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ECONOMETRIC STUDIES OF FOOD DEPENDENCY IN SOME DEVELOPING OIL-EXPORTING COUNTRIES.

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Introduction

According to the prevailing opinion, natural resources in general and oil in particular, are a curse rather than a blessing. The growing literature on the "curse of resources" and the "paradox of plenty" (Karl, 1997) has generated significant causal claims that link the abundance of resources with dependence on corruption, authoritarianism, economic decline and violent conflicts. It has often argued that oil-dependent states today are the most unstable economically, the most authoritarian, and the most tormented by conflicts (Gary & Karl, 2003). Realistically, oil is not the curse but the "oil bad management" or "oil misused" is the curse in the developing oil wealth countries, paradoxically can see a good example of "oil control" in developed countries as Norway and Chile. The developing oil wealth countries are suffering the two curses, internal curse referring to the bad management with no capital transparency and the external evil relating to violent war.

Kevin Tsui observed how developing oil-rich regimes neglect the non-oil industry and tend not to undertake necessary institutional enhancements and economic reforms. Consequently, these systems tend to have stagnant economies and are particularly vulnerable to price fluctuations of oil products. These structural problems are exacerbated by the high rates of population growth across the world, as well as by persistent corruption and clientelism that accompanying the oil-financed patronage. The presence of these economic trends is essential when evaluating the connection between oil wealth and the regime stability. Given the carelessness towards industries such as agriculture, Oil-rich governments are forced to allocate more and more resources to the aid of expensive increasingly food imports, thereby limiting their ability to finance mechanisms of stabilization of social spending and repression. Besides the lack of economic growth can force the population to rapid growth dealing with the growth of unemployment and poverty. Which therefore form the basis for the widespread discontent and mobilization anti-regime potentially destabilizing. Can it be considered surprising that, during the Arab Spring, socio-economic complaints were the heart of many

anti-regime protests? For sure, in the Arab Spring states where these kinds of problems more pronounced, The protests built entirely around issues such as poverty and unemployment. Thus, the socioeconomic roots of many Arab Spring protests indicate that oil wealth can lead to the instability of the regimes, creating long-term economic problems that lead to popular mobilizations (Tsui, 2011). Another long-term socio-economic challenge for oil-rich regimes is the unemployment of the most educated population. When in the 1960's and 70's of the last century, the revenues generated by the oil were booming, Arab regimes expanded their citizen's access to education as part of their oil-financed social expenditure. However, in many of these states, the lack of economic growth caused the inability to find work or the underemployment for these educated professionals. This dynamic is a cause of dissatisfaction among the educated population, which moved by the non-coincidence of its socio-economic ambitions with the economic reality in which brought the demand for political changes. This dynamic shows clearly that scholars, jurists, and other professionals play a fundamental role in launching and supporting anti-regime political mobilizations. The majority of oil-rich countries is depending on oil revenue sector and also depending to the importation of many domestic goods like food, this critical situation permit to these kinds of countries covering their hard dependency of importation by oil revenues. The largest addiction shows entirely in the agri-food sector imports, nevertheless; many developing oil-wealth countries don't investing sufficiently in agricultural areas as one of the important industry because, without an integrated national economy, there can be not sustainable food security or sovereignty. The challenge that how can improve the capacity of food production in the society that increases exponentially, and how can convince the private sector and foreign direct investment to investing in agriculture as a complicated industry. Particularly, in an arid, semi-arid and desert area that suffering economic water scarcity, low rainfall, and high temperature.

Economically, in the petro-states, the finance of project depends directly on oil revenues means the volatility of oil price has a direct and close impact on agricultural investment as

well as logistically, these countries need more agricultural technology, machinery, and more skilled labor in which usually are taken by developed countries. The developing oil-rich countries possess the two dependencies compared to other world countries; one is positive regarding the petrodollars budget wealth and another negative related to the great goods import dependence, particularly, the agri-food. The question that can pose; witch future of food without oil revenues in the oil-exporting state? Another challenge of these countries is the agricultural land availability.

The problem of food scarcities not just in the developing countries but all the world where the population could be around 9 billion by 2060 and how can feed the two extra billion (Bailey 2012). In 2009, according to the FAO estimation, 70% more food in 2050 will be needed. In the same time, the international food prices are rising continuously. Additionally, some exporter countries as China and India continue the reduction of its exportation product like wheat, corn, and rice for secure the high local demands. The food scarcity usually, influences the developing countries that can see about 785 million of their people undernourishment (FAO 2015), where the developing countries represent 82% of world population (United Nation, 2013). The agricultural industry needs more investment in the sector for securing the food sovereignty of the nations. The FAO administration seeking to promote food production and security. Especially, in some countries where some crops threatened by the climate change.

This study permits to explain “the resource curse” in some developing oil exporting countries that possessing the macroeconomic similarity regarding the oil dependency, and the identical environmental conditions in which these countries are; Qatar, United Arab Emirates, Saudi Arabia, Angola, Nigeria, and Algeria.

1. Oil export dependence analysis:

The petrodollar states more dependent on hydrocarbons revenues rather than other sectors where suffering no-economic diversity in which no-oil industry scant. The Oil-GDP variate between 50 to 90% in these countries. This dependency is a curse for the economic development that invests in other sectors depending highly to oil revenues where the challenge how can funding the projects in the era of continuous oil price volatility and how can protect the budget balance in the long term period or the era of oil scarcity.

1.1. The paradox of oil dependency in the developing oil-exporting countries.

The undeveloped petrodollars state budget is heavily dependent on the fluctuations of the hydrocarbons price. In fact, changes in the oil price cause fluctuations in national GDP in which these states most dependent to oil export for formation of their GDP. In parallel, dependent to importation per secure their domestic consumption of industrial, technological and agri-food products. The rentier states suffering economic stagnation in many sectors where the oil dependency destabilized the macroeconomic budget and discourage investment in no-oil industry, in the same time the economic balance depending to boom and busts of oil price. From one hand the oil-wealth countries exempt their citizens from taxes and subsiding many domestic products, and in another hand, the oil encourage a civil war such as in Angola and Nigeria (Basedau & Lay, 2009) and invasions such as Iraq and Libya, means no peace in developing oil-producing countries. These violent situation block foreign investment, promote ethnic tension and create more dictatorial and military regimes. Today the majority of these economies are in crisis either political or economic. About this critical reality, the founder of the OPEC Juan Perez Pablo Alfonso said *"I call petroleum the devil's excrement. It brings trouble, waste, corruption, consumption, our public services fall apart, and debt - a debt we shall have for years."* (The Economist, 2003). Wherever, could see the corruption in these

countries where one of the largest oil-producing countries is the most corrupted in the world as Nigeria (Karl, 1999). The oil could be the obstacle of development and why the developing oil wealth economies suffering slow growth, despite possessing sufficient wealth to investing profitably in all economic sectors. The negative correlation between natural resources especially hydrocarbon and economic development confirmed by many lecturers. Therefore, the economic stagnation is the major problem. Many economic studies observed that the majority of oil-exporting countries suffers the less democracy, institution deficiency, bureaucracy and chronic political system since the oil discovery. At the same time, the no-oil producing countries are more democratic rather than some oil-wealth countries. The oil considered as significant wealthy resources but will be a hell for their country if not well managed correctly, in parallel the natural resources lead to poverty more than development. The economic growth linked to natural resources where the economy of developing oil wealth countries growth slowly than no-natural resources countries (Okpanachi, 2011). The oil wealth counties don't look to invest in other sectors regardless petroleum sectors like tourism, services, infrastructure, and agriculture. In reality, there is a modest investment but not sufficient and efficient regarding its wealth capacities. Eventually, these countries become the most unstable, growing slower and performed worse rather than those without natural resources. The dependency to oil-wealth losing the spirit of action, competitiveness and strategic planning.

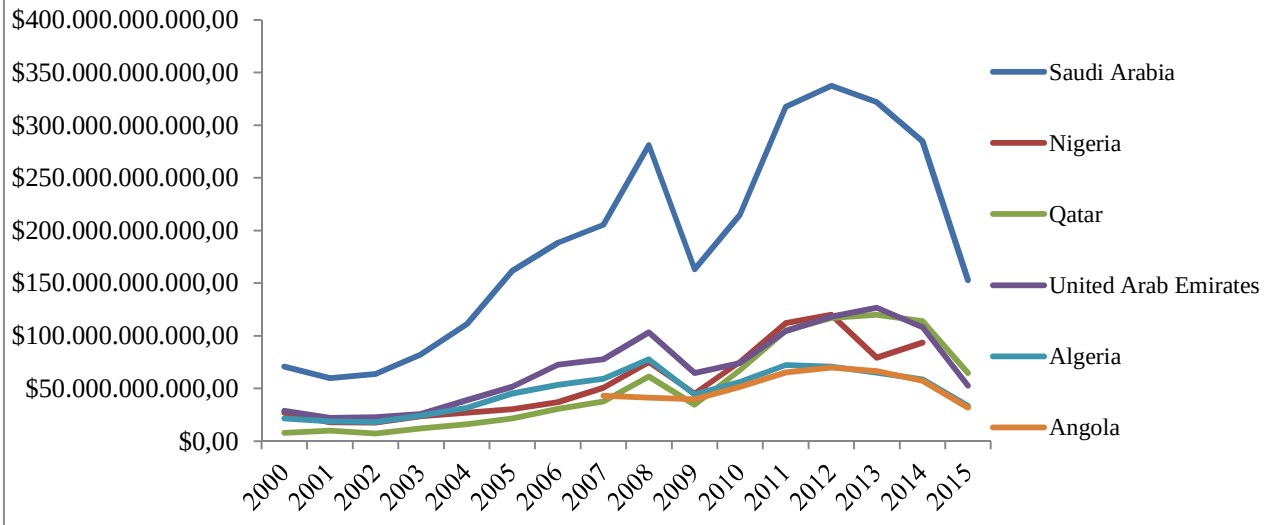
This study permits to explain “the resource curse” in some developing oil exporting countries that possessing the macroeconomic similarity regarding the oil dependency (Graph.1), and identical environmental conditions in which these countries are; Qatar, United Arab Emirates, Saudi Arabia, Angola, Nigeria, and Algeria.

The choice of these countries based on the data provided by UN Comtrade where taking into considerations the states that mostly fuel exports, at the same time highly dependent on agri-

food importation. The data permit to find countries in the middle east as Qatar, United Arab Emirates and Saudi Arabia then others in Africa as Angola, Nigeria and Algeria. These countries are under the econometric estimation.

Graph 1. GDP formed by hydrocarbons (Oil+Gas) revenues.

Source: UN Comtrade.



Qatar: This " Small state," with the minuscule population about 2,32 million, has begun the gas production since 1949, is the first gas producer in the world, the third largest gas reserves in the world that estimated by 900 trillion standard cubic feet. The Qatar Petroleum is the largest gas producer company in the world. The economy of Qatar is very dependent on hydrocarbon income which represents 61% of GDP, 95% of total exportation and 75% of budget revenue (Gardan, 2013). In 2015, Qatar gas revenue estimated by $50,52 Billion and by $64,53 Billion of oil revenues. Fortunately, in the recent years , the non-hydrocarbon GDP growth notably passing from 44% to 55% of GDP between 2000 and 2011.

The political system in Qatar is monarchic where the Gulf regimes are still monarchic and tribalism system. The economic system management basing in hydrocarbon resources, primarily the gas and oil revenues. According to Minister of Development Planning and Statistics in 2016, the gas price decline has a negative impact on Qatari budget in which the

hydrocarbon production decreased by 2.8% in 2016. Immediately after, in the late of 2015 The government canceled the subsidies for water, electricity, and taxing some other products and rationalized the public expenditures, at the same time the inflation pass from 3,4 percent in 2016 to 3,6% in 2017 and continue to increase that will arrive at 3,8% in 2018. Qatar and all Gulf cooperation council countries (GCC) will apply the value-added taxation at 5% on the underlying goods price at the beginning of 2018. After the decline of gas and oil price, the fiscal deficit in 2016 estimated at 7,8 percent of GDP and the liquidity reduced significantly. Qatar's trade surplus in 2015 fell by half of its value (in 2014) to 2.29% of GDP. This decline due to the lower of export revenues which shrunk by 39%. Other financial risks include the realization delay of the main infrastructure projects and increasing the cost of its implementation. The fiscal balance is also expected to remain in deficit in 2017 and 2018, although the reduction in expenditure and the moderate increase in hydrocarbon prices will ease its sharpness in comparison to 2016. The gas production is more important in Qatar than oil production. Indeed, the value of liquefied natural gas (LNG) exports in 2015 exceeded the value of all other hydrocarbon products and accounted for about 46% of total export commodities. Immediately, The Qatar GDP decrease from $210,1 Billion in 2014 to $152,5 B in 2015. Consequently, the total saving rate reduced from about 75% of total GDP in 2011 to 58,6% in 2015. After the hydrocarbons shock in 2014, the total revenue decrease by 20,7%, at the same time the income from hydrocarbon decrease by 23.3% in 2015. the investment also decreased immediately in the same year by 7.19% in which consists mainly from the profits of Qatar Petroleum. Away from hydrocarbon, Qatar economy based on importation that accounts for a high demand proportion in 2015 that estimated by 44,3% of final domestic spending.

Politically, Qatar plays a fundamental role in the middle east but has a political problem with neighborhood countries in which today suffers the “Business embargo” by the Gulf countries

and Egypt that these countries accuse Qatar its responsibility for supporting the terrorism, but Qatar denied. This embargo has an adverse impact on Qatari gas transportation due to the closure of sea crossings. According to Reuters news, the Gas price immediately raised by 4,5% but at the same time the Qatari money value "Riyal" decreased by 10%. Furthermore, many foreign Qatari citizens and businessman should leave the gulf countries. Consequently, humanitarian crisis and economic losses. The hydrocarbon wealth gives Qatar policy a leadership post among nations, especially in the GCC regions, this position is an imprecation for some other leading countries in the middle east as Saudi Arabia and Egypt in which Qatar disrupt the GCC countries decisions. Especially, the external policies with Iran which are very conflictual in the Gulf, excepting Qatar. But economically, after The gas discovery in the northern maritime field of Qatar, the largest liquefied natural gas output, it was a curse for Iranian gas exportation. For this reason, Iran attempt to increase its production in southern gas maritime parts field by the realization of a new project with France's Total in November 2016.

United Arab Emirates (UAE): considered among the prominent members of the Gulf Cooperation Council (GCC). UAE participates by 24% of Gulf area GDP that estimated for approximately $348,74 Billion , after Saudi Arabia by 46%, according to trading economics estimation. The economic situation of UAE as Saudi Arabia, more oil commodity exportation and more no-oil commodities importation. According to FMI, the UAE heavily dependent on oil revenue by 45% of GDP that in 2016 produced about 3 million barrels per day, classified the fifth's world oil producer by 5,8% of global oil total exportation (IMF, 2016). According to Organization of Arab Petroleum Exporting Countries (OAPEC), Annual statistical report 2016, the proven oil reserves of UAE at the end of 2015 estimated by 97,8 Billion of barrels and by 6091 Billion Cubic Meters of proven natural gas reserves, represent 3,10% of total world's gas. In 2015 after the oil price crisis, the GDP decreased by 4,7%. At the same time,

the gross international reserves declined at $85,4 Billion, passing from 38,1% in 2014 to 20,8% of GDP in 2016, according to CIA World Factbook 2017.

From a critical point of view, despite The UAE is " less resource cursed " compared to other oil exporting countries remains undeveloped countries. Indeed, the UAE's GDP is among the highest world's GDP, but until today the country suffering the mono-economy regime based on hydrocarbons sectors, away from industrial and technological production. A country as UAE with its massive exchange reserves could be the leader of no-oil industrialization investment in the middle east in which the oil dependency remains the long-term challenge of UAE government.

The political system in UAE commanded by seven monarchical federations in which the richest alliance is Abu Dhabi and Dubai . These Emirates possess many rentier millionaires, especially, surround the closed monarchical system. Instead, can see in UAE the paradox of people wealth or the inequality of the oil-wealth distribution between the seven federations. According to some political specialist of Al-Jazeera, the UAE possesses two faces, one brilliant regarding its high social level of life and the rapidity of its business, furthermore, considered the largest in the middle east about the foreign direct investment. The adverse face seems in the political assassinations, human right crisis, no freedom of expression and non-political participation. Recently, the political conflict between the two economic largest federations, Abu Dhabi by Al Nahyan family and Dubai by Al Maktoum family regarding the embargo decision against Qatar in which this attitude cost the UAE's state treasury about $11 Billion, after the withdrawing of money by Qatari businesspeople from UAE's banks. Furthermore, some political parties of the Arab world accused the UAE its support of the Arab spring chaos or " Arab winter " ultimately.

Saudi Arabia: The world's oil king is the largest producer of oil in the world, heavily dependent on oil revenue. The massive budget revenue from oil estimated by 87% dominating its economy, an account of 45% of GDP and 80 percent of export Earning. The oil production expected by more than 11,75 million of barrels per day with $637.8 billion of exportation budget in 2016. The prospective study provides the decline of oil production and GDP of Saudi Arabia which in the last decade induced economic difficulty and socio-political challenge (Krimly, 1999). The economic policies of Saudi Arabia are dependent to the fluctuation of oil price, at the same time, the kingdom's command the oil price because is the most prominent member of OPEC countries and possessing the largest proven oil reserves in the world estimated at the end of 2015 by 258 billion of barrels (IMF, 2016). The greatest challenge of Saudi Arabia is the oil shock decline where the oil price could continue to decrease until 2020. Immediately after the oil decline in 2014, the Saudi Arabia register a deficit balance that estimated by -13,6 % of GDP in 2016. Nevertheless, The investment in non-hydrocarbon sectors ligated directly to the oil revenues through the petrodollar spending (IMF, 2015).

