Assessing the Intra-Arab Trade Integration and Potential: Evidence from Stochastic Frontier Gravity Model

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International Trade Theme

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Abstract

Following the theoretical background on production theory, this study employs a stochastic frontier gravity model (SFGM) to investigate the intra-Arab trade performance and potential over the period 1998-2015. The trade performance against the maximum possible level of potential trade is measured by a stochastic frontier. The emphasis of this study is to examine the presence of '*behind the border'* and '*beyond the border'* constraints on trade flow among Arab countries, which have been neglected by previous studies. The empirical results indicate that '*behind the border'* constraints are responsible for a considerable gap between potential and actual trade among Arab countries. That is to say these constraints obstruct realizing the full trade potential despite the fact that these countries have initiated many trade arrangements to promote intra-trade during the last fifty years. The results also reveal that the influence of '*behind the border*' constraints on trade flows between Arab countries have been decreasing over time. Moreover, the efficiency scores of intra-Arab trade indicate a relatively low degree of trade integration among Arab countries, confirming the existence of both '*behind the border*' and '*beyond the border*' rigidities against intra-Arab trade. Finally, the paper ends with some policy implications to remove these barriers as a necessary condition to realize trade potential among Arab states.

Keywords: intra-trade performance, stochastic frontier gravity model, Arab countries

JEL Classification: F14, F15

1. Introduction

It has been widely recognized that regional integration represents one of the key factors that enhance economic growth and development in different countries and regions. In Arab world, the initiatives for regional integration have started since the second half of the past century. In particular, the history of trade integration in the Arab region dates back to the establishment of Arab League in 1945 in which the founding document articulated a strong commitment to promote economic cooperation and intra-Arab trade (Neaime, 2005 and Abu Hatab and Elkheshen, 2015). Subsequently, in 1953, the Arab League approved the first agreement on Trade Facilitation and Organizing Transit Trade among Arab States (Abu Hatab 2015). In 1957, Arab countries agreed upon the free movement of people and capital as well as the establishment of a common customs area. Lately in 1996, most of the Arab countries agreed on the Greater Arab Free Trade Area (GAFTA) that aimed to eliminate trade barriers between member states. However, despite all these efforts to encourage economic cooperation in Arab world, the actual intra-Arab trade performance is far less from the potential level. According to International Monetary fund' trade statistics, the volume of intra-Arab trade during the last decade is very low and do not exceeds 6% (IMF, DOTS, 2016).

From scholarly perspective, voluminous numbers of studies have tried to inspect the reasons behind the unsatisfactory intra-trade performance in the Arab region (e.g. Bolbol, 2006, Soderling, 2005, Bolbol and Fatheldin, 2005 and Al-Atrash and Yousef, 2000 and Abdmoulah , 2011), among others. However, all these studies have employed the two-stage conventional gravity model, which measures trade potential using the mean predicted values as a benchmark. In the first stage of this method, the parameters of gravity model are estimated, and then used (i.e. in the second stage) to project the expected trade flows between the countries. Then, these predicted outcomes had been compared with actual trade to assess the likelihood for future expansion or exhaustion of trade relations between a pair of countries. The underlying assumption of this method is that all of the deviations of observed trade volumes from their potential levels are due to the random noise component of the model and not due to trade inefficiencies. In other words, these studies have failed to recognize the role of '*behind the border*' and '*beyond the border*' inefficiencies in curbing (promoting) the achievements of trade potential levels[1]. However, the deduction drawn from these findings has been challenged by voluminous number of recent studies (e.g. Kalirajan, 2008; Ravishankar and Stack, 2014, Bhattacharya and Das, 2014 and Tamini et al., 2016). Specifically, these studies have indicated that the predictive ability of the two-stage gravity model procedure diminishes as increases in time period departs from sample mean. In addition, some scholars have argued that these studies do not measure trade performance against a maximum possible level of potential trade as defined by a stochastic frontier (Ravishankar and Stack, 2014). Furthermore, in the light of the current developments in Arab region and the world (i.e. global financial crises, Arab spring and the reduction in foreign capital flows, etc.), these studies may turn out to be inappropriate to explain the performance of intra-Arab trade. Given these facts and driven by the aim of circumventing the obstacles from the route of trade between Arab countries, this study follow the lead of recently emerged literature (e.g. Kalirajan and Singh, 2008; Ravishankar and Stack, 2014 and Bhattacharya and Das, 2014) to revisit the intra-Arab trade integration. To make this objective achievable, the study employs a stochastic frontier gravity model to assess the actual trade volume against the maximum level of possible trade (i.e. frontier) in Arab region. Adopting this modeling technique would assist us to consider what is called '*behind the border*' and '*beyond the border*' inefficiencies, which have been neglected by previous studies that based on conventional gravity model. In addition, the study examines how far is intra-Arab trade from reaching their potential level given the existing "behind the border" constraints and "beyond the border" constraints to exports and import.

