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Using DEA to Evaluate the Potentials and Impediments of Egypt-Africa Intra-trade: COMESA Case Study

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Abstract: *The Common Market for Eastern and Southern Africa (COMESA) was established in 1994 as a step forward the Preferential Trade Area for Eastern and Southern Africa established in 1981 and with the vision of establishing a Common Market and a Monetary Union in the future.*
This papers aims to identify the potentials and constraints facing the Egypt Africa intra-trade focusing on the COMESA region. The method used in the paper is based on Data Envelopment Analysis that will be used to identify the main factors affecting the trade dimension of integration process between Egypt and other COMESA countries using the Africa Regional Integration Index.
Keywords: *COMESA, Egypt, Intra-trade, DEA, Integration Index.*

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I. Introduction

The Common Market for Eastern and Southern Africa (COMESA) is one of the Regional Economic Communities (RECs) in Africa consists of 19 countries, which include Egypt, Burundi, Zimbabwe Comoros, Congo D.R., Zambia, Djibouti, Seychelles, Eritrea, Swaziland, Ethiopia, Kenya, Libya, Madagascar, Mauritius, Malawi, Rwanda, Uganda and Sudan. It was formed in 1994 to enhance intra-regional trade among its members.

COMESA was established in the mid-1960s, when Eastern and Southern African Countries initiated a process to create an Eastern and Southern African economic community. In 1981, the preferential trade area for eastern and southern Africa (PTA) establishing treaty was signed, entering into force in 1982. COMESA establishment treaty was signed in 1993 in Kampala, Uganda. It turned into a free trade area (FTA) in 2000. In 2009 COMESA Customs union was launched in Harare, Zimbabwe.

Despite the existence of COMESA for more than two decades, its influence on intra-trade between member countries is not clear. Most of the members slow rate of growth in exports, and structural increasing trade deficit.

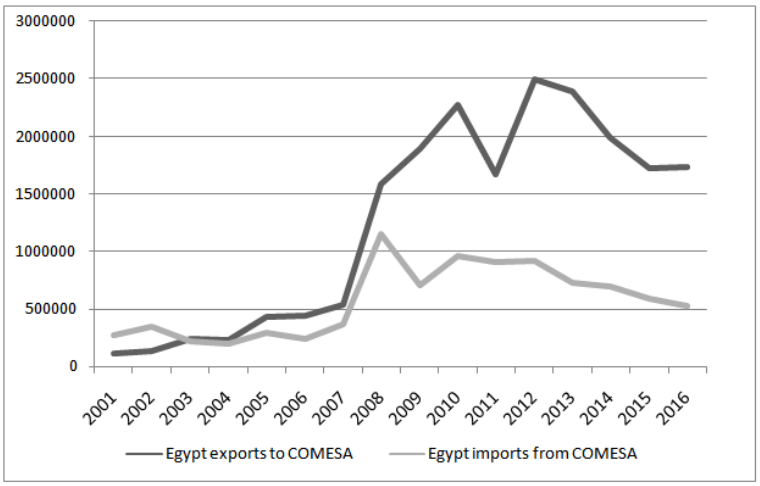
In this context, this paper is divided into two parts; the first part is the status and trend of trade relations within COMESA region using different indicators such as trade intensity and Africa regional integration index, while the second part is using DEA to analyze the potentials and impediments of trade between Egypt and other COMESA states.

II. Egypt-COMESA Integration Performance

2.1: Status and trend of Egypt COMESA intra trade:

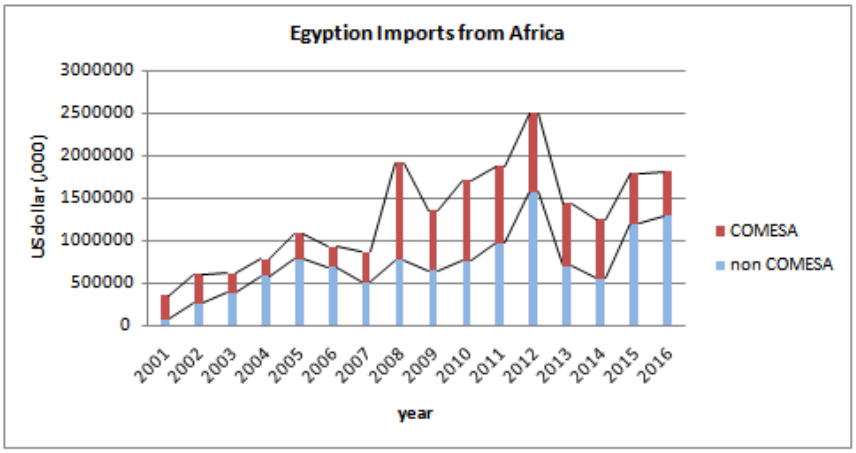
Since 1999, when Egypt became a COMESA member, the Egyptian trade with COMESA countries significantly increased as shown in figure 1 and 2. The Egyptian Exports to COMESA increased with an average annual rate of 29% from 2001 to 2016, comparing to 14% representing the annual rate of change of Egyptian total exports in the same period. The export volume increased from about 113 million dollars in 2001 to 1.7 billion dollars in 2016. From the import side, Egyptian imports from COMESA also increased with an average annual rate of 15% from 2001 to 2016, comparing to the annual change of Egyptian total imports that was14% in the same period. The imports volume rose from 276$ million in 2001 to 529$ million in 2016.

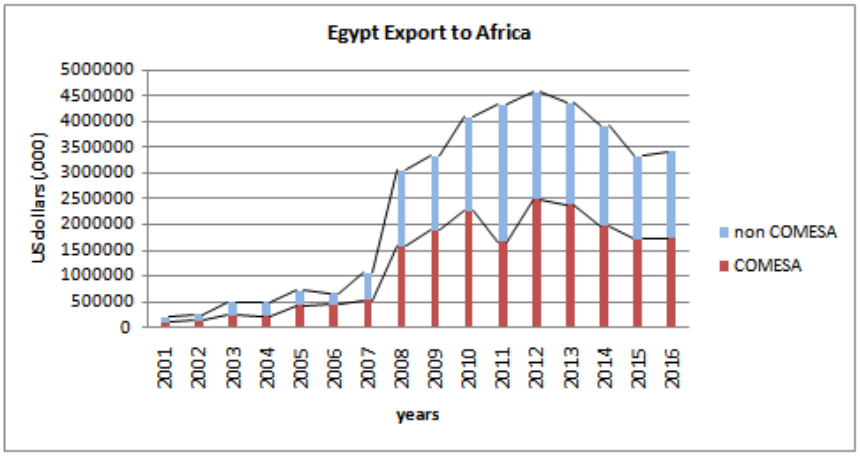
Figure (1)
Egypt-COMESA intra trade (, 000 US $)



Despite the significant increase of Egypt-COMESA trade, share of Egyptian exports to COMESA as a percentage of Egyptian exports to Africa remain relatively constant around 50%, while the share of Egyptian imports from COMESA members decreases (only 29% n 2016).

Figure (2)
Egypt-Africa intra trade

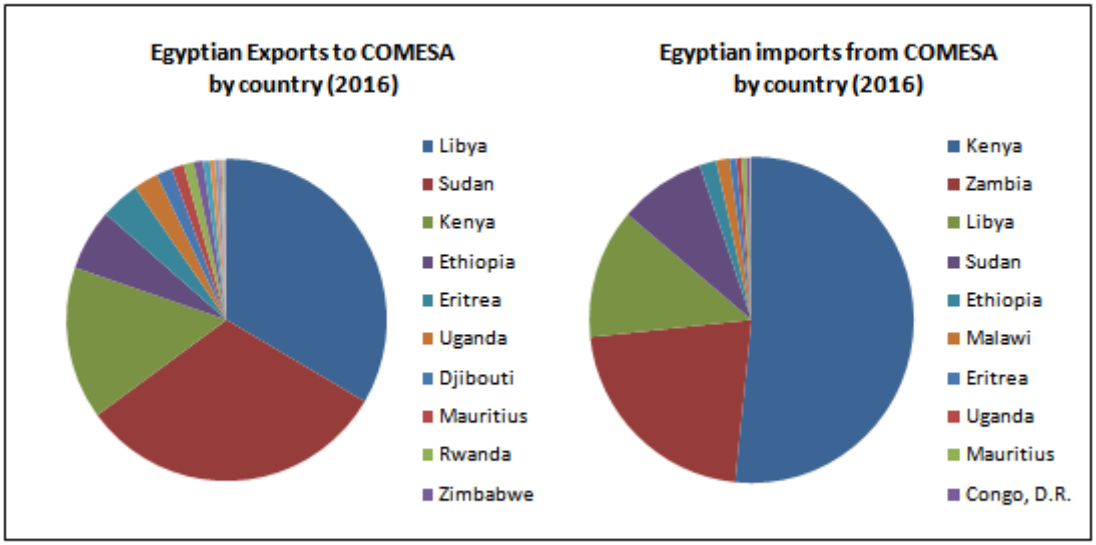




Source: prepared by the researchers based on the data of world trade map, available at: www.trademap.org