Politically, The oil in Saudi Arabia has a regional strategic importance that the petrodollar in Saudi Arabia's Sunni inducing war in the middle east, particularly in Yamen. Recently, on May 2017 the Saudi government hold a military business deal estimated at $400 Billion which trump's America. The Saudi political system was spending more for the defense rather than economic growth aiming to dominate the middle east policies, protecting its system and confronting the middle east dominance of Iran's Shiite. The petrodollar in Saudi Arabia creates the oil-rich Emir in which they control the power of the country and the people. Consequently, induced the authoritarianism and this domination has an adverse impact on the democracy and political participation, while that the political system in Saudi Arabia is monarchic since 1932 from Ibn Saud royal family. Furthermore, by oil-wealth money, the

Saudi Arabia promote the Wahhabism or Salafism ideology in the world where 37 years ago it financed the Taliban groups in Afghanistan for combating against the URSS " Russia Federation today " in favor to the United States. According to one former state department, about 3 to 4 billion of dollar of donation to Islamic causes financed by Saudi Arabia. Furthermore, the terrorism index of Saudi Arabia rose strongly in the recent years, passing from 2,41 in 2010 to 5,4 in 2016, according to trading economics. The oil was also a curse for the strategic relationship with Saudi Arabia neighborhood countries like Iraq in which after the UN security council sanctions on Iraq about the invasion of Kuwait in 1990, Saudi Arabia closed its territory where the Iraqi oil pipeline passing (McMillan, 2006). Eco-socially, and according to the official statistics of the Ministry of Social Services, the poverty in Saudi Arabia registers a high level that estimated by 35%, whereas the poverty line stands at $480 per month. However, the inequality " Gini coefficient " record its highest level in 2014 by 25,5%. These value corresponding for nothing to one of the highest GDP in the Gulf countries and the middle east even in the world, which estimated by $646,44 Billion in 2016 and about 25% of total Arab GDP. In other hand and according to the world bank data, the proportion of the Saudi Arabia population estimated at 32,83 million in 2016 that is modest when comparing to the public expenditures and the standard level of living. Inflation also has its part of the oil curse in Saudi Arabia, continuing to increase since 2000 that arrived at 4,4% in 2016 and expected to increase by the introduction of VAT in 2018 (IMF, 2016). According to the Saudi Arabia Economy Profile of Index Mundi (2017), The unemployment also registers a high level of 11,2% in 2016 but the youth ages unemployment arrived to 30% of which 21,4% male and 57,9% female.

The Saudi Arabia institutional systems are suffering the weakness, clientelism, and bureaucracy. According to the international budget partnership, the political curse of monarchic rentier state reflected in the no transparency with n**o** public budget information in

which the open budget index is zero out of 100, in parallel n**o** opportunities to engage in the budget process. In the Saudi Arabia could see many aspects of decadence whether political stagnation, economic regression, the crisis of mono-economy, the absence of justice, no media freedom, religious fundamentalism and poverty (Raphaeli, 2005). Despite its wealth, the world's oil king remain until today an undeveloped country, although the oil discovery since 1938.

Angola: Angola is a part of the Gulf of Guinea, One of the largest oil producers in sub-Saharan Africa, an important member of OPEC countries. This country possessing all natural resources whether; Oil, gas, diamonds, gold, water resources, and agricultural land. The hydrocarbons are the first export resources revenue. Angola is more dependent on oil income more than other African oil exporting countries as Nigeria and Algeria (De Sà & Belpaire, 2007). According to the U.S energy information administration, Angola oil production in 2015 estimated at 1,8 Million barrels per day, the second largest oil producer in Africa after Nigeria. Oil production contributes about 75% of government revenue and more than 95% of export (IMF, 2015) and according to *British Petroleum* Statistical Review of World Energy 2016, The proven oil reserves in Angola estimated at 12,7 billion of barrels, equivalent to 9,8% of African oil reserves in which the third largest in Africa. The decline of oil price at 60% in the recent years had a drastic impact on Angolan government revenues. The Angolan budget record a deficit about 3,5 % of GDP in 2015 and about 6,5% in 2016. Arithmetically, and according to the World Bank the GDP falling from $126,7 Billion in 2014 to 102,9 in 2015, and then 89,6 in 2016 (IMF, 2017). According to trading economics forecast, the GDP could continue to decrease arriving until 2020 to 76,78 due to fall in oil price. After the oil shock in 2014, Angola government followed the policy of austerity through rationalization of public expenditures, mobilizing non-oil revenues, elimination of subsidies, preserving the

export competitiveness, reducing the importation and accelerate the economic diversification (Mauzima & Gallardo, 2017).

Socioeconomically, the great oil price volatility improves the inflation that rose from 7,3 % in 2014 to 32,4 % in 2016. This terrible growth means that the government could not be capable controlling the market repercussions in which suffering the inefficient of social policy, no planning strategy, and deficiency of human economic capital. In the same time, suffering the chronic poverty in which 54,3% of Angolan people under $1,25 per day, less than global line poverty at $2 (Barros, 2012). According to trading economics estimations, Angola possesses a high public debt estimated at 38% of GDP. In parallel, the government budget registers a deficit of -4,2 in 2015. Furthermore, rising unemployment at 26 % since 2014 and decrease of the business confidence index at -34 in 2016. The Angolan situation like Nigeria among the "extreme resources cursed" or rather "the absolute paradox" that considered as non-democratic countries with a fragile state apparatus and suffers the no-investment with less diversified economy. According to International Transparency Organization 2016, the Angolan corruption perceptions index among the highest in Africa that register a low score estimated at 18, classified as 164 of world's rank out of 176 countries. Resultantly, the oil considered the obstacle of the economic development in Angola.

Angola since its independence from the Portuguese colonization in 1975 suffered civil war until 2002, between The people's movement for the liberation of Angola (MPLA) and The National Union for the Total Independence of Angola (UNITA). This Civil War financed by oil and diamonds exploitation of both parties and by external funding, particularly from the cold war blocks; Soviet Union block per MPLA finance and Unites State block per UNITA. The curse of barrels seems on manufacturing destruction, killed about 500,000 people, form 1 million homeless, kidnapping oil industry staff, sabotage of oil companies, interruption of oil extraction operations and delayed the foreign investment in all sectors, particularly, oil sector

by no exploitation of the considerable onshore reserves in Luanda capital's (Frynas & Wood, 2001). Additionally, the diamond is the second resources revenues after the oil that during the violent war conflict, Angola loses its extraordinary dominance as the world's primary producers, in which the diamond's sector remains under-exploited.

The Angolan " bloody oil " induced political, macroeconomic instability and provoke ethnic conflict in which until today the political situation remains fragile, maybe could be exploded any time. In the post-conflict period, after the peace agreement, the oil-economy register an estimable development but the non-mineral sectors remain scant.

Nigeria: Country of the "extreme paradox of plenty." the giant of Africa, the most populated (192 million in 2017), one of the highest GDP of Africa and heavily dependent to Oil revenue. In 2016 Nigeria registers $481,03 Billion of the budget after South Africa. At the same time, the only country in the word that record a budget deficit with a significant and high oil revenues. In 2014 the country registered $93,47 Billion of exportation between oil and gas After the oil shock price. The oil in Nigeria represents 90 to 95% of Nigeria's export revenues that contributing nearly for 40% of GDP. The Nigerian oil reserve estimated around more than 37 billion barrels, is the second largest reserve in Africa. Nigeria gas reserve is over185 trillion cubic feet (Tcf), the largest gas reserve in Africa. The Nigerian oil production in 2016 varied between 1,7 to 2,1 million barrels per day. Nigeria one of the prominent member of OPEC countries. The curse of oil in Nigeria primarily is political that between 1960 and 1999 more than $400 billion stole by politicians and rulers (Okpanachi, 2011). Indeed, all conflicts whether political, economic or social are around the oil where the oil in Nigeria located with blood. Moreover, the oil created a military conflict with Niger groups about oil Delta or " Oil rivers " the main oil-producing area in Nigeria where the benefit from oil in favor of Nigerian system and oil producer companies. On the front the delta people living in the hell of poverty, underdevelopment and pollution since 1960, after the oil

discovery and exploitation in which The environmental damage and ecosystem destruction due to oil spillage. In the beginning of 1992, the oil sabotage leads its extreme level between oil companies as Shell, Chevron, and the Nigerian National Petroleum Corporation (NNPC) against the movement for the emancipation of Niger Delta (MEND). Enormous economic costs have proven about oil conflict. Exactly, from 1999 to 2007. According to radio Nigeria, the country lost about $58 billion, about 300,000 barrels of oil wasted each day. The oil-wealth in Nigeria is the limiting factor of degradation, underdevelopment, and regression. The instability situation in delta Niger has an impact on raising of world oil price. The Niger Delta groups formed by three Nigerian states: Bayelsa, Rivers, and Delta. They are the responsible for the kidnapping of the foreign workers from oil companies between American, European and Asian people. Between 2006 and 2007, about 120 foreigner workers taken as a hostage, of which two killed (Obi, 2009). Oil is a curse for Nigerian people that the income per capita continuing to decrease rather than other world's countries where decreased from $3,221 in 2014 to $2,177 in 2016, according to world bank data. In another side, Indonesia has the similarity to Nigeria in many aspects where the two nations have been experiencing the colonialism, having a many ethnic, with high population, possessing oil wealth, experience of military regimes since 1966. In the same time, the income per capita of Indonesia doubled four-time. Furthermore, Indonesia transformed from a "fragile" to "Asian miracle country" where Nigeria remain under-development (Fuady, 2015).

Nigeria today one of the poorest 25 countries where in 1970 was one of the richest 50 countries. Among the highest Gini index in the world by 50.6 that means the suffering the highest inequality of wealth distribution (Onyeukwu, 2007). From 2015 to 2016, Annual inflation doubled to 18,6 and according to the Nigerian National Bureau of Statistics, The total foreign and domestic debt stocks at December 31, 2016, increased to around $11.41 billion.

The volatility of oil price has a significant impact on economic investment. In the recent years, especially three years ago, Nigeria registered a drastic decline in economic balance where the oil is the only commodity that can control the macroeconomic situation and financial stability of the country. The oil prices have an impact on business, especially; GDP, employment rate, consumer price and household consumption. The " Curse of governance " that Nigeria was not capable to manage the oil revenue correctly for the benefit of the all Nigerian citizens. The Nigerian oil money induces more corruption and clientelism. Although the developing oil exporting countries suffering from the curse of their resources.

Algeria: The major exportation of Algeria is gas and oil by 90 to 95% of export earnings, 60% of budget revenues by CIA The world factbook 2017. According to *British Petroleum* Statistical Review of World Energy 2017, Algerian proven oil reserves estimated at 12,2 Billion barrels and about 4,5 trillion cubic meters (TCM) or 159,1 trillion cubic feet (TCF) of proven gas. At the same time, the average of daily oil production in 2016 estimated about 1,57 million barrels and about 91,3 billion cubic meters of Gas production by 7,6% of world's total gas production. Algeria among the major's oil and gas producers in Africa, the 18th largest global oil exporter and 6th world's liquefied natural gas (LNG) exporter in which the second largest natural gas supplier for Europe destination, Approximately for 90 % of its exportation of natural gas, according to U.S. Energy Information Administration. Algeria suffers the high volatility of oil budget that reflected adversely on the economic growth and the project's investment, especially in oil shock period (Chakouri & Chibi, 2016; Elhannani & *Al*, 2016). This situation demonstrates the paralyze of non-fuel sectors that make the country more depending to foreign demands and external market price. Consequently, more inflation and less competitiveness. Algeria suffers from the "Dutch disease" where the economic instability is the chronical curse (Akacem & Cachanosky, 2017). Immediately after the oil price shock in 2014, the GDP declined by 27% passing from 213,98 in 2014 to 156,05 in

2016, according to the world bank data. At this period, the inflation raised from 2,92% in 2014 to 6,4% in 2016. The curse of the oil in Algeria is that the government since the oil discovery investing massively in the hydrocarbons sector at the expense of other sectors, in which promoting the mon-economic regime. This kind of economy, usually coincides with government subsidies intervention and no taxation for improving the social level. But after the drastic budget decline due to oil shock, the Algerian government changed its social policies by the application of austerity policy in which planning for ambitious fiscal consolidation and encouragement of no-oil sector for reducing the balance deficit that registered -14% of GDP in 2016, then aimed to close it to zero by 2019, according to International Monetary Fund 2017.

From a political point of view, Algeria as other developing oil exporting countries suffers a military authoritarianism, less democracy, one-party government, and corruption. Algeria remains a fragile country due to a negative response from those seeking a more transparent society. The serious structural problems that led to instability in the late 1980s of the last century are still present; High state dependency on oil price volatility; A strong state grip on economic resources and political power by a small and elitist group whose legitimacy goes back directly or indirectly to the Algerian revolution against France colonialism. Weak public institutions stuck in clientele structures, And last but not least, social tensions concerning identity issues. Algeria since the black gold discovery in 1954 and its independence from France in 1962 doesn't make measurable progress on both aspects; political and economic due to the bad governance. Paradoxically, more defense military spending by oil fund, especially, amidst and after the black decade of the civil war period, between 1991 and 2000.

Economically, and according to the global competitiveness index (World Economic Forum, 2017) Algeria suffers from the foreign and local investment due to many factors; the inefficient economic bureaucracy, less access to financing, delayed time to start a business,

less quality of infrastructure, policy instability, favoritism in decisions of government officials, no transparency of government policymakers and corruption.

1.2. Oil scarcity in the developing oil-rich countries:

Oil is not a renewable resource, even in some oil exporting countries with a less proven hydrocarbon reserves could see a severe scarcity in the next years. At the same time, its oil productivity could not answer to the foreign demands market and satisfying just its local necessity. For example; According to the forecasts of *British Petroleum*, Algeria could shows a tendency of crude oil decrease production with a drastic estimation, and a significant reduction of oil reserve by 2035. Some other developing oil exporting countries with a high proven oil reserves as Saudi Arabia, United Arab Emirates, and Nigeria could satisfy its local and foreign demands market in a long-term period but the challenge is the future of the hydrocarbons energy in era of new economy, and the question is; which oil price competitiveness could be had in front of renewable energy ?. Furthermore, The problematic will be not just the oil production but the oil price profitability because in oil period crisis the cost of extraction of some exporting countries sometimes more than oil price.

Could inspire two aspects about the oil scarcity; the oil availability and the oil extinction. The oil supply in the future could be increased due the increment of the population in which the demands of energy increase. At the same time, the decline of oil price induce the exporting countries to reduce the export quantities for increasing the price in which causes less fuel availability and shortage in the market. Cochet & Perrin in 2009 expected that the oil production will decrease significantly toward 2020 or 2030. In another side, the oil rarity or oil extinction, the author observed that the proven oil reserves possess enormous uncertainties in which the largest oil exporter countries don’t know exactly concerning reserves and resources and some oil exporting countries could see a severe scarcity in short-term. For this

reason, these countries should think in another economic model basing on the diversification of revenues, if not could have important macro and socioeconomic problems.

In 1996, Uri Noel also observed that non-renewable resources possess two type of scarcity; Malthusian scarcity referring to the law of diminishing returns of fixed non-renewable resources and the Ricardian scarcity referring to the diminishing of quality continuously. Among these two approaches there are four aspects; “Malthusian stock scarcity,” “Malthusian flow scarcity,” “Ricardian stock scarcity,” and “ Ricardian flow scarcity.” Econometrically, the index of scarcity according to Smith (1979), Johnson & *al* (1980) estimated by this model:

$$IND_{it} = \beta_{1i} + \beta_{2i} D20 + \beta_{3i} D30 + \beta_{4i} D40 + \gamma_{1i} t + \gamma_{2i} t D20 + \gamma_{3i} t D30 + \gamma_{4i} t D40$$

Where IND_{it} represent the index of scarcity in which taking into consideration the relative price and the unit cost, i represent the natural resources that in our case the non-renewable resources (Oil and gas), t represents the period, for example between 2020 to 2040 ; β_{1i} β_{2i} β_{3i} β_{4i} $\gamma_{1i} t$ γ_{2i} $\gamma_{3i} t$ $\gamma_{4i} t$ are parameters to be estimated.