This study would serve in assessing the intra-Arab trade integration and trade potential and, therefore, contributes to enhance regional integration among Arab countries in many fronts. First, this study fills the existing gap in literature concerning the assessment of trade integration in Arab world by using stochastic frontier gravity model (SFGM), as to the best of our knowledge this would be the first study to examine the intra-Arab trade performance and trade potential using this methodological approach (i.e. SFGM). Second, investigating the impact of

1 Behind the border constraints are institutional and infrastructure rigidities that exist in home countries, which are concerning with regulatory policies that impede trade flow such as, restrictions on foreign trade and investment, tolerance of business cartels, monopoly privileges given to public enterprises, and the cost and performance of infrastructure services, customs and transport that generally affect the domestic costs of production (Kalirajan and Singh, 2008). On the other hand, beyond the border constraints mainly refer to non-tariff barriers and other institutional rigidities that exist in the partner countries.

the hidden factors (i.e. behind and beyond the border) would provide policy makers with the basis to be more strategic in dealing with trade and trade facilitation matters. Third, Arab region is rich in terms of natural resources (i.e. oil, gas, …,etc.) as well as it enjoy strategic geographical location. These advantages can be exploited to make the region play fundamental role in international trade. However, this goal can be reached unless the inner constrains for trade are removed. Thus, this study represents a great attempt to touch and diagnosis these constrains. Finally, this study is timely and relevant if taken in the context of the currents political and social developments experienced by Arab countries.

The remainder of this paper is structured as follows. Section two provides some stylized facts on intra-Arab trade. Section three discusses the related literature, while Section four outlines the methodology of stochastic frontier gravity model (SFGM) along with data and data sources. Section five presents and discusses the empirical results. Finally, Section six concludes and offers some policy implications.

2. Some Stylized Facts about Intra- Arab Trade Performance

Arab countries are made up of twenty two Arab-speaking states which of the Arab League[2]. These countries have noticeable similarities in terms of language, cultural, historical, social and religious values. These factors along with geographic closeness facilitate the economic interaction and trade cooperation between member countries. The history of economic integrations in Arab world dates back to 1945, when the Arab League was founded (Neaime, 2005). The founding document of the Arab league included a number of legislative texts and institutional structures with an ambitious plan to promote economic cooperation and intra-Arab trade (Abu Hatab and Elkheshen 2015). Subsequently, in 1953, the Economic and Social Council of the Arab League has taken further step to promote intra-Arab trade by launching the first arrangements on Trade Facilitation and Organizing Transit Trade among Arab countries. In 1957, the same council approved an agreement on free movement of people and capital, as well as establishment of common customs area under the name “Arab Economic Union”. The common market became effective in 1964 and a number of Arab states have joined this

[2] The Arab countries include: Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates and Yemen.

agreement in 1965. The main goal of that agreement included progressive reductions in tariffs and taxes and the removing of administrative barriers, with aim of achieving full-trade liberalization among the joining countries (Romagnoli and Mengoni, 2009).

Although, the progress in the legislative framework to achieve integration among Arab countries, the trade integration and economic interaction among these countries remained very weak. However, by the early of 1980s, the agenda of regional integration received a great attention from Arab leaders, as there was a general impression prevailed at that time proclaimed that the effectiveness of trade blocs could spur economic growth and development. In 1981, Arab countries agreed on launching agreement for the "Facilitation and Promotion of Trade among Arab States" which aimed to enhance the Arab Common Market agreement to all member countries of the Arab League (Abu Hatab and Elkheshen, 2015). Moreover, in 1996, a program for the creation of the Greater Arab Free Trade Area (GAFTA) was approved by 17 Arab countries that agreed on a successive elimination of trade barriers (Abdmoulah, 2011). The GAFTA came into force in January 1998 in order to set up a free-trade area among the member countries.