The main Egyptian trade partners in COMESA from the import side are: Kenya (52%) followed by Zambia (22%), and from the export side are Libya (33%) followed by Sudan and Kenya (31%, 15% respectively) according to 2016 trade statistics..

Figure (3)
Egypt-COMESA trade by country



Source: prepared by the researchers based on the data of world trade map, available at: www.trademap.org

Despite the incentives of the COMESA agreement, and the increasing trend of Egyptian trade with COMESA, the importance of COMESA countries as trade partners to Egypt is still limited as shown by the share of Egyptian exports to COMESA as a percentage of total Egyptian exports which were 1% and 8% of imports and exports respectively.

To investigate whether the value of trade between Egypt and COMESA is more or less than what would be expected, given Egypt trade with the rest of the world, trade intensity indicators could be used. Regional Trade Intensity Indicator is calculated using the following formula (WB 2018):

$$TI_{ij} = \frac{Xij}{Xi} \div \frac{Xwj}{Xw}$$

Where,
TI_{ij}: export/ import intensity of country i with region j.
X_{ij}: Country i export/ import with region j
X_i: Country i total export/ import
X_{wj}: region j export/ import with the world.
X_w: total world export/ import.
If the value of trade intensity indicator is higher than (1), it means that country trade flow with the region is larger than expected based on countries importance in world trade.
As shown from table (1), Egypt-COMESA export/import intensity indicators from year 2001 to 2016 were larger than one, indicating the potential opportunities to increase trade between Egypt and COMESA. The trade indicators has an increasing trend, and relatively high if they compared to their values before Egypt joining COMESA where they were 1.27 and 1.91 in 1990 and 1995 respectively according to (Elmorsy 2015).

Table (1)

Egypt-COMESA Trade Intensity index (2001-2016)