Where:

$D20 = (0 \text{ for } t < 2020, \text{ and } 1 \text{ for } t \geq 2020),$

$D30 = (0 \text{ for } t < 2030, \text{ and } 1 \text{ for } t \geq 2030),$

$D40 = (0 \text{ for } t < 2040, \text{ and } 1 \text{ for } t \geq 2040).$

According to the Britain’s Greenest Energy Company about the end of fossil fuels, the oil could be vanished and decreased drastically until 2052 due to the continuous increment of world’s consumption in which the annual oil consumption estimated over 11 billion of barrels. In the same time, the gas could vanish until 2060 and coal until 2088. The developing oil exporting countries, in the era of *post-petroleum* could have the no-oil wealthy budget and

no-easy domestic energy. Moreover, when the resources become scarce, the local price of energy will rise tremendously. The developing countries could have more poverty and misery in time where are still developing at the moment of its "peak in resources capacity." The geopolitics of post-scarcity could conduce to the war where the powerful countries could aiming to find other wealthy resources. Especially, the solar energy in which the largest oil producing countries are a Saharan area, from the middle east by Saudi Arabia, Iran, Iraq, United Arab Emirates, Kuwait, and Qatar to Africa by Algeria, Libya, Nigeria and Angola. Aguilar-Millan & *Al* About the post-scarcity world of 2050-2075 concluded and said; " *If humans are inherently a warlike species, a post-scarcity economy will enhance leaders' ability to create the war over causes that might have seemed trivial during a time when there was scarcity to worry about...*"

2. Food import dependence analysis:

The Agricultural sector in the majority of the developing oil-exporting countries possesses a considerable limitation, suffering the underinvestment and lower rural area in some of these countries. These kinds of problems induce to the increment of the food importation in which the agri-food imports fluctuate by the fluctuation of oil price and oil-GDP where make these countries affronting a high risk of food insecurity and undernourishment.

2.1 Agricultural itinerary of some developing oil-exporting countries (Qatar, Saudi Arabia, United Arab Emirates Angola, Nigeria and Algeria).

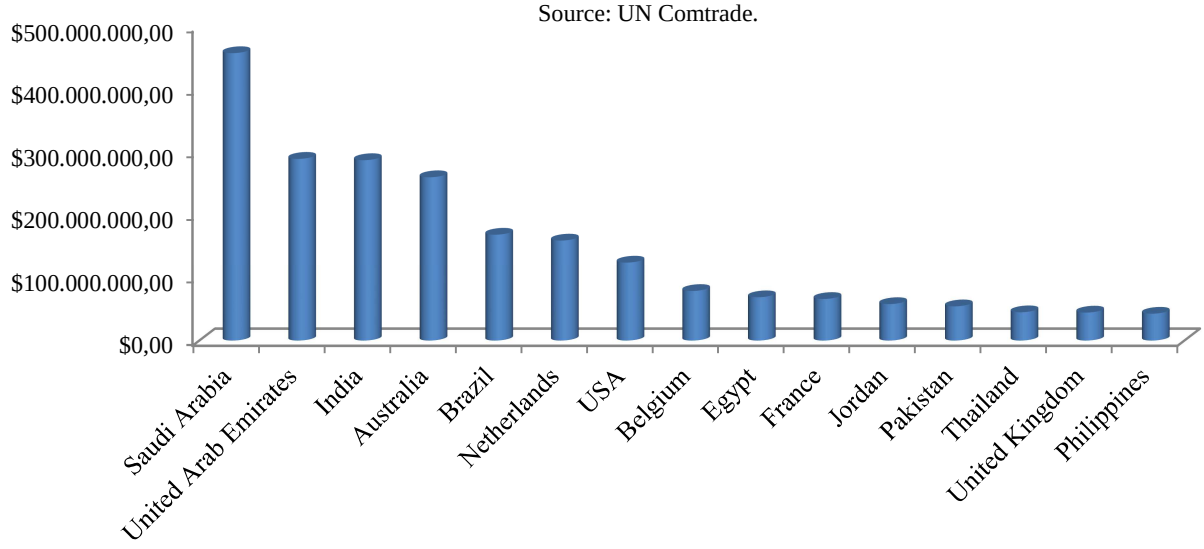
Qatar: Is one of the dry Arab micro-state with a total superficies about 11590 Km^2, the agricultural area represent 6,5% of total area, and the arable land by 1,6% or 25,4% of farmland, According to World Stat Info. The Persian Gulf surrounds the Qatar peninsula that means the fisheries sector is fascinating. Fishing, pearling and the date palm cultivation have a significant role for Qatari budget until the oil discovery in 1939, where remain the principal agricultural products in Qatar, nevertheless, no others local strategic agri-food products. Qatar

among the countries that suffering food insufficiency that covering the shortfall by a massive importation in which between 2000 to 2015 the food import multiplied for nine-times, passing from $300 million to $2,9 Billion, According to UN Comtrade. Additionally, the constant increment of domestic food price. Furthermore, The importation could continue its increase due to the rise of the world's population, particularly in the developing countries. Qatar as desert countries suffers the lower rainfall quantities that estimated less than 75 millimeters (3 inches) per year. At the same time, the highest temperature that arrives some time to 47 C°. In this critical environmental conditions with the problems of desertification, arable land deficiency, and water scarcity. Qatar imports about 90% of its local food demand and could not be able to secure its domestic production. Its principal's partner in the Gulf countries; Saudi Arabia, UAE, and Bahrain by 80% of Qatari importation and other nations; India, Australia, Brazil, Netherland and USA (Graph 2).

Since 2000, the agricultural share GDP is under 0,4% that continue to decrease, passing from 0,38 in 2001 to 0,16 in 2015. This situation doesn't bode well for Qatari food sovereignty in which after the economic and political embargo in July 2017 by Gulf countries, Qatar suffering the availability of food products in the market and quickly makes a new agricultural cooperation with other partners as Iran and Turkey to secure its heavy local food demands.

Graph 2. Qatar food import partners in 2015.

Source: UN Comtrade.



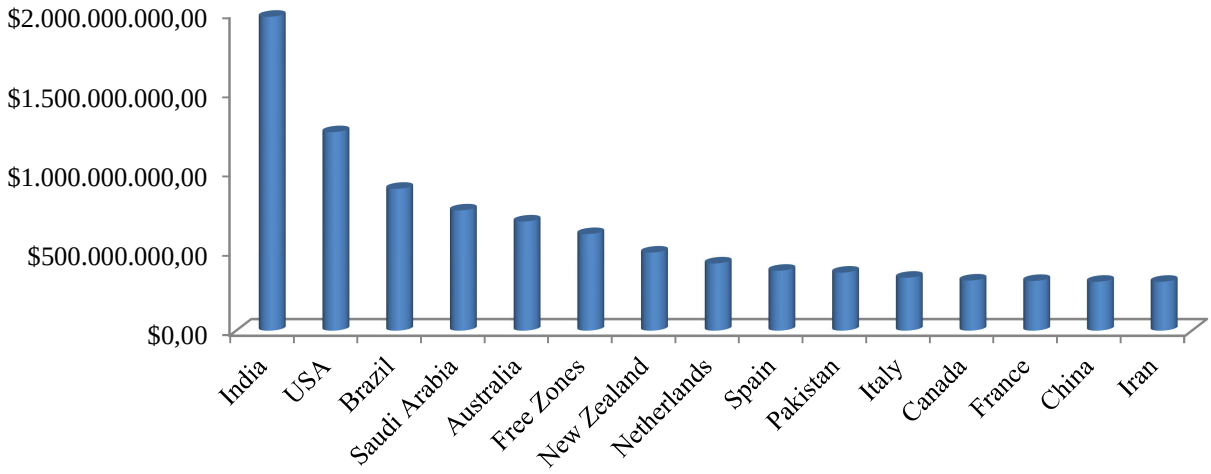
Qatar as all Gulf countries suffering from low water renewable resources, while the Qatari agriculture is very dependent to underground water aquifers; Rus, and Umm er Rhaduma but threaten by salinized sea water (Hawey, 2015). The groundwater as the only resources of fresh water is over-exploited, quality deteriorated, and becoming less favorable for agricultural usage and expected to expire in few years. Qatar for satisfying its domestic water demands agricultural or urban realized seawater desalination stations, but adversely these stations could conduce to more sea water salinization, the Arabic gulf could arrive at the " Salt peak," according to some expert. Consequently, water becomes so salty that the desalinization no longer becoming unfeasible economically and environmentally. In Parallel, The underground water is fastly depleting due to agricultural misused, wasting, and create other environmental problems as soil erosion (Osman & *Al*, 2016). Qatar very preoccupied with its local food production and water availability, about this reason, the government in 2008 installed "Qatar National Food Security Program (QNFSP)" guided by "Qatar National Vision (QNV 2030)" that basing to renewable energy. Especially the solar energy for food and water production with the collaboration of all institutional entities whether governmental or non-governmental. This program aims to enhance agricultural and fisheries self-

productivity, optimization the usage of natural resources, modernization the agricultural sectors through modern technology, improving agricultural research and training, promoting the legislation and regulation, and revised its global agricultural policies.

United Arab Emirate: The father of this nation, known as " The sage of the Arabs " Sheikh Zayed Bin Sultan Al-Nahyan said, " Give me agriculture and I will give you civilization ." But unfortunately, despite the efforts made, the agricultural field still late due to the geographic position of this country and environmental conditions in which the UAE is a desert area with the arid ecosystem, suffering less rainfall, high temperature, strong wind and desertification as all Gulf countries. The arable land possessed a huge decrease passing from 0,72% in 2000 to 0,45 in 2014. At the same time, the agricultural land estimated about 4,57% of total area (83600 km^2), according to the world bank. This critical condition makes UAE more dependent to importation where the agricultural production is insufficient, and consequently, the volatility of the foreign food price and market speculation. In another side, the UAE suffers " The extreme water scarce " which the water resources are; groundwater by 70%, desalinated with 24% and treated wastewater by 6% in which the water consumed by agricultural sector about 83% (Shahin & Salem, 2015). The agricultural GDP less than 4% that in the last decade see a high decline passing from 2,3 % in 2000 to 0,7% in 2015 where the Agricultural labor force estimated at 7%, According to the world bank. The UAE imports about 90% of its food demands, the major partners are; India, USA, Brazil, Saudi Arabia and Australia (Graph 3).

Graph 3. UAE Food import partners in 2015.

Source: UN Comtrade.



The UAE for secure its food consumption leased agricultural land in Sudan, Morocco, and Pakistan but the curse that these countries suffering from the climate change impact and drought (Sadik & *Al*, 2014). Fisheries and pearl extraction were significant resources of income before oil and gas discovery and until today remain popular products with an important role for food sufficiency in UAE (Fathelrahman & *Al*, 2014). The food importation continues to rise drastically passing from $ 5,4 Billion in 2000 to $ 28,5 Billion in 2015, fortunately, financed by oil revenues. According to UAE government, The agricultural sectors in UAE practiced in some area as; Ras Al-Khaimah, Fujairah, Al Ain and Liwa oasis. But its production suffers from the high costs, Agricultural pest and post-harvest losses due to heat. Recently, thanks to the late president of UAE Sheikh Zayed bin Sultan Al Nahyan, the agricultural sectors known a significant modernization. Particularly, by the installation of the modern irrigation system. The main production in UAE and Gulf countries are; Dates, Vegetables, Fruits, tobacco and cucurbit crops. The challenge of the food security in the UAE is the rapid increase of the population that could grow to 10,6 Million in 2030. Consequently, the rise of the food importation. According to the ministry of economy in 2013, the food manufacturing distributed between the seven UAE's federations of which; Dubai by 48%, Sharjah (19%), Ajman (13%), Abu Dhabi (8%), Ras Al-Khaimah (5%), Umm Al-Quwain

(4%), and Fujairah with 3%. For combating against desertification, the UAE's government installed a program of green area implantation, such as the establishment of forests and protected area for protecting cities, village, roads, and farms from the shifting sands. Furthermore, the creation of Zayed international center for agricultural and environmental research which focuses on the study of the sandy dunes movement and improving the desert agriculture.

The UAE implied on the impact of the climate change for the long-term food security, through a program launched by the environmental agency of Abu Dhabi in 2013 known as " Local, National, and regional climate change (LNRCC) program ". The program aims to reduce the risk of climate change and the agricultural productivity shock in National (UAE) and Regional (GCC) countries. The climate change will contribute to the rise of the food price until 84% in 2050, Particularly the core foods as wheat could increase by 34,4%, Rice about 58,6% and Maize at 72,2% (Nelson & *Al*, 2010). Econometrically, The constrained food imports under the climate change could be estimated by this equation:

$$FIS = \begin{cases} \text{" Unconstrained," } for \quad R_{min} - A_{max} < 0 \quad and \quad A_{min} - R_{max} \geq 0 \\ \text{" Partially constrained," } for \quad R_{min} - A_{max} < 0 \quad and \quad A_{min} - R_{max} \leq 0 \\ \text{" Constrained," } for \quad R_{min} - A_{max} \geq 0 \end{cases}$$

Where:

FIS: Food import status.

$\mathbf{R}_{\mathbf{min}}$ is the minimum required food import volume based on population projections.

$\mathbf{R}_{\mathbf{max}}$ is the maximum required food import volume based on the maximum population growth scenario.

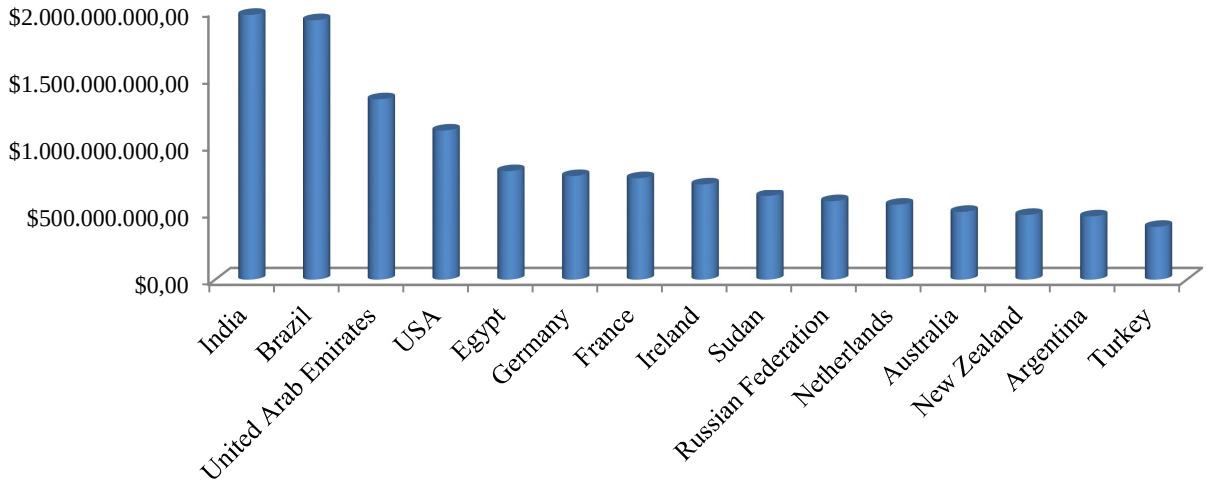
$\mathbf{A}_{\mathbf{min}}$ is the minimum actual food import volume available based on the climate change scenarios.

A $_{max}$ is the maximum actual food import volume available based on the climate change scenarios.

Saudi Arabia: The kingdom's arable land estimated at 1,63% (236026 ha) and the agricultural land about 80,78% (3502000 ha), According to trading economics. The food imports dependency in 2013 nearly for 80%. The importation increased rapidly passing from $9,2 Billion in 2000 to $39,6 Billion in 2015. Its primary partners are; India, Brazil, United Arab Emirates, USA, Egypt, Germany, and France (Graph 4). Agriculture in Saudi Arabia is suffering a shortage of rainfall that the average is less than 100 mm/year in normal conditions. At the same time, the kingdom among the few countries where the temperature in summer surpasses 50 C°. These climatic conditions make the agricultural sectors limited to some products as date palm, fodder, barley, wheat, melons, and tomatoes. The agricultural GDP see also a sharp decline in the last decade that decreased from 5,2% of GDP in 2000 to 2,26% in 2015 that means regression of agricultural local and foreign investment. Furthermore, the less agricultural labor force that estimated in 2015 by 6,1% of total employment, according to the world bank.

Graph 4. Saudi Arabia food import partners in 2015

Source: UN Comtrade.



Saudi Arabia as all Gulf and MENA countries suffers the water scarcity and desertification in which the food commodities could arrive at 100% of importation by 2050. The challenge of the kingdom's government is how could secure the food production amidst the threat of water scarcity where agricultural used about 88% of the total water consummation (Fiaz & *Al*, 2016). The agriculture water resources coming from conventional resources formed by water surface by 2,4 Billion Cubic Meter (Billion m^3) per year that mainly located in the west, and groundwater by 2,2 Billion m^2 that usually supplied by the infiltration of water surface where the total renewable water resources about 6 billion m^3. The non-conventional water consists by treated wastewater for 730 Million m^3 and sea water desalinization in which the Saudi Arabia is the largest producer of desalinized water by more than 1 Billion m^3/ or 26% of the total world's seawater desalination (Ouda, 2013).