Furthermore, the efforts of regional integration among Arab countries have been extended during the last four decades by adopting many bilateral, and sub-regional trade agreements (Hakimian and Nugent 2005, and Abdmoulah, 2011). The most prominent sub-regional Economic agreements are the Gulf Cooperation Council (GCC), the Arab Maghreb Union (AMU), and the AGADIR trade Agreement. The GCC was established in 1981, since the UAE, Bahrain, Saudi Arabia, Oman, Qatar and Kuwait agreed on founding the Gulf Cooperation Council to achieve economic and social integration among the member states, and to achieve unity at a later stage. The Gulf Cooperation Council (GCC) declared a custom union among its member states in 2003. In 1989 the Algeria, Libya, Mauritania, Morocco and Tunisia established the Arab Maghreb Union (AMU) to enhance multilateral trade among member countries. Finally, AGADIR trade agreement launched in 2004 between Egypt, Jordan, Morocco and Tunisia, with the aim of setting up a Free Trade Area among Arab-Mediterranean countries. AGADIR agreement comes into force in March 2007, and become an effective free trade area among the Arab-Mediterranean countries.

Nevertheless, despite the efforts have been done to promote trade relations and economic integration among Arab countries, the performance of intra-Arab trade is the lowest when compared to other regional integrations blocs such as ASEAN and NAFTA (Harrigan 2014, Abu Hatab and Elkheshen, 2015). That is to say despite the relative homogeneity in terms of religion, culture and language along with the preferential market access, the regional integration in the Arab region is far less than its potential.

Regarding the economic and trade performance of Arab countries, Table 1 show some basic economic and trade indicators on Arab economies. The table reveals that Arab region hosts about 383.06 million of inhabitants which they are vary considerably from country to another, ranging from less than one million in Comoros and Djibouti to about 94 million in Egypt.

Table 1: Arab countries: Selected Economic and Trade Indicators -2000 &2015

Country	**Population (million)**	**GDP per capita (USD)**		**Intra-Arab Exports- in USD million**		**Intra-Arab Imports- in USD million**		**Share in Total Arab Trade (%)**	
	2015	**2000**	**2015**	**2000**	**2015**	**2000**	**2015**	**2000**	**2015**
Algeria	39.87	3,541.07	4,759.60	312.18	2,087.02	190.35	2,471	1.25	2.19
Bahrain	1.37	22,955.09	22,436.21	490.67	10,145.36	427.43	6,351.1	2.29	7.94
Comoros	0.77	806.43	769.48	0.03	0.57	2.35	41.79	**0.01**	**0.02**
Djibouti	0.92	1,072.62	1,579.92	2.451	121.97	20.08	612.28	**0.06**	**0.35**
Egypt	93.77	1,950.61	2,665.35	566.22	7,878.27	1,394.3	9,039.6	4.89	8.14
Iraq	36.11	4,311.28	5,285.67	1,124.58	1,947.88	463.34	3,099.5	3.96	2.43
Jordan	9.15	2,810.04	3,297.89	581.02	3,340.43	1,076.2	5,131.2	4.13	4.08
Kuwait	3.93	35,792.71	35,490.29	512.48	3,866.84	1,061.8	6,225.3	3.92	4.86
Lebanon	5.85	6,747.63	7,044.61	326.93	1,596.10	766.95	2134.2	2.73	1.80
Libya	6.23	8,967.25	NA	189.57	518.43	214.02	630.1	1.01	0.55
Mauritania	4.18	998.11	1,306.65	2.44	43.72	15.482	413.7	0.04	0.22
Morocco	34.80	1,972.30	3,204.75	258.49	1,118.65	1,431.24	3,512.56	4.21	2.23
Oman	4.19	18,698.40	17,070.96	1,331.84	8,139.45	1,715.93	13,668.36	7.60	10.50
Qatar	2.48	60,858.19	67,277.24	728.71	7,280.00	539.46	5,755.89	3.16	6.28
Saudi Arabia	31.55	18,263.23	21,507.96	10,859.36	28,263.64	1,880.96	17,987.52	**31.75**	**22.27**
Somalia	13.90	NA	NA	113.91	683.35	64.06	448.95	0.44	0.55
Sudan	38.64	1,003.00	1,881.90	447.09	1,833.78	418.11	2,058.54	2.16	1.87
Syria	18.73	NA	NA	3,159.73	531.06	458.6	932.2	9.02	0.70
Tunisia	11.27	3,004.61	4,264.52	432.91	1,541.95	666.7	1,573.1	2.74	1.50
UAE	9.154	62,833.25	40,159.56	3,245.50	29,084.46	1,603.00	13,374.44	**12.08**	**20.44**
Yemen	16.10	1,138.25	772.03	210.42	466.29	817.38	1,763.37	2.56	1.07
Arab World	383.06	257,724.06	240,774.5	24896.53	110489.22	15227.74	97224.7	100.00	100.00