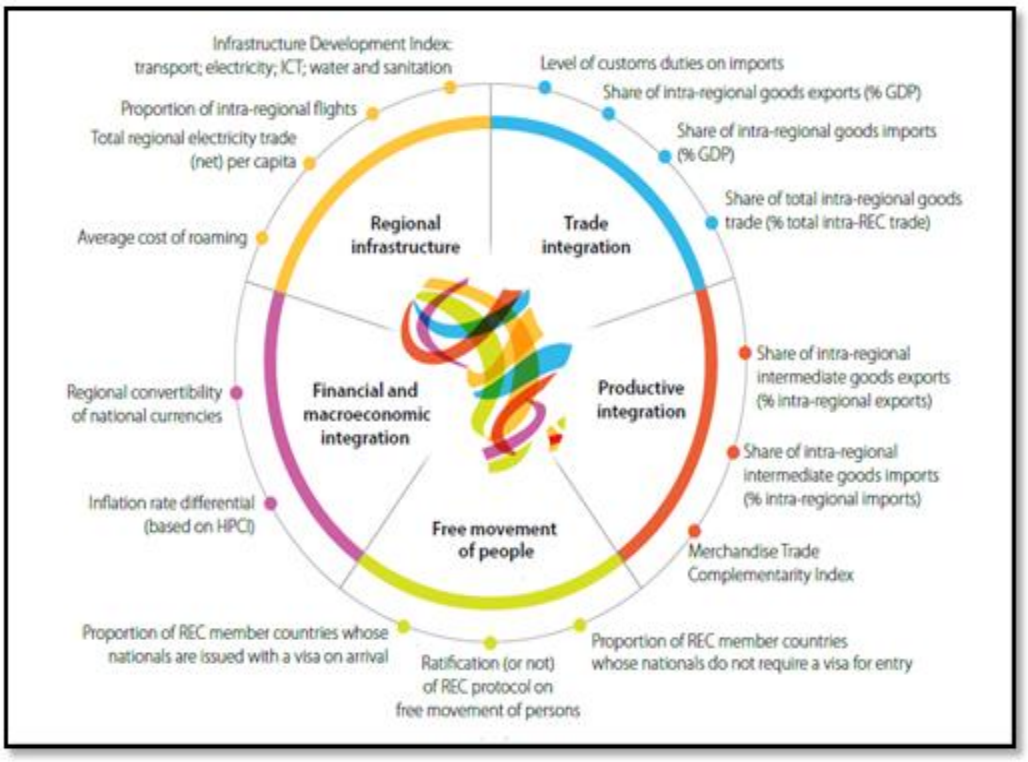
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
egypt export to COMESA	111	133	237	231	418	443	535	1585	1892	2277	1674	2496	2101	1986	1727	1737
Total Egyptian exports	4141	4662	6359	7680	10646	13720	16157	25967	24382	26312	31582	29417	28780	26812	21967	22507
world Export to COMESA	35268	36474	31564	42182	54423	62922	72906	127904	110789	138166	149708	176185	175895	180819	186492	128114
Total world exports	6135523	6404340	7461959	9086146	10943377	11953434	13777548	15975981	12317363	15065848	18078275	18469415	18968536	18976454	16525532	15840040
egypt export intensity	**5.32**	**6.00**	**9.25**	**8.80**	**7.87**	**6.13**	**6.25**	**7.52**	**8.70**	**9.43**	**6.40**	**8.89**	**8.96**	**7.77**	**6.97**	**9.55**
egypt imports from COMESA	276	343	225	199	236	219	363	1149	708	962	906	922	732	699	594	530
Total Egyptian imports	12720	12496	10893	13841	19811	20593	27031	52751	44912	53003	62282	60805	66666	71338	74361	58052
world imports from COMESA	35268	36474	31564	42182	54423	62922	72907	127903	110789	138166	149708	176185	175895	180819	186492	128115
Total world imports	6135523	6404340	7461959	9086146	10943377	11953434	13777548	15975981	12317363	15065849	18078275	18469415	18968537	18976454	16525532	15840040
egypt Import intensity	**4.38**	**5.77**	**4.97**	**3.58**	**2.15**	**2.20**	**2.54**	**2.72**	**1.75**	**1.98**	**1.76**	**1.58**	**1.18**	**1.03**	**0.71**	**1.13**

Source: calculated by researchers based on data from: **world trade map**, available at: www.trademap.org

2.2. Evaluate the Egypt regional integration in COMESA using African Regional Integration Index (ARII):

The ARII is consists of five dimensions, which are the main socio-economic parallel of economic integration based on Abuja treaty. Each dimension measured by a set of indicators (showed in graph 1), so that the ARII is calculated using 60 indicators. ARII value varied from 0 to 1 where 1 indicates the best integration performance.

Figure (4)
Indicators and dimensions of ARII



Source: AFDB, UNECA and AUC: **African Regional Integration Index: Report 2016**, p.11.

The African Regional Integration Index could be used to compare the performance of RECs and their members on the overall integration or in each dimension of the ARII.

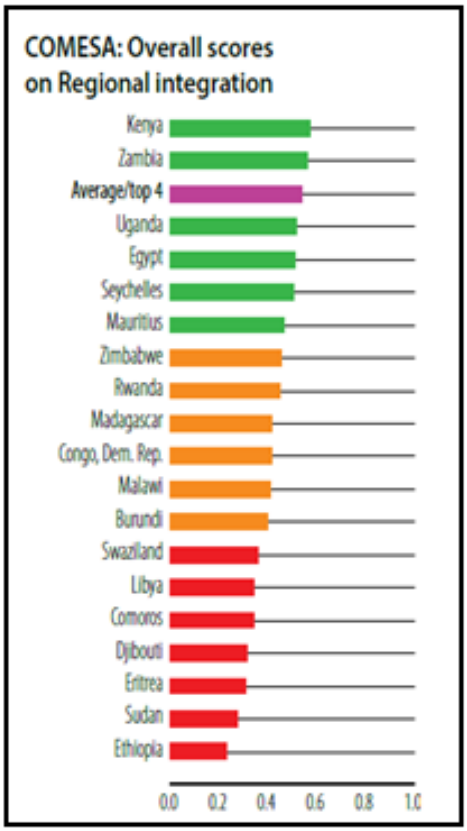
According to ARII, COMESA Rank in the integration is the lowest just before CEN-SAD, while the best REC is EAC followed be SADEC and ECOWAS.