Saudi Arabia for securing its long-term food demands installed a project for agricultural land investment launched in 2009, year after the world food supplies and price crisis, known as " King Abdulla's initiative for agricultural investment abroad ", aiming to support the staple commodities; rice, barley, wheat, sugar, corn, green fodders, and animals resources in which the Saudi star agricultural development in 2010 signed the largest Ethiopian lease agreement by 10,000 hectares for rice farming, where investing about $2,5 Billion until 2020 and expect to acquire extra 290,000 hectares until 2060. In Zambia, Saudi Arabia invests around $125 million for pineapple fruit production. In Sudan, The kingdom's considered the largest renter of agricultural where 1 million acres approved by Sudanese national assembly in favor to Saudi Arabia for 99 years of land investment, and for water security three dams should be constructed in the north of Sudan; The Kajbar, Dal and Al-Shiraik dams by an amount about $ 1,7 Billion. Additionally, $500 million for others water and electricity projects. In Pakistan, Saudi Arabia leased more than 500,000 acres or (1,25 million ha) of land, and approximately $ 46,2 million of agricultural investment. Privately, by Almarai, the largest dairy company in

the middle east, the kingdom's bought about 1,790 acres in Blythe, California along Colorado river to grow fodder in which the land cost around $31,8 million. Another 10,000 acres nearby Vicksburg, Arizona for around $48 million. Saudi Arabia, together with other Gulf countries, looking for 1 million hectares for wheat production in Australia. In Indonesia, the Saudi Arabia's Bin Laden Group invest around $4,3 Billion for 2 million hectares of farmland. But despite these efforts, some opponents consider these kinds of investments a new sort of "land grab or neocolonialism ." At the same time, Saudi policy outlooks for more agricultural land investments in other countries as Turkey, Philippine, Ukraine, Brazil, Vietnam, and Kazakhstan

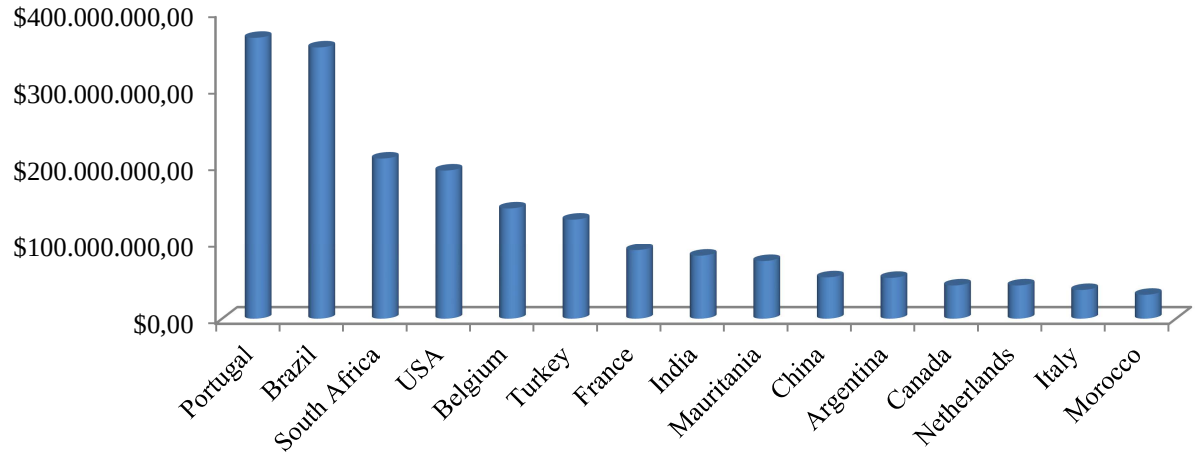
Angola: Angola possesses tremendous agricultural potential by approximately 47,5 million hectares of farmland of which 3,5 million available arable lands, according to World Bank 2015. Notwithstanding, enormous Angolan capacities with the highest rural population in Africa, Angola exploited only 4 million hectares of its agricultural land that means the country enable to generate its local resources. Agricultural share GDP about 12% or around $102 billion of the total budget. Angola in the last years shows a significant enhancement that the Agri-GDP increased from 4,6% in 2008 to 9,9% in 2015, According to the domestic authorities. Paradoxically, before this period, and during the civil war, the no-investment and abandonment of the agricultural sectors induced more dependency on importation and food aid by United Nations. The Angolan food imports record more than 50% that estimated by $2,22 billion in 2015. The principal export partners; Portugal, Brazil, South Africa, USA, Belgium, and Turkey (Graph 5). In the same time, Angola export some products as; coffee, sisal, banana, sugar cane, and cotton in which over 90% of local agricultural production by familiar farmland.

Ecologically, Angola possesses two types of climate; heaviest rainy in the north by up to 1,800mm annually, and warmer particularly in the south. The southern Angolan agriculture

suffers from the drought that caused a loss estimated at $242,5 million in 2015, and about 500,000 heads of livestock died in 2016. At the same time, the cereal production registers a deficit by 40%. However, this grim situation affects the food security of about 1 million people and could have an impact on more than 400,000 in the future that will suffer the food deficiency. Furthermore, Angola suffers the climate change.

Graph 5. Angola food import partners in 2015.

Source: UN Comtrade.



According to the projections of Intergovernmental Panel on Climate Change (IPCC), the sub-Saharan countries could have the greatest temperature rise in the world combined systematically with the high decline of rainfall (Ringler & *Al*, 2010). Currently, Angola has not a problem of water scarcity that possesses 47 rivers basins in which the agricultural sectors consume about 61,5% of the total water, according to Aquastat FAO.

Recently, Angola for securing its local food sovereignty invested about $2 Billion in the agricultural industry in 2009, then installed the National development plan (NDP 2013-17) by 7,5% of the budget for improving irrigation systems, supporting farm cooperatives and fisheries industry (Muzima & Gallardo, 2017). In the same time, the country invests in the infrastructure for mobilizing the agricultural activities. Furthermore, Angola received about

$70 million from the World Bank in 2016 to increase smallholder agriculture, technical competence, and management. In 2013, the Indian government credited about $37 million for boosting agricultural industrialization in Angola. As well, in October 2015, China by its two multinationals Hassan and Forever Groups committed to investing a combined amount of $650 million in Angola's agriculture aiming to build new firms, and personal training centers for producing cassava, tomato, Maize, and wheat, according to Forever Green manager Wam Xan.

Despite these efforts, Angolan people until today suffers from the malnutrition in which Angola considered the highest world's under 5 years old mortality rate by 167 death per 1000 live births in 2013, and the Angolan stunting children estimated at 20% in 2012 or around 820,000 child. For minimizing this dramatic situation, the European Union and non-governmental organizations gave donors to Angolan government for inducing the nutrition quality and reducing the children mortality in which should be decreased by 10% until 2025, according to the European Commission.

Nigeria: Nigerian farmland about 85 million hectares in which only 40% cultivated (Onuka, 2017). Nigeria among the largest producers of some cultures in Africa as; cassava, cocoa beans, palm oil, palm kernels, groundnuts, bananas, rice, rubber, and sorghum. In 2015 the agricultural share GDP estimated at 24,18% of total GDP where about 70% of population engaging in agricultural sector (Odeh, 2011). Agriculture in Nigeria suffering the logistic problems due to the poor manufacturing, poor transportation, bad food conservation quality, and bad packaging. Resultantly, Nigerian agriculture suffers from non-sustainability farming.

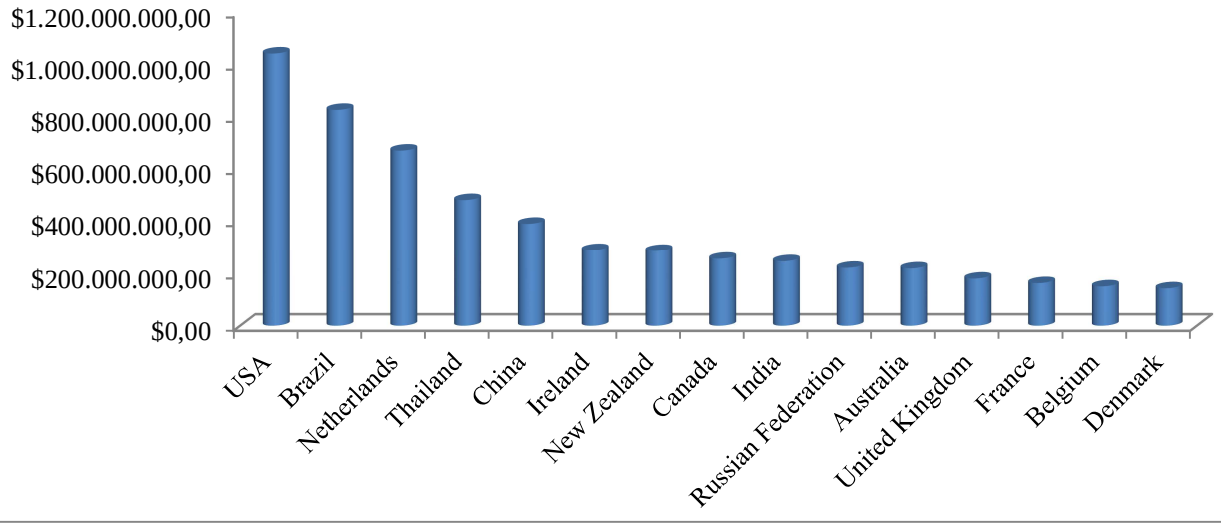
In 2016, Nigeria spends around $20 Billion for food imports, particularly for the largest consuming products as; wheat, sugar, rice, dairy products, frozen fish, and vegetables. The major's partners are; Asia by 44,6%, European Union (33,6%), Americas (14,1%), Africa

(6,5%), and others by 10% (Graph 6). The total food imports (% of merchandise imports) estimated at 17,03% in 2014, according to the world bank.

Nigeria possesses a potential of water resources by 267,7 billion cubic meters (BCM) of surface water and 57,9 BCM per underground water (Odetola & Etumnu, 2013). But regrettably, 66 million people have not access to water potable, according to UNICEF. In 2016, the government for reducing the severe water shortage and progressing the water availability whether agricultural or urban around the all country, implemented 116 water projects; 41 water supply projects, 38 irrigation projects, and 37 dams, according to the minister of water resources. But regrettably, 66 million people have not access to water potable, according to UNICEF.

Graph 6. Nigeria food import partners in 2014.

Source: UN Comtrade.



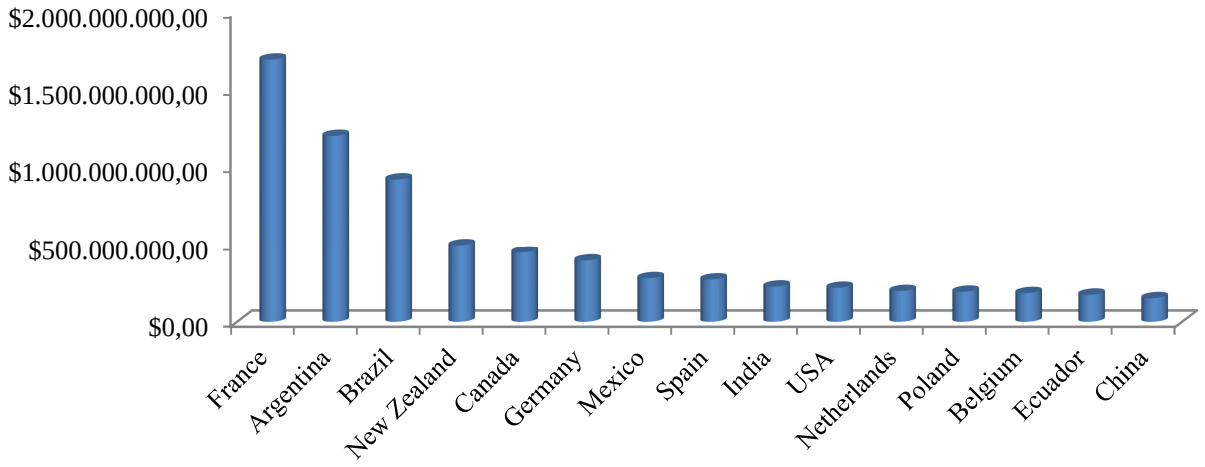
In Nigeria, The agro-food production in the rainy seasons generally in the favorable agro-climatic seasons (Autumn and summer). For improving the agricultural sectors, Nigerian government and FAO launched an project of Youth Employment in Agriculture Program 2013-2017 (YEAP) by an amount around $235 million, aiming to implement 750,000 young farmers and agribusiness entrepreneurs. The FAO's expertise administration in Nigeria seeks

to improve nutrition security and public food, support for agricultural policy and regulatory framework, support for the agricultural transformation agenda (ATA) and promote employment for youth and women, sustainable management of natural resources, improved disaster risk reduction, and emergency management (FAO, 2015). The U.S. Agency for International Development (USAID) invests nearly $60,5 million for incentivizing the smallholders farmers toward a new markets by a project called MARKETS II that focused on cocoa, cassava, rice, sorghum, soybeans, maize and aquaculture (Downie, 2017). Moreover, the Nigerian richest man in Africa (by $12,1 Billion of wealth) planning to invest about $4,5 billion for farming ($3,8 Billion for sugar and rice, $800 for dairy production). Aiming to produce 1 million tons of rice per year by cultivation about 350,000 hectares of farmland, and 1,5 million tons of sugar through 200,000 hectares, at the end of 2020. In another side, 500 million liters of milk per year by 2019, according to Bloomberg Markets.

Like the majority of fuel exporting countries, Nigeria before the oil discovery possessed food self-sufficiency, but after this period, Nigerian people suffered from many crises of nutrition, Notably, the crisis of 1976, due to the exponential rise of population, and negligence of agricultural sector. Immediately, in the same year, the government launched the plan of “Feed Nations” (1976-1979), and strengthened after by the “Green revolution.” In the decade, exactly in 2001, the government looked for a new ambitious agricultural strategy by “ New agricultural policy on agriculture.” In which under this policy, there are two pillar programs. Firstly the program of “ National Economic Employment and Development Strategy” (NEEDS II 2008-2011), aiming primarily for combating the highest level of poverty in which 112 million of Nigerian people living under the poverty line or about 67,1 % of total population. The other wider program “ National Food Security Programme NFSP 2008 ” looking for achievement the national food guaranty by ensuring the availability and accessibility of quantity, even quality food for all citizens.

Algeria: Before the independence of Algeria in 1962, and the discovery of oil in 1954, Algerian agriculture covered 90% of domestic food demand. Subsequently, agricultural production began its decline to cover, in the 1980s, only 30% of the Algerian food needs (Tounsi, 1995). Until 2000, Algerian policies concentrated on urbanization heavily, causing a drastic subtraction of northern fertile agricultural land. As well as the phenomenon of the rural exodus (Bessaoud, 2006). All this, in conjunction with a period of high demographic growth, the food demands increased by 75%, with an annual increment of 11.45%. In fact, only in recent years, the value of food imports passed from about $7.5 Billion in 2012 to over $9.3 Billion in 2015. Algeria's leading suppliers in 2015 are France (by 22% of market shares), Argentina (16%), and Brazil (11.4%), (Graph7). The Government introduced an integration of the prices of the most imported agricultural products such as wheat, flour, milk, sugar, and the food oil. However, paradoxically, the integrated food price could cause for public finance problems, in the event of the increment of international price, without solving the problems, mainly structural, of the agricultural sector.

Graph 7. Algeria food import partners in 2015.
Source: UN Comtrade.



Since 2000, the Algerian Government, through the introduction of the National Plan for Agricultural Development (PNDA), Gave the way to a new policy for modern agriculture

(Bessaoud 2006). Between 2001-2004, to ensure the food security of the country through the PNDA, more than €600 million was disbursed for the relaunch of the agricultural sector, for promoting farms employment with the improvement of the socio-economic conditions of farmers, and enhancing the sustainable management of natural resources (Khiati, 2007).

The PNDA, in 2002, was enlarged to the National Agricultural and Rural Development Program (PNDAR). This program is looking for ensuring the preservation of natural resources and aims to revitalize rural areas through the modernization of the agricultural sector by the improvement of the living conditions of the rural population (Akerkar, 2015). The main relevant instrument that has adopted for rural development is "Integrated Rural Development and Projects of Proximity" (PPDRI), it has been set up to strengthen local development activities, especially from a structural point of view.

In recent years, the Ministry of Agriculture and Rural Development relaunched the "Agricultural and Rural Renewal Policy" Whereas, from 2008 until 2014, implements more ambitious policy than the previous programs. In fact, highlights the urgency of revitalizing Algerian agriculture to ensure food security but also to make it the force for the economic growth. The first phase of this new policy, which commits the five-year period 2010-2014, is based on three pillars: The agricultural renewal, rural development, and the program for the strengthening of human capacity and technical support to producers (PRCHAT) (Maghni, 2013). According to the Ministry of Agriculture, Rural Development and fisheries, the agricultural renewal could be achieved through the modernization of the agricultural sector to increase production and productivity. Moreover, the integration of 10 priority products such as Cereals, raw milk, dried vegetables, potatoes, olive cultivation, industrial tomatoes, arboriculture, date palms cultivation, red meat, and aviculture. All this will have to go through the establishment of a regulated market system (SYRPALAC) which has a primary purpose, the guaranty of the internal supplies of broad consuming products (Cereals, milk, oil,

potatoes, tomatoes, and meat) and protecting the farmer's income. The achievement of this object requires the implementation of specific measures for the facilitation and protection of the agricultural activity, such as the possibility for farmers to receive interest-free loans (RFIG); Strengthening of leasing credit for the purchase of farm machinery and materials; Insurance to compensate for any reductions in income as a result of natural disasters (FGCA); Strengthening the communication between actors in rural areas to facilitate the exchange of skills; Support for the professional organizations; Improvement the mechanisms of food production, and improvement the security of the agricultural territory.