Source: Authors' calculations based on data from World Bank Indicators and IMF' direction of trade statistics (DOTS)

- Palestine is excluded because its trade data are not available

The level of economic situation measured by GDP per capita (constant 2010 US$) is also varies widely among Arab countries. Some countries like Comoros and Mauritania exhibit very low levels of GDP per capita, while others like Kuwait, Qatar and UAE report high level of GDP per capita. Moreover, some countries have experienced a sizable increase in GDP per capita during the period 2000-2015. For example, the per capita income of Morocco and Sudan has increased by the rate of more than 1500% during this period. These variations in the per capita GDP reflect the high disparities in economic performance in Arab countries.

Regarding the regional trade performance, it appears from Table 1 that Arab countries have experienced some improvements in trade integration over the last two decades. This can be indicated by the substantial increases in the intra-regional exports and imports between 2000 and 2015. In 2015, for instance, the intra-exports of some countries like Saudi Arabia and UAE were very high, while other countries like Djibouti, Libya and Mauritania have reported very low intra-exports and imports.

Moreover, the intra-Arab exports and imports performance for Comoros, Djibouti and Mauritania did not exceed 500 million US dollars in 2015. Notably, Saudi Arabia and UAE have a lion share in the intra-Arab trade during the last 15 years. The huge contribution of Saudi and UAE can be explained by the successful efforts of the two countries regarding economic diversification and trade liberalization, as these countries has been regarded as a hub of trade in the region. Except Egypt, the Arab spring countries, have reported a decline in intra-Arab trade during the period (2000-2015), which can be attributed to the conflicts and political instability in these countries. That is, countries like Libya, Syria, Tunisia and Yemen have witnessed a decreasing trend in intra-exports and imports during 2000-2015. Strikingly, the contribution of Syria in Arab trade has declined from 9.02% in 2000 to 0.7% in 2015. Overall, Oman, Saudi Arabia and UAE were the most active trading partners amongst Arab states, as their contribution to total trade in 2015 accounted for more than 10 percent. Within the Arab countries, Djibouti and Morocco were the highest importers while Bahrain, Saudi Arabia and UAE are among the top exporters. The remarkable increase of both exports and imports for most of Arab countries between 2000 and 2015 implies that the creation of the Greater Arab Free Trade Area (GAFTA) as well as sub-regional integrations such as, AGADIR and AMU has led to notable improvement in intra-Arab trade.

3. Literature Review

Considering the key role of regional arrangements in trade performance and economic prosperity, a huge body of literature on assessing the regional trade integrations has been grown in the last decades. However, there is a dearth on studies regarding the Arab integration arrangements and most of the exiting studies have employed the conventional gravity model. In this section, we review a number of empirical studies on evaluating trade performance. On the whole these studies can be divided into two categories namely, studies that used conventional gravity model and studies that employed stochastic frontier gravity model.

Regarding the first category, there is a relatively huge body of literature using conventional approach. For example, Pastore et al. (2009) examined the trade performance of European Union (EU) members with the Mediterranean (MED) countries and the new EU members using a two stage gravity model of intra-EU trade including thirteen members over the period 1995-2002. Employing an out of sample method, they found that there is a substantial unexploited trade potential within both groups of partners, but the ratio of potential to actual trade with the MED countries was much larger, more dispersed and stable compared to that with the new EU members. The paper also indicated that the potential trade tends to congregate to actual trade in a much longer time in the case of Mediterranean countries.