On the country level, the report consider a country as "broadly integrated" when it is strongly integrated on three or more of the ARII dimensions. And the Country is "deeply integrated", when it is among the top performing countries on the regional integration overall (among the top four in the REC that has more than six member and one of the top two other wise).

IN COMESA, although Egypt is the first contributor of wealth creation in COMESA, it is the fourth on regional integration. The ARII of Egypt is 0.511 higher the average ARII of the COMESA countries 0.415.

The Egyptian integration Performance within COMESA could be analysing according the the five Dimensions of the index[1]:

[1] For more details about these indicators and the way by which they are calculated, see:
AFDB, UNECA: African Regional Integration Report 2016, p.48. at:
http://www.uneca.org/sites/default/files/PublicationFiles/arii-report2016_en_web.pdf



Source: ARII 2016, p.14.

Figure (5)

1) Trade Integration: this dimension include 4 indicators: level of customs duties on import, intra- exports as %GDP, intra- imports as %GDP, and total intra- trade as % total intra-REC trade.
In this dimension, Egypt score is 0.9, the 2nd highest in the region after Zambia
2) **Regional Infrastructure:** it includes: percentage of intra-regional flights, Infrastructure Development Index, average cost of roaming, and total regional electricity trade per capita. Egypt score in this dimension is 0.506, the forth in COMESA after Seychelles, Libya and Burundi.
3) **Productive Integration:** it's calculated using 3 indicators: percentage of intra-exports of intermediate goods, percentage of intra-imports of intermediate goods. Merchandise trade complementarily index. In this dimension Egypt is the highest in COMESA with a score 0.762.
4) Free Movement of People: it has 3 indicators: enforcement of REC protocol on free movement of persons, percentage of REC countries whose citizens do not require a visa for entry or on arrival. Egypt has the lowest score (0.032) in this dimension just before Libya.
5) Financial and Macroeconomic Integration: it is calculated using: Regional convertibility of national currencies, and Inflation rate. Egypt score in this dimension is 0.354, and ranks as the 11th between COMESA members.

According to ARII report Egypt integration in COMESA is "deep and broad" since the country is between the top four in the COMESA and performs strongly on three dimensions of the index: Trade Integration, Regional Infrastructure and Productive Integration.
The main constraints facing Egypt integration in COMESA according to this index are: **a) Free movement of persons:** Seven African countries are allowed to enter Egypt visa-free or with a visa on arrival, which places the country joint forty-third in Africa for this indicator. And, **b) Trade integration:** Egypt has made a progress towards removing tariff barriers to intra-community imports: its average applied tariff on imports COMESA is just 0.1 per cent. Egypt also scores well in terms of trade facilitation; it is the eighth in Africa on the ease of trading across borders according to "Doing Business" index. In addition, Egypt ranks second highest in terms of its trade complementarities with the rest of the continent, behind only South Africa, which suggests a high degree of specialization between Egypt and its neighbours.

III. Potentials and Impediments of Egypt-COMESA intra trade:

3.1: Literature Review:

The literature Review about integration could be organized into two groups: the first is the theoretical and conceptual literature on Regional Integration, and the other is the Empirical Studies of integration.

3.1.1: Theoretical literatures:

Many theories are developed to identify the creation of international trade itself and its important to economic development. This theoretical body can be divided into: classical theories as: comparative advantages and relative competitive advantages theories, trade- general equilibrium analysis, the Heckscher-Ohlin theory and its extensions. And the new trade theories that based international trade on, imperfect competition, economies of scale and variation in the development and spread of new technologies over time among nations.

The main conclusion of these theories is that factors behind trade is basically depends on the trade partners themselves; most of the trade between developed and developing countries is based on differences in factors endowments (including technology), while most of trade among industrial countries is based on economies of scale in differentiated products (Salvatore 2001).

On the other hand many theories are specially developed to analyse the trade of the developing and least developed countries. One main theory is the Dependency theory (Tanyanyiwa 2014). According to this theory, Regional integration and trade between developing and least developed countries can be seen as a useful tool for eliminate the dependence of developing countries. Dependency theory argues that poverty in the developing countries is not because they are not integrated but because of how they are integrated. Poor countries offer natural resources, cheap labour, a place for obsolete technology, and markets to the developed nations. The main way for those countries is to reduce links to the core (developed countries) through import substitution polices and south- south co-operation, one form of such cooperation is regional integration (Inotai 1991).