The "Rural development", second pillar of the new agrarian reform, based on an innovative approach, represented by the " Integrated Rural Development Project" (PPDRI). Rural development is primarily focusing on disadvantaged areas where the production conditions are more challenging as mountains, steppes, and Sahara. Also, aiming for more efficient forest management to facilitate the control of fires. The further goal of rural development is the involvement in the national economy through the promotion of local resources and typical products, so far neglected, as a potential source of agricultural export. Rural development based on five programs, such as protection of river basins; Management and protection of forest heritage; Combating the desertification; Protection of natural spaces, and development of the territory.

Finally, the program for strengthening human capacity and technical support to producers (PRCHAT), is an action mainly aimed at innovation in the agricultural sector, Increasing investment in research and development, and improving training to facilitate the development of new technologies and its rapid transfer to farmers. Other goals of the PRCHAT programs are; Strengthening of the material and human capacities of all institutions and organizations, enhancement of monitoring and protection services, veterinary, and phytosanitary certification services for seeds and seedlings.

The action plan of the government, scheduled for the five-years 2015-2019, with an annual appropriation of €2,8 Billion, it provides for the development of infrastructure and the internal policy for encouraging the national and foreign investments. To achieve, in the next five years, an annual average growth of the agricultural sector, greater than 13%. This aim could be achievable through the implementation of technical measures such as the increment of irrigated surfaces by about one million hectares, reinforcement the mechanization, using of highly productive propagation material, strengthening olive cultivation areas (from 370,000 to 1 million hectares), developing the infrastructure. Besides, the new program of the Algerian Government provides the enhancement of the administration, and regional institution for secure the implementation of agricultural and rural development programs.

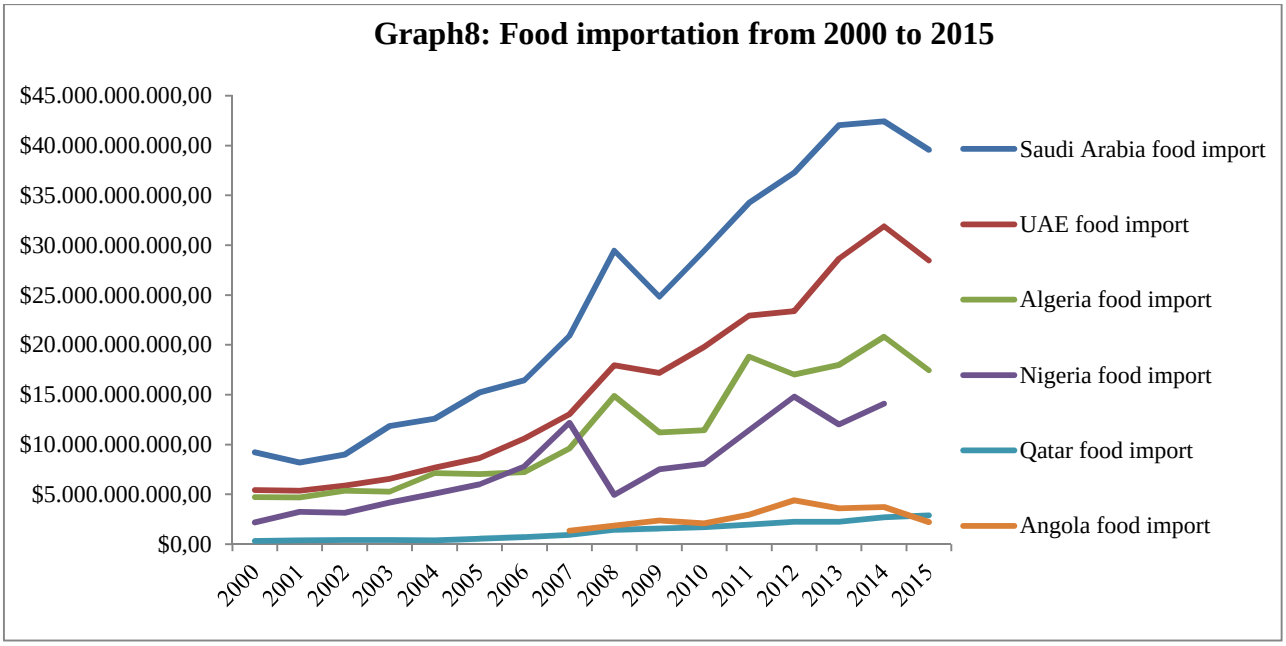
Eventually, the strategy of the agri-food industry (IAA program), Promoted by the Ministry of Industry set as the primary goals, the intensification of the industrial food fabrication, through the creation of 500 modern companies that must comply with the food safety standards required by foreign markets (ISO 22000 standards). The IAA strategy also provides for the establishment of five export consortiums and reduction of the food importation.

2.2. The *post-petroleum* food system in the developing oil-wealth countries.

The developing oil-wealth countries are unstable economically; therefore, this situation is risky for their food system and puts in front of a twofold question: In an era of oil scarcity, what will be the future of the agro-food system?. Also, in a time of *post-petroleum*, how can the policymaker diversify revenue? The lack of crude oil means that the government will not be able to respond to socio-economic challenges in the coming years without implementing a policy of diversification to maintain the economic balance, what could generate an financial and social crisis as has happened in the past in some oil-exporting countries.

The supply of food has been obtained, for decades, through imports. This trade was financed almost exclusively by the income from the petroleum industry. But in the era of oil scarcity, the oil-rich states should be thinking about other economic models for additional revenue to secure the domestic economy. The agricultural sector could be the proper alternative where the industrialization sector in the developing countries is limited. About this critical situation, Awokuse & Xie in 2015 posed this question: Does agriculture matter for economic growth in developing countries?. The agricultural power could contribute for guarantee the internal food sovereignty and enhances the national budget. For imagine a new model of development no longer focusing solely on the extraction of crude oil, an important role could, and should, take on the agri-food sector.

In our study could see six nations that have many similar macroeconomic and environmental characteristics that possessing high income from hydrocarbons, but varying between it about the external food dependency. Could see a direct relationship about oil revenues and volume of food imports in which, immediately, after the fuel shock price in 2014, the quantity of the agro-alimentary imports decreased sharply and could continue to drop by the fall of oil price that means the food security closely ligated to hydrocarbons revenues. In another side, the figure (Graph 8) represents the similarity trend of the food imports between the six states in which influenced by the fluctuation of the oil revenues. In the same time, could see a significant similarity between hydrocarbons revenues trend (see Graph 1) and food importation trend.



From a critical point of view, many others questions could pose, that how can finance the agricultural projects in the epoch of fuel paucity?; and how long time the sustainable agriculture will be dependent on rentier income? For responding to these crucial questions, the political system forcedly should thinking for a long-term financial strategy, in which has been absent for decades. Without a diversified economy, it will be difficult to secure the future food system. The challenge of the oil reserve decline combined with environmental degradation, and the over-increment of the population don't predict well for the future of the world's food security (Wright, 2009). On the other hand, the additional challenge could be the biofuel economy in which the farmers could be motivated to investing in the biofuels production, leaving the farmlands to avoid the sharp food price volatility and the climate impact. Naylor & *Al* in 2007 expected the price volatility in the era of biofuel economy in which the wheat price could fluctuate between (2.5% to 65%), corn (2.5% to 65%), sugar (-8% to 66%), and soy (-11% to 76%). Moreover, 2 to 2.5 billion world's people living by $1 to $2 per day under the risk of the food insecurity due to the continuous rise in food price.

3. State of the art in the study of international trade

This chapter proposes an analysis of the main economic models formulated for the study of international trade, some of them constitute the theoretical foundations on which the gravity model based. It then described how this model works and the how empirical enrichment proposed over the years. Finally, a review carried out on the insertion of barriers to trade, both tariffs and not, in the gravity model.

3.1 THE STUDY OF INTERNATIONAL TRADE

Several models try to explain the motives that lead two countries to market among themselves. The simplest of these is the Ricardo model. In this model, the work is the only productive factor, and countries differ only in labor productivity in different sectors. Relatively, the country's export goods that produce high efficiency and import those which provide low efficiency. In other words, the production model of a nation determined by its comparative advantages.

Since resources are scarce, in production there is a trade-off. When used all the working hours available to produce a higher quantity of the good *x,* is necessary to give up part of the production of *y*. The model explains how trade brings benefit to both nations in two ways; The first is to think of trade as a method of indirect production. Instead, producing an asset autonomously, a nation can produce another good and market it with the desired good. The model shows that every time an asset imported is worth the principle that the "indirect production" requires less work than direct production. Secondly, the trade increases the consumption possibilities of a country, which implies a benefit from the trade. The distribution of benefits from the trade depends on the relative prices of the goods that a certain nation produces for determine these relative prices, is necessary to refer to the global supply and demand.

In the Ricardian model, the trade leads to an international specialization, where each country shifts its workforce from the industries where are relatively inefficient towards those where are relatively more efficient. Since the work is the only productive factor in the model, and that assumed its mobility without cost between one industry and another, there is no possibility to be damaged by trade. Consequently, the Ricardian model suggests that not only all countries could take advantage from commerce, but also every individual should increase his welfare because the trade does not affect the distribution of income.

However, considering the work as a single production factor leads to limitations, because the specific resources of the countries not taken into account. There is a theory, initially developed by Eli Heckscher and Bertil Ohlin, which explains how international trade strongly influenced by differences in resources between countries. The developed model takes the model name Heckscher-Ohlin (HO) or Heckscher-Ohlin-Samuelson (HOS), by the name of the Economist Paul Samuelson. The essence of the model that the trade conditioned by the difference in the abundance of productive factors between countries, and leads to formulate four predictions: a) The HO theorem: A country tends to export the good that uses more intensely, the factor of which is relatively more abundant; b) The price equalization Theorem: With diversified productions, the international trade equalizes the prices; c) The Stolper-Samuelson theorem: Keeping the production factors fixed, an increase in the relative price of an good generates an increase in the real output of the factor, in which used more intensely in the production of the good in question. In the same time, reduces the output of other factor; d) The Rybczynski theorem: By keeping the prices of goods fixed, an increase in the assignment of a productive factor generates a more proportional increase in the production of the good which uses that factor intensely (at the same time, a reduction in the production of the other good that uses the increased factor with less intensity).

The model with specific factors, developed by Samuelson (1971) and Jones (1971), as the Ricardian model, assumes an economy that produces two goods and that can distribute the workforce in two sectors but has the difference to allow the existence of production factors other than work. Given an economy that produces two goods *x* and *y*, which require the use of two or more production factors, unlike the model of Heckscher-Ohlin, the model with specific factors foresees that only one factor, the work, can be moved freely between the production of one of other good. The other factor remains fixed, and for this defined as specific. The international trade has essential effects on the distribution of profits between nations, and therefore the actors can profit as losses from the trade. The theory behind the model has specific factors that the different distribution of profits born for two reasons: The first is that the production factors cannot be moved instantaneously and without cost from one industry to another, while the second is that the change in the mix output of a given economy has effects on the demand for different production factors. The specific factor model allows a distinction between generic-use factors (which can be moved between sectors) and factors that are specific to certain uses. In the model, the differences in the level of resources can involve divers offering curves between nations, and consequently cause international trade.

There is then the monopolistic competition model, which provides for an imperfect competition where one or more producers sell products that are differentiated from those competitors who are not perfect substitutes. here are six characteristics that distinguish the monopolistic competition (Goodwin & *Al*., 2009; Hirschey., 2000): a) the products between them are differentiated; b) There are many companies in the market; c) There is the freedom to enter and exit the market; d) Enterprises take their decisions independently, as they were in a monopoly situation; e) Companies have market power; f) Sellers and buyers do not have the perfect information.

In the monopolistic competition an enterprise takes as data the prices set by its competitors, and at the same time ignores the impact of the price of its products on other companies (Krugman, 2011). In such market, enterprises could have a kind of monopoly in the short term due to product differentiation, and they can also use this market power to generate profits. In the long term, with the entry of other companies into the market, the benefits derived from differentiation decrease by the increase of competition, and companies could not benefit economic profits. This is because the monopolistic competition model provides for barriers limiting the entry and exit of the actors, as a result, when the price of the asset exceeds the average costs, occurs the entry of new companies in the sector, while when the price is less than average costs occurs an exit. This process of entry and exit leads in the long run to have a profit of zero.

In the monopolistic competition model, each country will export classes of differentiated products with other countries. Although the industries of the different states can theoretically produce different categories of products, as seen from the models of the international trade occurs in practice a specialization that leads to maximization of the profit. The business of these products called "*Intra Industry Trade*"-IIT.

In the monopolistic competition model and the model of (HO) with the *continuum* of goods expected the existence of many more assets than factors; This assumption allows the full specialization in different classes of products between countries. In this case the determinants of trade can be described through a relatively simple equation called "gravitational equation" which is described below.

3.2 THE BASIC CONCEPT OF THE GRAVITATY MODEL FOR THE STUDY OF INTERNATIONAL TRADE

The use of the gravity models for the estimation of international trade dates back to 1962, when Jan Tinbergen began an extensive empirical literature on gravitational equations for the study of world import-export. Since then, these have been widely used in the analysis of bilateral flows between different geographic regions.

The theoretical concept that the model refers to the “universal gravitation Law” proposed by Newton in 1687. In this, it stated that the attractive force between two objects *i* and *j* is equal to

$$F_{ij} = G\frac{M_i M_j}{D_{ij}^{\theta}}$$

Where F_{ij} is the attractive force, $M_i M_j$ are the masses of the two objects, and *Dij* is the distance. G is the universal gravitation constant, which depends on the units of measure of mass and strength.

In 1962 Tinbergen has, therefore, resumed the same functional formula, applying to international trade flows. This was also repeatedly used in conjunction with a wide range of those that can be called "social interactions", including migratory flows, tourism and foreign direct investment. This new gravitational equation for social interaction can approximate in the following way:

$$F_{ij} = G\frac{M_i^{\alpha} M_j^{\beta}}{D_{ij}^{\theta}}$$

Where

- F_{ij} is the flow from source *i* to destination *j*;
- M_i and M_j are the size of their economies. If *F* measured as a cash flow (e.g., Value of export), usually *M* measured as gross domestic product (GDP) or gross national product (GNP) of each region.
- *Dij* is the distance between the two regions (usually measured between the respective centres).

Noting that, returning to the previous Newton equation: $\alpha = \beta = 1$, and $\theta = 2$.

3.3 ECONOMIC EXPLANATION OF THE GRAVITY MODEL

The gravitational equation can be thought as a schematic representation of the forces of supply and demand. If *i* is the country of origin, *Mi* represents the total amount of an good that is willing to provide to all its customers, while *Mj* is the total demand of the country *Mj*. The distance acts in terms of transaction costs, imposing trade charges and lowering the level of equilibrium of trade flows.

Recently (starting from Anderson, 1979) there were several attempts to derive the gravitational equation formally; then the theoretical bases of Anderson are reported:

If *Mi* is the total expenditure of the country *j* for all assets of any source *i* , and *Sij* is the share of *Mj* expenditure for goods of the country *i*, then *Fij = Sij Mij*. Accordingly *Sij*:

1. Must be between 0 and 1.
2. It should increase if *i* produce a wide variety of goods (wide n_i) and/or produce goods that perceived as high-quality (large μ).
3. Should decrease with the presence of trade barriers, such as distance, *Dij*.

In the light of these arguments it is obtained that:

$$S_{ij} = \frac{g(\mu_i, n_i, D_{ij})}{\sum_{\varphi} g(\mu_{\varphi}, n_{\varphi}, D_{\varphi i})}$$

where the g(.) function should be positively correlated with the first two arguments, and inversely correlated with the distance, for all i $S_{ij} > 0$.

At this point, necessary a specific form for g ( ). An approach proposed by Bergstrand (1989) uses the monopolistic competition model of Dixit and Stiglitz (1977), for different but symmetric companies. This model fixed μ_i = 1, and makes n_i proportional to *Mi*. A second approach proposed by Anderson takes a single asset from each country, n_i =1, but allows to enter a parameter of preference μ_i that can vary between subjects, depending to the constraint of the market. The differences must also be proportionate to the size of the *Mi* economy. Both of these models allow to consider the costs for trade as an exponential function of the distance.

Allowing the variation of n and μ between countries, obtaining that:

$$g(n_i, u_j) = \sum_{v=1}^{n_i} (\rho_{ijv}/\mu_{ijv})^{1-\sigma}$$

Where ρ is the price, and v indexes the particular substitutable varieties with the elasticity of substitution given by σ. If the goods of a given country are differentiated but of the same average quality, and subject to the same cost of transport, then it is possible to eliminate the parameter v and establish $g(\ ) = n_i (\rho_{ij}/\mu_{ij})^{1-\sigma}$

The next step is to relate the final price (adjusted with the quality factor) with the price in the country of origin and the costs of transport between source and destination. The assumption report as follows: $p_{ij}/u_{ij} = (\rho_i/u_i) D_{ij}^{\delta}$

The price of Origin p_{ij}, is often considered as the FOB price (free on board). In the basic gravitational model are not considered price differences. This is not totally unrealistic as it initially might seem (Head, 2003), however it is required that the FOB price varies proportionally to the quality of the exporting nation's product, in other words that $\rho_i / \mu_j \approx k$.

