by Fortune Global 500. By the end of 2018 SABIC was the world's 281th-largest corporation.

9) Saudi Arabian Mining Co is a diversified mining company, active in gold, base metals, mining and infrastructure industry, it is the largest mining company in Saudi Arabia.

10) Alcoa Corporation is an American industrial corporation. It is the world's eighth largest producer of aluminum, with corporate headquarters in Pittsburgh, Pennsylvania.

11) The Industrial Clusters and the Saudi Geological Survey Report 2016, the Ministry of Petroleum & Mineral Resources.

12) This could be due to the movie industry and digital recording which rely on new technologies.

13) Foreign labor account for about a third of Saudi Arabia’s 33m population and more than 80 per cent of the private sector workforce. https://www.stats.gov.sa.

14) The level of detail in this study is in between micro (industry -level) analysis and macro analysis of growth. A drawback of this approach is that we may still miss out on important dynamics within sectors.

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