3.1.2: Empirical literatures:

Empirical Studies applied on different regional integration schemes and its impact on intra-trade gives mixed results. But in general, almost all of these studies agreed on the existence of series constraints facing the economic regional integration in Africa and impeding its role in enhancing African intra-trade.

In (Carrere 2004), the paper found that African regional agreements generate a significant export growth between member countries especially in UEMOA and CEMAC. There is also the study of (Ajayi 2005) about integration in West Africa. The study found that engaging in the ECOWAS increased trade between member countries. Yet, the challenges of political stability, effects on fiscal resources, monetary constraints presented considerable concerns for the creation of an economic union. In (Musila 2005) gravity model was used to estimate the intensity of trade diversion and creation in COMESA, CEEAC and ECOWAS, from 1991 to 1998. This study found that although trade intensity varied, the effect of trade creation is stronger than trade divergence which was low in the three regions. (Karamuriro 2015) examined the effect of COMESA agreement on intra-exports using panel data for the period 1980 to 2012 by applying augmented trade gravity model. The study found that the formation of COMESA has improved export performance among its member countries by more than 35%. The study also identifies the main factors that influence the level of trade, which are: economic level convergence, infrastructure level, official common language and contiguity. The absence of macro-economic policy coordination between members of African RECs and political instability are the main constraints of integration according to the study (Kamau 2010). More specifically, the study of (Elfadil 2007) focus on the potential trade of agriculture products in COMESA found that there is a great potential for intra-regional trade in agriculture products, and that the policies of COMESA member countries should emphasis more on encouraging integration to benefit from existing potential of trade and comparative advantages in the region.

On the other hand there are many other studies on the African regional blocks suggested that the African integration hasn't a significant impact on trade in Africa. According to (Jebuni 1997), trade liberalization is a more useful trade policy than joining preferential trade agreements. The paper concluded that regional trade integration may be difficult to be enforced since it may lead to reduce tariff revenues and instability in the balance of payment, and that African countries usually have high transportation costs for intra-trade compared to the costs of non regional trade relations. (Ogunkola 1998) studies the impact of regional integration in ECOWAS by comparing regional exports before and after integration. He found that intra-ECOWAS export level is very low. In the study of (Kagira 2001) about the performance of intra-industry trade in Eastern and Southern Africa named many non-tariff barriers which are: export and import licensing, quantitative restrictions, foreign exchange allocation, stipulation of import sources, charges for acquiring foreign exchange, prevention of advance import deposits, and conditional permission for imports. According to the study of (Carrillo-Tudela and Li 2004), Africa RECs suffer from many problems as regional imbalance, price

variations, political instability, and inconsistence custom regulations. In (Anne Maria Mayda 2006), the study found that in general South-South trade agreement create limited economic gains, through its limited impact on trade volume but the effect varies from one country to another; low income countries have inelastic demand curves and therefore less likely to benefit from trade reforms.

To sum up, although empirical studies on Africa regional integration and its impact on intra-trade performance give mixed results, they agreed on the existence of different constraints faces African integration. These constraints could summarize into two groups: economic constraints, such as economic divergence, economic structure similarities and monetary or exchange problems, and non economic constraints, such as weak infrastructure, political welling and political instability.

In this Study, DEA analysis is used to reveal the impediments of Egypt COMESA intra-trade. This method was used in (Naeher 2015) to estimate the untapped potentials of Asian Integration. In his study he used two inputs: logistic performance index and business regulation environment index, while the output is regional integration index. DAE is applied on six Asian regions and for a sample of 19 regions. The researcher concluded that south and central Asia have the largest unused integration potential among the Asian Regions. On the world level, all regions included in this analysis still have untapped integration potentials. But Africa is found to achieve about 70% of its integration potential.

3.2. Method: Data Envelopment Analysis:

Data Envelopment Analysis (DEA) is mathematical approach defined as: a "data-oriented" approach used to evaluate the performance of number of peer entities (Cooper 2011). DEA introduced in 1978 by Charness, William Cooper and Rhodes who develop its Basic Model known by their names CCR Model (Toth 2009), assuming that DMUs works under constant returns to scale.