It is not possible to observe the number of varieties in each country directly. It is preferable to use the property of the model Dixit-Stiglitz, means that all companies with the same size. In this case, $n_i = M_i/q$ where q is the size of the enterprise. By imposing this last assumption, defined as: $\theta \equiv \delta(\sigma - 1) \geq 0$ obtaining that $g(\ ) = n_i \left(\rho_{ij}/\mu_{ij}\right)^{1-\sigma}$

This implies that the market share for exporter i in Country j is: $S_{ij} = M_i\, D_i D_{ij}^{-\sigma} R_j$ where $R_j = 1/(\sum_\varphi M_\varphi\ D_{\varphi j}^{-\theta}$. Substituting and adapting the terms, obtaining a very similar result to the departure equation: $F_{ij} = R_j \frac{M_i M_j}{D_{ij}^{\theta}}$

The main difference is that now the term *Rj* replaces the gravitational constant *G*. As a result would have that: $R_j = 1/\sum_\varphi M_\varphi = 1/\ M_w\ e\ F_{ij}^{*} = M_i M_j / M_w$ (Dove w represents the world).

3.4 THE ESTIMATION OF THE GRAVITATIONAL MODEL

The multiplicative nature of the gravitational model involves the possibility of using the natural logarithm and obtaining a linear relationship between the logarithm of the trade flows and those of the size of the economy and the distance.

$$In\ F_{ij} = \alpha\ In\ M_i + \beta In\ M_j - \theta\ In\ D_{ij} + \rho\ In\ R_j + \epsilon_{ij}$$

The OLS regression (Ordinary Least Squares regression) could estimate the stochastic equation (including the error term ϵ_{ij}) . If the assumptions made previously are accurate, is reasonable to expect the estimation of $\alpha = \beta = \rho$.

3.5 DIMENSION OF THE ECONOMY

The economic dimension of the exporting and importing country, *Mi*, *Mj* are generally measured as gross domestic product. Generally, the estimated coefficients are not significantly different from the value of one, but is not normal to obtain predictive estimates in a wider range, ranging from 0.7 to 1.1. However, it should point out that in the economic model the empirical formula of the gravitational equation assumes a coefficient equal to one, consequently, lacking a theoretical interpretation for coefficients that deviate from this value. There are also other problems that result from the use of logarithms of *Mj* and *Mi* as regressors. The first is high collinearity (Head, 2003), at the moment where is difficult to imagine the world's large economy do not trade more, in absolute terms. Secondly, since export and import are part of GDP, there is always a relationship between F_{ij}, M_i, and M_j.

Also highlighted by McCallum (1995), which reports a problem of endogeneity in the use of gravitational models because the dependent variable (the export) is the component of one of the regressors (GDP). Some studies tried to solve the latter problem by using the instrumental variables method, for example, inserting the population as an instrument instead of GDP. A simple solution is to impose unitary elasticity. This involves to moving the term refers to the income in the left part of the equation. Subtracting $In\ M_i + In\ M_j - In\ M_w$ on both sides, getting that:

$$In\left(F_{ij}/\ F_{ij}^{*}\right) = InM_w\ +\ \rho InR_j -\ \theta In\ D_{ij} +\ \epsilon_{ij}$$

The dependent variable measures the deviation of the current commercial flow from the ideal one which would occur in the absence of friction. The sum of the first two terms on the right side estimated as a regression constant; This means that the variation shown as an error. There are two statistical tests allow to verifying, if the data reject the hypothesis of the absence of restrictions on trade statistically. One of these is the statistic (t) on the constant, and the other is the statistic (t) on θ.

3.6 DISTANCE

The distance is always measured using the formula of the "Large Circle." This formula approximates the shape of the earth with that of a sphere, calculating the minimum distance along the surface.

For calculate the distance have to use longitude and latitude of the "economic center" of each economic study. The distance obtained by the application of the following formula:

$$D_{ij} = 3962.6\, arcos\, ([\, sinY_i\, .\, sinY_j\,]\, +\, [\, cosY_i\, .\, cosY_j .\cos\, (X_i - X_j)])$$

Where X is the longitude in degrees multiplied by 57.3 to convert it to gradients, and Y is the latitude multiplied by-57.3 (if measured in west degrees).

In fact, The main problem of this method that, even in the air transport, the distance measured by the formula of the large circle underestimate the real distance, at the moment, does not consider that the most trade routes avoid crossing the North Pole. However, for maritime voyages, not considered the deviations which made compulsory by the presence of emerged land and ice blocks. Besides, many air and marine routes are drawn taking into account the presence of vital nerve centers, the so-called "economic hubs."

Moreover, as various international shipping cartels often lead to a low relationship between cost and travel distance; Finally, the cost of packing, loading and unloading are mostly fixed costs and, therefore, do not undergo changes with the distance.

Take together; these elements suggest that the distance should have a slight influence on trade; however, the distance hinders the trade enormously. An analysis conducted by Head and Disdier on the estimation of the distance in the gravitational models, starting from 595 regressions reported in approximately 35 works, showed how the elasticity value (θ) concerning the distance is equal to 0.94. That means the doubling of distance trading roughly to halve. The study sample covered a historical period from 1928 to 1995, and the trading partners were mostly nations, although some results have been included on the provinces of Canada.

Leamer and Levinsohn (1994) researched empirical evidence of international trade, identifying the effect of distance on international trade as "the clearest and most robust empirical evidence in economics." An effect of 0.6 found in their study.

On the grounds of this enormous influence of distance on trade, the economists formulated six main explanations (Head, 2003):

1. The distance is a transport cost proxy. For several authors, shipping costs (transport and insurance costs) can explain, in large part, the influence of distance;
2. The distance implies a loss of time during shipping. For perishable goods, the probability of non-alteration is inversely proportional to the time of transport. The meaning of perishability can interpret in a rather broad manner, including the following risks:
    a) Damage or loss of property due to bad weather or ill-treatment;
    b) Decomposition and ruin of organic matter;

c) Loss of market (the possible buyer becomes unable or no longer willing to make the payment).

3. Synchronization costs; When businesses combine different inputs into the production process, there is a need for these inputs to arrive in time to the appearance of "bottlenecks." One possibility to get around this problem is to use stores to maintain a supply of each input, but this approach has several drawbacks (increased costs, technological obsolescence, changing tastes, and low pressure on quality controls). Replenish of inputs from neighboring firms then lowers the synchronization costs;
4. Communication costs; According to Paul Krugman (1991), the distance influences the possibility of personal contacts between suppliers and customers;
5. Transaction costs. The distance can also link to the research costs of commercial opportunities and the establishment of a fiduciary relationship between two potential trading partners;
6. Cultural distance; The increase of the geographic distance leads to the increment of the cultural distance. Cultural differences can prevent trade in different ways, such as hindering communications, generating misunderstandings, and contrasts in the form of negotiation.

3.7 ISOLATION

Several jobs implicitly assume *Rj* is constant between nations and therefore represent the intercept in the regression equation. On the other hand, *Rj* is essential, as it reproduces the alternatives set of each importer. Countries with different suppliers of goods, which are generally also those with low *Rj* values, import less from each specific supplier. Some studies considered variables such as, referring to them, as "isolation." (remoteness). However, some of these measures differ from the correct theoretical *Rj*, which could be problematic. For

example, Helliwell (1998) measures isolation as $REM_j = \sum_\varphi D_{\varphi j} \ / M_\varphi$. This method makes the isolation variable very high if includes distant nations (high $D_{\varphi j}$) , and at the same time, the small dimensions (low M_φ). Because in the literature there is usually $\theta \approx 1$ (Head, 2003), a better insulation measurement is $1/(\sum_\varphi M_{\varphi j} \ / D_\varphi)$. In This formula the dimension of very distant nations becomes irrelevant. The importance of isolation in current trade patterns can be easily illustrated, comparing trade between Australia and New Zealand with trade between Austria and Portugal. The distance between the two major cities of the respective couples is the same: Lisbon-Vienna and Auckland-Cambera, are among them 1430 miles. Moreover, the product of their GDP is similar, with that of the two oceanic countries that is smaller than 20%. Consequently, excluding isolation, the gravitational model predict that trade between Austria and Portugal is slightly higher. In fact, in the year in which the analysis refers, trade between Australia and New Zealand was nine times higher than that between Austria and Portugal.

3.8 ENRICHMENT OF THE GRAVITATIONAL MODEL

Although the gravitational model provides good results in explaining trade using only the economic dimension and the distance between two regions, there is an immense commercial variability that cannot be explained. For this reason over the years many authors have added other variables, Although not of the same theoretical basis, only because past studies had shown that contributed to enrich the empirical formulation. The main are:

Income per capita:

Several authors estimate the gravitational model through the logarithm of the income per capita $In\ M/POP$ of the importer and exporter countries, including also the logarithm of the total income $In\ M$ (Suaré, 2006; Head and Mayer, 2010; Fieler 2011).

The idea behind the use of this variable is that countries with high income generally trade more. Two possible causes of this fact can attributed to a better transport network (internal roads, ports, airports, etc.), and generally, to the lower tariffs applied by high-income countries. On the other hand, a clearing effect may be represented by the fact that the latter tend be more oriented towards the purchase of services, involving a lower level of trade in goods for a given level of GDP.

The estimated coefficients of the logarithm of GDP per capita show considerable variations between nations, ranging from a minimum of 0.2 to a maximum of 1.

Adjacency:

Adjacent or contiguous countries are those that share a border. Several studies include a variable dummy to identify this proximity.

The estimated coefficients are generally close to 0.5, suggesting that trade increases by about half in case of sharing a border. It is not clear why the adjacency should be considered important, if already including the distance in the model. One possible explanation is that the distance of the states based on two points can lead to an overestimation of the same, because neighboring countries often have large volumes of trade (Head, 2003). A further theory is that the adjacency tends to provide qualitative information that allows to discriminate the distance, instead ,which is a purely quantitative information.

Common language and colonial ties:

These variables resume the theory that the impediment to trade exerted by distance is due to transaction costs caused by the difficulty of communication and cultural differences. As a result, it is reasonable to expect that countries speak the same language trading more.

Empirical evidence strongly confirms this hypothesis. Two countries with the same official idiom trade two or three times more than those who do not share any language.

A part of this phenomenon due to the fact that there is usually also a common historical past that has led the two countries to speak the same language. As a result, colonial bonds are also positively correlated with trade.

By including these variables as a control, allows reducing the effect of the language, which is usually still high.

Border Effects:

A more recent literature, begun in 1995 by John McCallum, studies why the frontiers of a country affect trade.

Regarding the Borderless World, K. Ohmae and McKinsey assert that “National frontiers have actually disappeared and the economic logic that made them useful lines of demarcation at first.”

McCallum's examination of Canadian trade determinants shows that, in fact, national boundaries have a significant effect, since the Canadian provinces trade 20 times more with other Canadian provinces than American provinces, with the same distance and the same economic size. The practical example reported by the author considers Ontario's expeditions to British Columbia (BC) and the Washington State. The distance is the same, but in one case there is the border crossing while another does not.

In the case the borders have an irrelevant effect, the gravitational model predicts that exports to the BC should be 60% of exports to Washington due to the size of the two economies. Instead, BC receives from Ontario a quantity of goods 12.6 times higher than Washington.

Consequently, in this case, the effect of the border, defined as current trade divided by the expected one, is 12.6 / 0.6 = 21.

With the establishment of Canada-US Free trade Agreement The trade between these two nations increased rapidly, and the effect of the borders fell to an average of 12. Instead, Anderson and Van Wincoop found more content results, showing how the frontiers reduce the trade by 29% between industrialized countries.

The effects of borders can also be calculated without intra-national trade flows, which are available only for a few countries. This method, developed by Shang Jin Wei, therefore requires estimates of intra-national distances. The effects of borders can also be calculated without intra-national trade flows, which are only available for a few countries.

Evaluation of favorable trade policies:

Countries often establish preferential agreements with the aim of facilitating mutual trade. The liberalization agreements between different geographically close countries (e.g. European Common Market, NAFTA) or not, have rapidly increased since the mid-80.

Generally, the Free trade agreements-FTAs increased the trade by 50%, although a study by Frankel and Rose (2000) reports how the FTAs lead to triple the trade between the countries that stipulate the agreement.

3.9 STATE OF THE ART ON THE USE OF GRAVITATIONAL MODELS IN INTERNATIONAL TRADE

Gravitational models widely used to make inference on the effect on international trade in distance (Disdier, 2008), Common Borders (McCallum, 1995), Tariffs (Baier and Bergstrand,

2007), Technical Barriers to trade (Maskus and *Al*, 2000), fixed costs to trade between nations (Helpman, Melitz and Rubinstein, 2008), and other costs to trade.

Gravitational equations used for decades thanks to their outstanding empirical performance but lacked theoretical foundations until Anderson (1979) that proposed these foundations in the presence of imperfect substitution between goods. The theory explains that in addition to an influence exerted by the size of their economies, trade between two regions decreases according to the existing bilateral barriers, the average trade barrier that has towards all other partners. Consequently, The more significant is the resistance to trade towards all other regions, the higher is the push to trade towards a given partner. Anderson also introduced the theoretical foundations for the use of the gravitational model with constant elasticity of substitution (CES). The replacement elasticity estimated with a regression of the bilateral flows on the basis of different control variables and a measure of the costs to the trade. The coefficient of trade costs is then used as a replacement elasticity between the varieties.

Since the end of the 80, there have been numerous applications of this model, both in its classical form and including new explanatory variables. In particular, gravitational equations have been widely used to assess the effects of the various national provisions on trade, such as tariff agreements, exchange rates, but also the importance of other parameters such as language, ethnicity, and borders.

Further developments shown the consistency of gravitational equations even in the case of situations characterized by monopolistic competition (Bergstrand, 1989). Deardoff (1998) also establishes connections between the Heckscher-Ohlin and gravitational models. One of the most cited works in the use of the gravity model in international trade is McCallum (1995), which uses a gravitational equation where the bilateral commercial flow depends on the outputs of both regions, from their distant and whether or not separated from a frontier.

McCallum, otherwise , what was done in most of the literature, does not use data on international trade to estimate the impact of barriers for trade, but uses a combination of intra-national and international trade data to estimate the effect of the variable “nation” (and therefore frontier) between the determinants of trade. To insert a dummy variable into the equation, which assumes the value one, if deals with trade between state provinces and zero if instead, the business takes place between region and state abroad. The results show that at the parity of GDP and distance of two geographic regions, the trade considerably more, if are not separated from a frontier.

Anderson and Van Wincoop (2003) claim that the original model proposed by Tinbergen has some shortcomings due to the lack of a variable that measures a hypothetical medium-trade barrier, which named the “multilateral resistance.” In literature is often not considered this multilateral resistance, or is included in the variable “isolation”, related to the distance between the two trading partners. The variable isolation does not captures any of the other trade barriers, and, even if the distance is the only bilateral barrier, its functional form is in conflict with the theory (Bergstrand, 1989).

The aims are to solve the “border puzzle” of McCallum, estimating in a first phase the gravitational equation based on what is proposed by McCallum (1995), but adding the variables of multilateral resistance. Instead, the second step is to perform a comparative statistic of general equilibrium, removing the border between the United States and Canada to determine the effects of borders in international trade. It found that borders reducing bilateral trade with a substantial magnitude. The results of several study, which show a much higher border effect is attributed to the fact that (i) consider the effect of frontiers by comparing intra-national trade with the international one, (ii) that the effect of frontiers is large intrinsically for small nations and (iii) that the not considered variables push the estimation of the effects of the borders upward. The Results show once again that the use of the

gravitational model in its basic form not only increases the estimation of the effect of the borders but also produces potential inconsistencies in estimating the level of aggregation between different Business partners.

Also, a similar approach developed by Head and Mayer (2000), which always takes into account the multilateral resistance in the determination of commercial flows, but differs from the model of Anderson to use an empirical specification of two steps, instead, of the fixed effects for the control of the multilateral resistance. In addition, the model of Head and Mayer allows to modeling the asymmetry in the consumer preferences, which is the traditional version of gravity are considered equal for all countries and captured by the fixed effects. This model used by Olper and Raimondi (2008a) to explain the effects of frontiers in the trade in agri-food products between the United States, Canada, the European Union and Japan, by detecting the existence of important asymmetries Market access. The results show an essential role of policies, information costs and cultural proximity in explanation the incidence of the border, while tariff and non-tariff barriers can able jointly explain 28% of trade reduction.

The multilateral resistance also included by Xiong and Beghin (2011a) on the effect of European regulation of aflatoxin on African peanut export. It reported as main problems of the gravitational models the presence of zero to the trade and the heteroscedasticity, which makes it impossible to interpret as truthful the elasticities provided by the models log-linearized. Several estimation techniques used for the gravitational model: the Trun-OLS, the HMR (Helpman-Melitz-Rubinstein) and the maximum likelihood models. The latter are the PPML (Poisson pseudo-maximun-likelihood) proposed by Silva and Tenreyro (2006) and the variants proposed by Burger et al. (2009) To adapt to the large dispersion of data resulting from the presence of zero: The negative binomial pseudo-maximun-likelihood estimator (NBPML), the zero-inflated Poisson pseudo-maximun-likelihood model (ZINPML) and the zero-inflated negative Binomial pseudo-maximun-likelihood model (ZINBPML). Their

results resulted in believing the model Trun-OLS lower than the others because of its inability to explain zeros and access to the market, while the most suitable one proved the ZINBPML followed by the HMR. Their results have led the Trun-OLS model to be inferior to others due to its inability to explain zero and access to the market, While the most suitable one proved the ZINBPML followed by the HMR.

A very bright discussion point on gravitational models is the use of OLS estimates. Silva and Tenreyro (2006) move a critique to the usual practice of interpreting logarithmic patterns where elasticity estimated through OLS, which can lead to misleading results in the presence of Heteroscedasticity. Because the expected value of the logarithm of a random variable depends on the moments of its distribution. Also, if the errors are heteroscedastic, the transformed errors are correlated with the covariate. A further disadvantage of the use of the linear logarithmic model that is incompatible with the presence of zero in trade data, which leads to unsatisfactory solutions to remedy the problem, such as the elimination of Zero from the sample or additional nonlinear transformations of the dependent variable. The authors assert that the gravitational models, with constant elasticity generally, should be estimated in their multiplication form and propose a method of estimation of type pseudo-maximum-likelihood (PML). This method able to be consistent even in the presence of heteroscedasticity, providing an optimal solution even to the problems posed by the presence of zeros in the dependent variable. Comparing the results obtained with the PML and OLS techniques using the Monte Carlo method, is highlighted that the latter tends to overestimate the coefficients of GDP (the PML technique signals them lower than the unit, unlike what is reported in the classical bibliography using the OLS method), as well as the role of colonial ties and geographical distance (Silva and Tenreyro, 2006).

However, several authors continue to use the OLS, among these Baier and Bergstrand (2009), employing this method to approximate the costs of international trade using an equation of

gravity type. Helpman & *Al* (2008) Developed a method for estimating international trade of gravitational models, which allows predicting positive but also nil trade flows between pairs of countries, and allows the variation of the number of exporters to a determined Nation. Allows also decomposing the impact of the clutches on trade in intensive and extensive margins, where the first refers to the volumes marketed by the exporter and the second to the number of exporters. This model produces a generalized gravitational equation that allows the selection of companies in the export market and their impact on the marketed volumes. Subsequently, the two-step estimation procedure developed that uses an equation to select the trading partners in the first phase and an equation of the trade flows in the second. This procedure implemented by parametric, semi-parametric and non-parametric, showing that in all three cases the effects of the restriction on the estimated trade are similar. By acting in this way, the authors were able to estimate the extensive and intensive trade margins, demonstrating that the classical estimates lack objectivity and that most of the alterations are not due to the selection but to the omission of extensive margins. Among the works that employ a gravitational model for the study of the determinants of international trade, found Cipollina e Salvatici (2010) who use a gravity model to estimate the effect of the reciprocal trade agreements (RTAs) in Trade flows between two partner countries, using a meta-analysis approach. The results obtained made it possible to reject with the standard level of significance that the RTAs do no effect in the trade. In particular, time estimates of the relevant parameters obtained from different studies used as single observations for the Multiple regression analysis models (MRA), adopting the method of the weighted least squares – WLS, and testing the Robustness and sensitivity of the results. Subsequently, a focus is on the effects of specific FTAs on trade, using a probit model to identify which factors contribute to the positive and significant impact that RTAs possessed on bilateral trade. The study also criticized the use of the fixed-effect model (FEM) for the estimation of gravity, since there is a part of the literature that demonstrates the inability to summarize high

heterogeneity through an estimation of fixed effects. For this reason, a random effect (REM) model used.

Raimondi and Olper (2010) Use a gravitational model to study the effect of the elimination of tariffs in 18 agri-food sectors, in a broad sample of developed and developing countries. Using the CES Monopolistic competition model introduced by Krugman (1980) complemented by a rich set of international asymmetries as proposed by Lai and Zhu (2004), that estimated the elasticity of substitution by simulating the consequences of abolishing duties. The study shows a significant variation in the estimated elasticity, depending on the model econometrically used, and in particular that the pseudo-maximum-likelihood of Poisson (PPML) significantly increases their magnitude.

The results indicate that trade liberalization would increase the importance of exports of foodstuffs, especially for countries with high GDP per capita, with a consequent decrease in the market share of the developing countries.

The authors emphasize the extent of their study that the fact of having placed attention exclusively on tariffs which, although particularly important in the agri-food sector, are not the only barriers that act on trade. Therefore, suggested to consider also the effect of non-tariff barriers (NTBs), which remain an important challenge for the analysis of trade, assuming as a more appropriate approach of the CES with a Gravity model.

On the same line Yue, Beghin and Jensen (2006), Xiong and Beghin (2011b) use a constant-elastic replacement model to incorporate the heterogeneity of the goods into a gravity model. Also Arkolakis & *Al*. (2008) and Feenstra (2009) use an CES model to study the benefits of international trade, by detecting how in the monopolistic competition model the amount of the trade depends strongly on only two parameters: The percentage change of household expenditure as a result of the exchange rate trade barriers, and a gravitational estimator of the

elasticity of imports on the variable trade barriers. Liu and Yue (2009), broaden the model of Yue, Beghin and Jensen (2006) by development a methodology to quantify the combined effect of the two main non-tariff barriers, using an CES model with a factor that can consider the technical progress for incorporating changes in the quality of goods.

Henderson and Millimet (2008) Underline how, despite the substantial theoretical foundations on which gravitational models based on bilateral trade, the empirical implementation requires different assumptions that do not follow the theory directly. Firstly, the unobserved commercial costs assumed to be a linear logarithmic function of the observable ones. Secondly, the effects of trade costs considered being constant between pairs of countries. Maintaining consistency with the theoretical foundations, but removing the constraints previously described, the gravitational model estimated with non-parametric methods. Parametric ones offered an equal or superior reliability regarding of sample prediction and out-of-sample prediction in most cases. Besides, formal statistical tests do not allow to reject the presence of the constraints, implying higher efficiency of the parametric models. The conclusion of Henderson and protector is that the gravitational model, with the assumption that the costs to trade are linear and homogeneous, is a correct representation of the bilateral trade. The results obtained by excluding zeros, contrary to what was proposed by Silva and Tenreyro.

Li and Beghin (2011) Perform a meta-analysis to explain the systematic changes in the results of the estimates the effects of technical regulations on trade, using different methodologies and methods of sampling the data. The results obtained show that the agri-food industry tends to be more affected, or less advantageous, by these measures and barriers than what is happening in other sectors. The results obtained show that the agri-food industry tends to be more affected, or less advantageous, by these measures and barriers than what is happening in other sectors. Moreover, does not consider the “multilateral resistance” increases the

possibility of inflating the effects of the impediment to trade due to technical regulations. Otherwise, is not possible to put the endogeneity potential of trade policies into an opposite effect, and it can lead to the erroneous conclusion that does not reduce trade. Studies using the MRL (*maximum residual limits*) tend to detect a more significant impediment to trade than other measures and lead to apparent effects of policies since its focused on a specific measure. Other proxy measures tend to generate confusion in results, increasing the likelihood of inconclusive results and weak policy implications.

3.10 MODELING OF COMMERCE BARRIER

As mentioned the gravity model can be enriched by several variables, including the most interesting ones are certainly barriers to trade (tariff and non).

Tariff Barriers:

It is often more complicated than it can initially appear in a gravitational model. In fact, few countries have a single duty for each of the 6-digit HS codes (HS 6) related to the wine in its different classes, which bottled, sparkling and bulky. The most common is to find differences in the levy depending on the alcohol degree or other parameters set by the various national authorities. The presence of different ranks of levy leads to the need to make an association between them, to obtain an average data that reflects adequately the tax operated by a state towards each of its suppliers, subjects also face for HS code 6.

Transformation in ad valorem equivalent.

The aggregation of tariffs is, however, a relatively complicated procedure, and there is still no universally recognized methodology as the most suitable. A first problem that arises when comparing the tariff profiles of different countries, often is very duties that not expressed as a

percentage on the value. Instead, refer to the quantity or other parameters (as can be for example the grad of alcoholic in the case of wine). Therefore, in these cases is necessary to calculate the respective AVE (ad valorem equivalent) to have a set of rates comparable to each other.

The tariffs converted into the respective AVE by dividing the duty through the unit value of the asset. Therefore, the problem lies in the choice of the unit value, which encompasses different complications both from a statistical and methodological point of view. Theoretically, the duties have a more critical impact on goods of the higher unity of value, and even if the 6-digit HS classification allows to differentiate very well between different classes of products, however, is not entirely excluded the heterogeneity between it.

The use of the respective unit values can initially seem very interesting, is entirely consistent with the size of the collected duties, also allows to operate a qualitative differentiation of the respective trade flows. On the other side, is more sensitive for errors in the estimation of data provided by the reporting countries, and is not represented if the magnitude of trade is modest. Calculating the AVE based on the world average of the import proposed by Gibson & *Al* (2001) offers better guarantees regarding the robustness of the data, but without considering the qualitative differences between products to reflect differentiation between partner countries, while avoiding the excessive volatility of data. Bouët & *Al* (2008) proposed a calculation of the AVE based on the average unit value of world export, calculated from a group of reference countries of which the exporting member belongs. Then, each nation included in a group of countries with similar characteristics, defined by a hierarchical cluster analysis based on GDP per capita (concerning purchasing power parity) and commercial opening. Using the unit value of the reference group offers three main advantages: (i) considered the differences in the unit value between countries with different qualitative preferences, (ii) the problems of endogeneity deriving from the push to vary the quality of the

products in response to specific tariffs are more content than those that would be working with bilateral unit values, since the value calculated on world export; (iii) The use of the group of countries is more robust for estimation errors than the respective unit value; Being based on the median is not strongly influenced by outliers. However, once all the tariffs transformed into its consideration, AVE is a second methodological problem, that is to summarize it correctly in a single representative figure in case there are more sublines within the C Odice HS 6.

Data aggregation Methodology

The first approach to aggregating tariffs is to use the simple medium to capture the overall level, and the standard deviation to measure the dispersion seen as the differential of observations from the arithmetic average. The use of the average tariff without any weighting offers, however, different disadvantages. The first of these is that the tariffs have incredibly uneven distributions, and therefore the average cannot be the most suitable summary measure. In These cases, the mean value may improperly represent the central tendency, and the most representative measure could be the median. When the tariff profile has a normal distribution, the average and the median should be very close, otherwise when the distribution is not homogeneous both the media and the median can provide useful information. Cases recorded a high average, and a low median (or the opposite) suggest an extremely high (or low) protectionist level for a few specific product categories, while most of the tariff lines are low (or high). Also, Anderson and Neary (2003) criticize the use of simple media, considering it to be free of foundation and reporting two main problems arising from the use of the same: To equally treat all commodities and sensitivity to any variations in the HS classification. Of the same opinion Bouët & Al (2008) which consider the simple average without any theoretical basis, and therefore advise against its use.

The most commonly used methodology for aggregating tariffs remains the use of their weighted average , using the respective import quota valued at the border. The formula for calculating the weighted average rate is as follows:

$$\tau^{\alpha} = \sum \omega_K^* \ \tau_K$$

Where τ^{α} is the tariff share to valorem of the good k and the weight based on the value of the import of the good ω_K^* balancing to the total import.

$$\omega_K^* = \frac{M_K P_K}{\sum M_k P}$$

While this equation easy to calculate, on the other hand, this measure suffers from the higher price of the tariff, the higher efficiency of the restriction on trade, depending on the elasticity at the price of the application (Anderson & *Al*., 2003; Bouët, 2008). There is no apparent solution to this problem (Bouët, 2008). However, many authors proposed different methods of weighting tariffs. The first of these is Leamer and Levinsohn (1974), which proposes the use of world import as a weighting measure. However, if on the one hand this solution is able to solve the problems of endogeneity, on the other it does not allow to consider the specificities of the different national economies.

Gibson & *Al*. (2001), working on a large group of nations, converted all tariffs using the unit value of world trade to the 6-digit HS code level, while Bureau & *Al*. (2004) moreover, Jank & *Al*. (2002) Used the calculated average price, but the average of the last three years on the 8-digit HS code. The first of these two approaches influenced by some tariff spikes that may be present within the 6-digit HS code, while the latter has the defect of being able to use only data from specific countries and no the world average. Therefore, the problem of identifying a robust methodology but that allows at the same time to discern between the peculiarities and differences of the individual nations.

A solution to this problem proposed by Bouët & *Al*. (2008) In the construction of the MAcMap database, where once again used for weighting, import of a group of reference countries. The import of each group of countries then normalized taking into account the size of each country.

Unfortunately, this approach, as well as other weighting methodologies that use parameters other than the national import, cannot be used with a higher level of detail than HS code 6, since HS codes with 8 or more digits differ from country to another, and therefore are not comparable.

Non-Tariff Barriers:

The inclusion of non-tariff barriers in the gravity model has also a crucial importance in the estimation, as reported by Raimondi and Olper (2010). The implications of these measures on market access mechanisms are generally more complex than a traditional barrier based on a tax levy, mainly because market imperfections being formed (asymmetry of information, externalities, etc). Therefore, the non-tariff barriers tend to change the consumer information set and their behaviour, as well as the behaviour of the producers. For these reasons cannot be easily transformed into a simple tax or equivalent price (Xiong and Beghin, 2011b). In the literature, different measures proposed and used to identify non-tariff barriers and to estimate their impact. However, is possible to classify these methodologies into four main groups:

Estimation by frequency and coverage indexes:

Frequency indexes shall only take into account the presence or absence of the non-tariff barrier in question. These indexes do not provide any further information on the respective value of the affected products, which can be acquired through the hedging index. The latter is ideally calculated using the value that the import would have assumed in the absence of the

NTBs (Leamer, 1990). However , this value is undetectable and the domestic or worldwide imports often used as an alternative weight. Despite, this approach suffers from endogeneity problems: if the barriers to trade actually reduce the transactions, the index is underestimated (Fontagné & *Al*. 2008).

Deardoff and Stern (1997), mention two other limits of frequency and coverage indexes; The first is that do not indicate the deterrent effect that the non-tariff barriers have on the average of quantity and price, the goods purchased by the importer. Secondly, these indexes do not provide any indication of the possible effect of barriers on prices, productions and international trade. Dollar and Kraay (2004) claim that the hedging indexes do not seem to be able to capture the severity of a non-tariff barrier.

The frequency and coverage indexes used in several studies: Nogués, Olechowski and Winters, (1986), analyse the impact of NTBs on the import of sixteen industrialised countries for the years 1981-1983, finding that non-tariff barriers influence more than 27% of the global import and more than 34% of import from developing countries. Other authors and institution who used these indexes are: OECD 1995; Fontagné, von Kirchbach and Mimouni, 2005).

Estimation of the quantitative impact:

When trying to quantify the NTBs, a fairly used technique which cannot be explained by the tariffs. A typical methodological approach is to rely on the residues of the trade determinants, inserted in the econometric regressions of the trade flows.

This method uses models for estimating commercial flows (mainly gravitational models) in which the information on non-tariff barriers included as explanatory variables. The comparison between the expected commercial flow in the absence of NTBs and the current

one provides information on trade restrictions operated by these barriers. Frequency or coverage indices usually do the insertion of barriers to trade in the model.

Critically, this approach justifies the trend of the trade from what the model can explain, using a set of political effects including the NTBs, while the model may not be able to explain all commercial flows, even in the absence of domestic regulations and other factors falling under the frontier effects. When focus on specific products and related trade flows between nations, the estimate becomes so sensitive to the assumptions made by the model (Beghin and Bureau, 2001).

Leamer (1990) and Harrigan (1993) Use this method to determine the impact of NTBs on trade in 1983. The results obtained by Leamer show how trade barriers reduced the export of South America to major industrialized countries, while Harrigan conclude are that tariffs and transport costs between OECD members, significantly operate higher restriction than non-tariff barriers.

Otsuki & *Al*. (2001) Use a gravitational model to explain the determinants of trade between nations and to determine the effect of the European standard on aflatoxin of African export. Their results show that the new and more restrictive regulations seem to be the main barriers to the export of dried fruit. Xiong and Beghin (2011a) move two criticisms to the study of Otsuki & *Al*. (2001); The first is the time variation of the standard set by law, which makes its effect not distinguishable from the multilateral resistance of which it has already spoken. The second derives from zero elimination, which limits the economic interpretation of the model.

Moenius (2004) based on this approach to study the impact on trade of bilaterally recognized (shared) and country-specific standards. Its analysis, operated on 471 production sectors in 12 countries for the period 1980-95, shows the existence of a positive influence of the shared standards, while for specific ones the results vary depending on the sector.

Henry de Fraham and Vancauteren (2006), studying the process of integrating European technical regulations into the agri-food industry, highlight how harmonization helped to raise trade within the European Union. Finally, Fontagné & *Al* (2005) use the quantity-impact measures to estimate the effect of SPS and TBT on trade in fresh and processed foodstuffs, showing a significant or positive impact on most goods.

Jayasinghe, Beghin, and Mama (2010) use the gravity model with constant elasticity of substitution to incorporate intermediate demand for maize seeds and to calculate the tariff equivalent of SPS regulations.

Heien and Sims (2000) use a gravitational model to study the Free Trade Agreement (FTA) between Canada and the United States and its effect on wine export. The study attempts to quantify the impact of the reduction of wine export restrictions from the United States to Canada. The methodology foresees an initial estimate of the demand function for wines exported from the USA to Canada. Using data from the period before the FTA, therefore, the elasticities found by the estimated model, used for predict the percentage variation of the import, based on the historical variation of three variables: Price in Canadian dollars, replacement price in Canadian dollars, real wage and annual income. The difference between real and expected imports attributed to two remaining factors: tariffs and non-tariff barriers. An increase in imports of 10% calculated as a result of the removal of tariff barriers and 17% of non-tariffs.