The original CCR model for n DMUj where j=1,…,n, that produce Y_{rj} where (r= 1,…, s) using X_{ij} where (i= 1,2,….,n), takes the following formula(Joe 2006):

$$MAX\theta = \sum_{r=1}^{s} U_r Y_{r0}$$

Subject to:

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \le 0, \quad j=1,2,\ldots\ldots,n$$

$$\sum_{i=1}^{m} V_i X_{i0} = 1$$

$$^{*}U_r, V_i \ge 0, \qquad r=1,2,\ldots\ldots,s \text{ - } i=1,2,\ldots\ldots,m$$

3.3: Data Description:

In our analysis we use output orientation approach to build CCR model with one output and three inputs to evaluate the potentials and constraints of integration in the community.

The output used was: **African Regional Integration Index[2],** which mentioned previously in section 1.3, while the inputs selected to reflect the potential constraints of integration, as follow:

1) **Logistic Performance Index (LPI)[3]:** as an indicator for the trade infrastructure of COMESA member countries.
2) **Trade Complementary Index (TCI)[4]:** as indicator for economic structure similarity between trade partners.

[2] African regional integration index is chosen in this paper as the output rather than using other trade indicators since any improvement in any of the dimensions included in the calculation of ARII will eventually enhance the intra trade of the region.

3 The index is designed by WB as a summary indicator of logistics sector performance, ranged from 1 to 5 where higher score represented better performance. The indicator is consists of six sub-components: the efficiency of customs and broader clearance, the quality of trade and transport infrastructure, the ease of arranging competitively priced shipments, the competence and quality of logistics services, the ability to track and trace consignments, and the frequency with which shipments reach consignees within scheduled or expected delivery times.

3) **Dual Membership**: this indicator is used to include the main problem facing economic integration in Africa which is dual membership of a country in more than one RECs leading to contradicted commitments to these blocs and so impeding the integration process in Africa. The indicator used here is the number of memberships of each country.

The following table shows the data for the selected output/ inputs indicators for year 2016.

Table 2: Inputs and output variables of DEA

country	output	Inputs		
	ARII [1]	LPI[2]	TCI[3]	Membership[1]
Kenya	0.573	3.33	0.3	4
Zambia	0.565	2.43	0.2	2
Uganda	0.52	3.04	0.3	3
Egypt	0.511	3.19	0.5	2
Seychelles	0.506	3.57	0.1	2
Mauritius	0.47	2.5	0.2	2
Zimbabwe	0.454	2.08	0.2	2
Rwanda	0.45	2.99	0.1	3
Madagascar	0.42	2.15	0.1	2
Congo, D.R.	0.419	2.38	0.1	3
Malawi	0.412	2.8	0.1	2
Burundi	0.401	2.51	0.2	3
Swaziland	0.359	2.5	0.2	2
Libya	0.345	2.26	0.2	3
Comoros	0.343	2.58	0.1	2
Djibouti	0.317	2.32	0.3	3
Eritrea	0.308	2.17	0.1	3
Sudan	0.275	2.53	0.2	3
Ethiopia	0.233	2.39	0.1	2

Sources: (1) AFDB: African Regional Integration Report 2016.
(2)world bank online database, at: http://data.worldbank.org
(3) UNCTAD online Database, at: http://unctadstat.unctad.org/EN/

From the previous table:

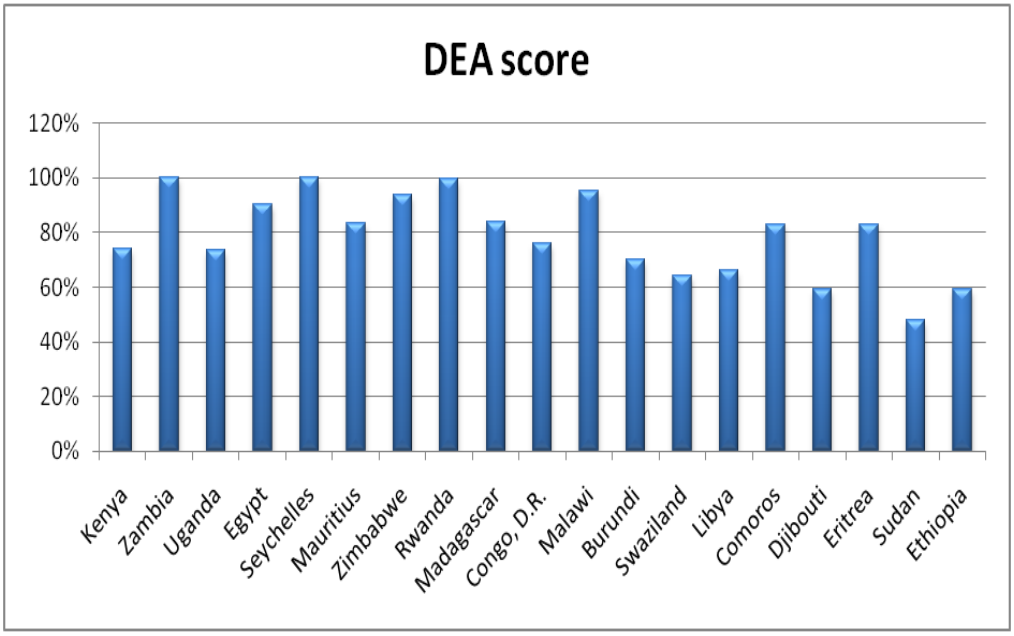
- The integration infrastructure level measured by LPI in COMESA region is relatively low in all member countries (almost less than 3.5), but the best performing country in this context is Seychelles, while the lowest one is Zimbabwe, While Egypt rank is the third.
- The trade complementary index is low, and this is could be explain in the light that most of these countries depending on exporting natural and agricultural product leading to a noticeable similarity in their export structure. Egypt is the only exception where TCI value is 0.5 since its export structure is more comprehensive and diversified than other COMESA countries.
- All COMESA countries are members in more than one regional economic community. Kenya is a member in four RECs, eight countries are members in three RECs, and ten are members in two RECs.

3.4: Result and Discussion[5]:

An output-oriented DEA is performed using the DEA on line software available at www.deaos.com to estimate the untapped integration potentials between COMESA member countries. Figure (6) shows the resulting efficiency scores for 15 of COMESA members and their corresponding ranks.

4 This index measures to what extent the export profile of a country matches the import profile of its trade partner. The index values range from 0 to 1 with 0 indicating that there is no correspondence between country export structure and its partners import structure and 1 indicating a perfect match in their export/import pattern. Higher index between two partners indicate more gains from trade agreements.

[5] Note that DEA is a tool to measure relative efficiency, meaning that the calculated score and rank is relative to the cases and indicators used in the analysis.



The previous DEA shows that only three COMESA countries are fully achieved the maximum integration potentials they could achieve given their economic and non economic circumstances: Zambia, Seychelles and Rwanda, while there is still a room for improvement or untapped potential for the rest of those countries. Egypt score for example is 90% meaning that Egypt is currently achieving 90% of its possible integration level given its economic and non economic circumstances. On the other hand, countries as Ethiopia, Sudan and Djibouti are currently only achieving less than 60% of their possible integration levels. By analysing the main constraints or impediments facing those countries, using the improvement possibility analysis of DEA given by the software, are the dual membership of the countries, and the structure similarities.

IV. Conclusion and Policy Implications:

The empirical findings of this paper provide answers to two important questions: what is the status of Egypt trade and integration levels with other COMESA countries? And what are the main constrains or impediments of this trade?

To answer the first question, the paper examined the current status of trade relations between Egypt and COMESA countries, and the following results are found:

1- Despite the significant increase of Egypt-COMESA trade, share of Egyptian exports to COMESA as a percentage of Egyptian exports to Africa remain relatively constant around 50%, while the share of Egyptian imports from COMESA members decreases.
2- By using African Regional Integration Index, COMESA Rank in the integration is the lowest just before CEN-SAD, while the best REC is EAC followed be SADEC and ECOWAS.
3- The ARII of Egypt is 0.511 higher the average ARII of the COMESA countries 0.415 and the main constraints of integration in Egypt were the monetary constraints and the free movement of people and capital.

With regard to the second question, using output-oriented DEA showed that although the existence of such constraints Egypt is getting used of about 90% of its potentials concerning integration and trade with COMESA countries, although the result or the rank is high but there is still a place of improvement, meaning that given the existence constraints Egypt could still increase its trade with COMESA countries.

Although Egypt trade Performance with other COMESA Countries is relatively well, there is still a room for enhancement. This could be happened through:

1) Pay more effort to facilitate trade between Egypt and other COMESA countries through establishing trade offices and agencies that provide a detailed market research for the real need of the potential markets in COMESA to get benefit for the diverse economy Egypt has which could be considered as a relative advantage of Egypt in this region.
2) Enhance the cooperation COMESA countries especially concerning the issues of shipping and movement of goods and people between region countries.

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