Price-wedged Estimate

This approach based on the idea that NTBs can be estimated based on its impact on the domestic price in comparison with a reference price. The primary use of this method is to obtain a given AVE (ad valorem equivalent) of non-tariff barriers, directly comparable with tariffs. Since the price that would have with the total absence of barriers is not observable, the

effect of the price, also known as "price weight" is usually obtained by simple comparison between the domestic the domestic and world price in the presence of NTBs.

There are several limitations reported by several authors of this methodology; Among these, the principal is that the measure of NTBs implicitly as AVE, is valid only below the assumption that the imported goods are perfect substitutes. There is a possibility that there is a distortion due to qualitative differences between domestic and imported products. Also, this method makes it possible to quantify the effect of NTBs set present in the market but rarely makes it possible to identify with certainty and precision. Finally, the comparison between domestic and international prices can influenced by differences in the elasticity of demand and supply between countries.

Campbell and Gossette (1994) Use this method in different sectors, including food and agriculture, by applying quality adjustments to make comparable products. The USITC 19 regularly uses this method to measure the AVE price differential per sector in the United States, even in this case adjusted according to the qualitative differences. Calvin and Krissof (1998) estimate the AVE of the technical regulations in the apple field, comparing the monthly CIF price of U.S. apples sold in foreign markets with the wholesale price found in these markets. The authors assume that the price differential is due to tariff and technical barriers in the case of similar apples (e.g., Same variety, size and quality, period, similar price in the sales channel). In the study, also the cost of transport taken into account, and the average monthly price divided into the known tariff and the non-tariff barrier AVE, which constitutes the residue.

Bradford (2003) Use this methodology to calculate the AVEs using the correct import price with shipping costs, distribution costs, and taxes. Dean & *Al*. (2006) Apply price comparisons to a large group of nations and products, estimating the AVE using directly an equation

derived from a model of product differentiation based on retail price. Yue, Beghin, and Jensen (2006) Expand this methodology, taking into account the imperfect substitution between the domestic and imported goods. In particular, used a constant of elasticity substitution (CES) to incorporate the heterogeneity between goods in consumer preferences (qualitative differences), and to calculate the tariff equivalent of TBT.

Liu and Yue (2009) also quantify the effect of the two main barriers to trade, using a CES model and price-wedged method. Besides, the authors resumed the extended model of Yue, Beghin, and Jensen (2006) by introducing a factor that could consider technical progress to incorporate qualitative changes in goods. Their results suggest that the elimination of non-tariff barriers would lead to an increase in imports by the Japanese industry of cut flowers. Xiong and Begin (2011b) Use the AVE of SPS and TBT inserted in a gravitational model to estimate its effect, also separating a positive component (which increases the demand for the imported goods) and a negative (which decreases it).

Estimate the price effect using the elasticity of the importer's demand

This methodology, developed by Kee, Nadkarni, and Olarreaga (2006), also provides the NTBs. Using the comparative advantages methodology proposed by Leamer (1990), the quantitative impact of NTBs on imports at the 6-digit HS code level estimated. The Leamer approach based on the construction of a forecasted import model using the production factors. In the case of the presence of NTBs, the real import is different from that could be envisaged, this difference represents the impact of the barrier on trade. The quantitative impact then converted to AVE using the elasticity of the importer's demand.

The complicated calculation is the main problem that the model suffers. Moreover, the unavailability of detailed price data for countries and, or products often makes it impossible to use this method.

4. Econometric estimation of food dependency

The evaluation of food import dependency and the prevalence of undernourishment of the selected six developing oil-exporting countries (Qatar, United Arab Emirates, Saudi Arabia, Angola, Nigeria, and Algeria) permit to use the gravity model for the estimation. In which, could see a significant role of the independent variables on the influence of the foodstuffs import and the prevalence of undernourishment.

The generic form that uses for this study is log-log under the following equation:

$$\boldsymbol{In\, F_{ij} = \alpha\, In\, M_i + \beta In\, M_j + \rho\, In\, R_j - \theta\, In\, D_{ij} + \epsilon_{ij}}$$

Additionally, the study permit to use the quantile regression model for the estimation of the dependent variables in different quantile. Technically, Quantile regression methods have advantages beyond providing a richer characterization of the data. Median regression is more robust to outliers than least-squares regression. Moreover, quantile regression estimators can be consistent under weaker stochastic assumptions than possible with least-squares estimation. Leading examples are the maximum score estimator of Manski (1975) for binary outcome models and the censored least absolute deviations estimator of Powell (1984) for censored models.

For a continuous random variable *y*, the **population** *q*th **quantile** is that value μ_q such that *y* is less than or equal to μ_q with probability q. Thus

$$q = \Pr[\, y \leq \mu_q \,] = F_y\,(\mu_q),$$

where F_y is the cumulative distribution function (cdf) of *y*. For example, if $\boldsymbol{\mu_{0.75}} = 3$ then the probability that $y \leq 3$ equals 0.75. It follows that

$$\mu q = F_y^{-1} \text{ y } (q).$$

Leading examples are the median, $q = 0.5$, the upper quartile, $q = 0.75$, and the lower quartile, $q = 0.25$. For the standard normal distribution $\mu_{\mathbf{0.5}} = 0.0$, $\mu_{\mathbf{0.95}} = 1.645$, and $\mu_{\mathbf{0.975}} = 1.960$. The 100$q$th **percentile** is the qth quantile.

For the regression model, the **population** qth **quantile** of y conditional on **x** is that function μ_q (**x**) such that y conditional on **x** is less than or equal to μ_q (**x**) with probability q, where the probability is evaluated using the conditional distribution of y given **x**. It follows that

$$\mu_q \, (\mathbf{x}) = \; F_{y|\mathbf{x}}^{-1} \, (q),$$

where $F_{y|\mathbf{x}}$ is the conditional cdf of y given **x** and we have suppressed the role of the parameters of this distribution. It is insightful to derive the quantile function μ_q (**x**) if the dgp is assumed to be the linear model with multiplicative heteroscedasticity

$$y = \mathrm{x}'\beta + u,$$
$$u = \mathrm{x}'\alpha \times \varepsilon,$$
$$\varepsilon \sim \text{iid } [0 \, , \sigma^2] \, ,$$

where it is assumed that $\mathrm{x}'\alpha > 0$. Then the population qth quantile of y conditional on **x** is that function μ_q (x, β, α) such that

$$q = \Pr [y \leq \mu_q \, (\mathrm{x} \, , \beta, \alpha \,)]$$
$$= \Pr \left[u \leq \mu_q \, (\mathrm{x} \, , \beta, \alpha \,) - \mathrm{x}'\beta\right]$$
$$= \Pr \left[\varepsilon \leq [\, \mu_q \, (\mathrm{x} \, , \beta, \alpha \,) - \mathrm{x}'\beta \,] \, / \, \mathrm{x}'\beta \right]$$
$$= \; F_\varepsilon (\mu_q \, [(\mathrm{x} \, , \beta, \alpha \,) - \mathrm{x}'\beta] \, / \, \mathrm{x}'\alpha)$$

where we use $u = y - \mathrm{x}'\beta$ and $\varepsilon = u / \mathrm{x}'\alpha$, and F_ε is the cdf of ε. It follows that

$[\mu_q \, (\mathrm{x}, \beta, \alpha) - \mathrm{x}'\beta] \, / \, \mathrm{x}'\alpha = F_\varepsilon^{-1} \, (q)$ so that

$$\mu_q(x, \beta, \alpha) = x'\beta + x'\alpha \times F_\varepsilon^{-1}(q)$$

$$= x' \left(\beta + \alpha \times F_\varepsilon^{-1}(q) \right)$$

Thus for the linear model with multiplicative heteroskedasticity of the form $u = \mathbf{x}'\boldsymbol{\alpha} \times \varepsilon$ the conditional quantiles are linear in **x**. In the special case of homoskedasticity, $\mathbf{x}'\boldsymbol{\alpha}$ equals a constant and all conditional quantiles have the same slope and differ only in their intercept, which becomes larger as q increases.

For univariate random variable y the usual way to obtain the sample quantile estimate is to first order the sample. Then $\widehat{\mu}_q$ equals the [Nq]th smallest value, where N is the sample size and [Nq] denotes Nq rounded up to the nearest integer. For example, if N = 97, the lower quartile is the 25th observation since [97 × 0.25] = [24.25] = 25. Koenker and Bassett (1978) observed that the sample qth quantile $\widehat{\mu}_q$ can equivalently be expressed as the solution to the optimization problem of minimizing with respect to β

$$\sum_{i:y\,i \geq \beta}^{N} q\,|\,y_i - \beta| + \sum_{i:y\,i < \beta}^{N} (1 - q)|y_i - \beta|.$$

This result is not obvious. To gain some understanding, consider the median, where q = 0.5. Then the median is the minimum of $\sum_i q\,|\,y_i - \beta|$. Suppose in a sample of 99 observations that the 50th smallest observation, the median, equals 10 and the 51st smallest observation equals 12. If we let β equal 12 rather than 10, then $\sum_i q\,|\,y_i - \beta|$ will increase by 2 for the first 50 ordered observations and decrease by 2 for the remaining 49 observations, leading to an overall net increase of 50 × 2 − 49 × 2 = 2. So the 51st smallest observation is a worse choice than the 50th. Similarly the 49th smallest observation can be shown to be a worse choice than the 50th observation.

This objective function is then readily expanded to the linear regression case, so that the *q*th quantile regression estimator $\hat{\beta}q$ minimizes over βq

$$Q_N(\beta_q) = \sum_{i:y_i \geq X_i'\beta}^{N} q\,|y_i - X_i'\beta| + \sum_{i:y_i < X_i'\beta}^{N} (1-q)|y_i - X_i'\beta|,$$

where we use β_q rather than β to make clear that different choices of q estimate different values of β . Note that this is the asymmetric absolute loss function, where $\hat{y}$ is restricted to be linear in x so that e = $y - X_i'\beta_q$. The special case q = 0.5 is called the **median regression estimator** or the **least absolute deviations estimator** (Cameron & Trivedi, 2005).

In our study, the impact of explanatory variables (oil export, crop index, gross national expenditure, total population, and corruption) proved on the food importation (Table 1) by quantiles regression. Also the impact of some other explanatory variables as food import, oil export, gross national expenditure, rural population, arable land, and corruption on the prevalence of undernourishment in the targeted countries. Where interesting results regarding the **paradox of plenty** shown in the (Table 2). The study released econometrically by STATA software.

The source of the variables (dependents and explicative) shown in the following table:

Variables	**Unit measurement**	**Source of data**
Food import	$US Billion	UN Comtrade
Prevalence of undernourishment	% of population	World bank
Oil export	$US Billion	UN Comtrade
Crop index	Coefficient (2004-2006=100)	World bank
Arable land	% of land area	World bank
Gross National Expenditure	% of GDP	World bank

Total population	Million	World bank
Rural population	% of total population	World bank
Index of corruption	Average score from scale 0 to 100	Transparency international

Table 1: Models of the dependent variable In (food import) via OLS and Quantile regression (QR).

Explanatory variables	OLS	Q (0,25)	Q (0,50)	Q(0,75)
ln (oil export)	0,354***	0,738***	0,481***	0,431***
In (crop index)	-0,006***	-0,004	-0,006*	-0,002
ln (total population)	0,179	0,172	0,434***	0,773***
ln (gross national exp)	0,556***	0,152	0,362**	-0,144
In (corruption)	-0,019**	-0,043***	-0,033**	-0,047***
R-squared	0,83	0,63	0,61	0,64
N	96	96	96	96

Level of significance: * $p < 0,1$; ** $p < 0,05$; *** $p < 0,01$.

Table 1 Analysis: The OLS estimation demonstrates that the dependent variable (food import) of the six selected countries related synergistically with fuel export and gross national expenditure by a significance level of 1% of both. In the same time, linked adversely to the crop index (crop productivity) with 1% of importance, and corruption by 5%. In the other hand, non-impact of the population on food importation. This study possesses a goodness fit at approximately 83% that means the model (OLS) explain the independent variables significantly.

Regarding the alternative models by its different quantiles is considerably different to the OLS regression, could see more signification in the quantile of 25% about oil export where the raise of 1% of oil export lead to the raise of 0,78% of food import better than the other quantile of 50% and 75% that means the oil export has a good impact on the lower food import. About the crop index could see its lower impact just in the 50% quantile and OLS that means the local food production in the selected six countries not sufficient to decrease significantly the food importation. Regarding the population has more impact on the greatest quantiles of 50% and 75% that the increment of the total population provoke more food importation. The gross national expenditure registers its impact just in the median quantile of 50% where the raise of 1% lead for the increment of the food import by 0,36% but the corruption decrease the food import in all the models, particularly in the quantile of 75%.

Table 2: **Models of the dependent variable In (prevalence of undernourishment) via OLS and quantile regressions:**

Explanatory variables	OLS	Q (0,25)	Q (0,50)	Q(0,75)
ln (Oil export)	9,2***	4,13***	8,183***	10,86***
ln (Food import)	1,707***	-3,06***	-3,45***	-3,49***
ln (Gross national exp)	-9,74***	-1,57***	-6,658***	-10,20***
In (Rural pop)	-0,315***	0,02	-0,18	-0,39***
In (Arable land)	-0,172***	-0,23***	-0,238***	-0,15***
In (Corruption)	0,126***	0,02	0,082	0,13*
R-squared	0,91	0,4	0,56	0,75
N	96	96	96	96

Level of significance: * $p < 0,1$; ** $p < 0,05$; *** $p < 0,01$

Table 2 Analysis: The OLS analysis shows a full significance of all independent variables with the prevalence of undernourishment. Some variables react positively on

undernourishment level as food import, rural population, arable land, and gross national expenditure in which its potential increment decreases the malnutrition significantly. Paradoxically, the more oil exportation in the developing countries doesn't influence on the reduction of undernourishment positively. Moreover, the corruption remains the limiting factor in its adversary impact on food import and undernourishment. The high R-squared of the OLS model nearly 91,5% demonstrate the greater significance of the independent variables.

The quantiles regressions for the prevalence of undernourishment also considerably different to OLS regression and could show a significant results in all quantiles where the food imports decease more the undernourishment in the median and higher quantiles (50% & 75%) but regarding the oil export could see a contrary or negative relationship where coefficient is positive that means the increment of oil exportation don't decease the undernourishment, particularly in the quantiles of 50% and 75%. This results confirm the theory of "the paradox of plenty". The rural population registers its positive impact just in the highest quantiles of 75% where the increment of rural population by 1% decrease the undernourishment by 0,39%. In the same time there are not any significance in the others quantiles. About the gross national expenditure registers its positive impact in all quantiles, particularly in the greater quantiles of undernourishment by more than 10% means the food availability in the selected countries very related to the government subsidies. Regarding the lower availability of arable land could see a lower positive impact on the higher level of undernourishment by 0,15% but in the same time could register a significant impact in the lower quantiles under 25% of undernourishment. About the impact of the corruption could see a more significant impact in the quantiles of 75% that means the increment of the corruption increase the undernourishment.

Finally, comparing the two tables could conclude that the “oil export curse” record its highest significance solely (at 1%) by all models estimation (OLS, Q0,25, Q0,50, and Q0,75) on the food import dependency and the increment of undernourishment rate.

Conclusion:

Food dependence on oil finance opened an economic debate in oil-exporting politics. In relative terms, imports of food products, which are increasingly expensive, led the oil governments in recent decades to introduce strategies to increase the percentage of food self-sufficiency. The analysis of this phenomenon allows the use of empirical models that favor the study of trade relations between fuel countries and the exporting states of agri-food products. To this end, the use of gravitational models allows taking into account distance, population, GDP and other economic and non-economic factors that influence the flow of import-export. For remedy this problem, the hydrocarbon governments put in place austerity policies to support the financial budget. This system is, once again, a sign of economic instability and food insecurity of the aggravated countries, the latter, from scarce or difficult to use natural resources for agricultural production. In other words, being rich in natural resources, have been neglected in the last decades due to the presumption of the durability of the wealth derived from the oil that has proved to be not entirely truthful. A recent intervention by the developing oil-rich government to ensure the food self-sufficiency has been the sustainable modernization of the agricultural sector, allowing the exploitation of some available resources such as uncultivated land and the groundwater. The implementation of an efficient system of financing and crop insurance through the strengthening and revitalization of banks and agricultural agencies to ensure more significant mobilization of the credit of rural areas and for promoting agriculture in combination with higher economic stability.

Agriculture could represent a viable alternative to oil in the developing countries where industry and technology are limited. Not to be neglected, it will be the investment in human capital as well as the stability of agricultural prices given the increase of the demands caused by the demographic growth in all the world, particularly in the developing countries.

The question of food security is not limited to the agricultural sector but must accompany by a growth of the whole economy. If the country wants a prosperous agriculture that contributes to the improvement of food security and sovereignty, it will also have to develop other strategic sectors such as services guaranteeing the funding sources that could satisfy the needs of farmers and rural areas in general. Without an integrated national economy, there can be no security or sustainable food sovereignty.

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