Chauvin and Gaulier (2002) examined the potential of intra-South African Development Community (SADC) trade, using three complementary approaches: export diversification index, revealed comparative advantages and trade complementarity indices as well as the gravity model technique. They found that South Africa represents the most significant member in terms of exports and it plays an important role in fostering the intra-trade in the SADC region. The authors also indicated that there is some complementarity between SADC countries; and that SADC countries have similar comparative advantages; hence, the room for further trade integration within this trading bloc is limited. In the same vein, Khandelwal (2004) examined the prospects and challenges for trade expansion in COMESA and SADC. He argued that the

COMESA FTA has taken a market-liberalization approach to regional integration, but has been hampered by the country-level implementation issues. On the other hand, SADC has taken the approach of addressing infrastructure and supply constraints but also suffered from implementation problems. Khandelwal also found that possibilities of enhancing intra-regional trade may be limited, but that the two trade arrangements provide opportunities for their member states to adopt policy credibility for trade reforms and trade liberalization and to address structural problems.

Simwaka (2011) assessed the performance of SADC FTA over the period 1998-2007. He disaggregated the sample into two periods; pre-integration (i.e., before the adoption of FTA 1998-2000) and post-integration (i.e., after SADC FTA came into operation 2003-2007). Using a gravity model, he found that the potential trade is higher than the observed one, suggesting an existence of trade potential among SADC members. The author also indicated that SADC FTA leads to trade creation and enhance the trade capabilities of member countries. This result, however contradicts the findings of Chauvin (2002), who found that SADC trade potentials are rather small or negative, especially for South African exports. Finally, comparing SADC with other regional integrations, the paper found that ASEAN and NAFTA trade integration perform better than SADC.

Ebaidalla and Yahia (2014) examined the performance of intra-COMESA trade integration in comparison with ASEAN integration. Using an out-of-sample approach and two stage gravity approach, they pointed out that COMESA’ countries are far from their potential trade level, implying unfavorable performance of the regional trade integration among COMESA members. The authors also found that the gap between potential and actual trade has decreased over time, suggesting a convergence toward the potential trade.

For Arab countries, Al-Atrash and Yousef (2000) examined the trade performance of 18 Arab countries with 43 trading partners during the period 1995-1997. Using a gravity model, they found that within the sub-regional arrangements, the intra-Arab trade is higher than overall intra-Arab trade. They also found that cultural characteristics measured by language have mixed effect. For instance, English-speaking countries tend to trade more with each other, while

French-speaking countries exhibit weak trade relations. Moreover, they pointed out that GCC and AMU trading arrangements have no significant effect on promoting integration among member countries. In contrary, the Mashreq sub-regional arrangement is found to be has achieved considerably higher levels of regional integration among member countries.

Abdmoulah (2011) investigated the factors influencing Arab trade integration focusing on main trade arrangements (i.e, GAFTA, AMU, GCC and AGADIR) over the period 1997-2008. Adopting zero-inflated negative binomial gravity model, he found that market size, distance between trading partners and common colonizers and borders are found to be the most important factors affecting intra-Arab trade. He also found that the performance of Arab trade arrangements is disappointing except for GAFTA.

The second strand of empirical studies that adopted stochastic frontier gravity model (SFGM) has been emerged in recent years. This kind of model is first adopted by Kalirajan (1999) and later by Ravishankar and Stack (2014), Bhattacharya and Das (2014), and Tamini et al., (2016). For instance, Stack and Pentecost (2011) employed a stochastic frontier specification of the gravity model for a twenty OECD trading partners with EU countries during the period 1992-2003. Based on an out-of-sample approach, they project the potential trade for ten new member states and ten associated countries. Their results revealed that the projected trade ratios for the ten new member states are multiples of actual 2003 levels, indicating that trade expansion between these countries will tend to expand in the future. On the other hand, for the Mediterranean countries, the ratio of potential to actual trade is found to be near unity value, implying fewer opportunities for further trade expansion within the EU.

Kalirajan (2007) examined trade flows between Australia and Indian Ocean Rim-Association for Regional Cooperation (IORARC) countries. Using stochastic frontier gravity model, he found that the socio-political-institutional factors (i.e. behind the border) are the most significant constraints preventing Australia from realizing its exports potential with IOR-ARC countries. The empirical analysis also indicated that on average, Australia has been able to achieve more (about 15%) of its potential exports with IOR-ARC countries due to regional trade cooperation with these countries.

Koh (2013) examined the determinants of Brunei Darussalam's trade and its trade potential as well as the performance of ASEAN integration. Using a stochastic frontier gravity model estimated via panel data over the period 2000-2011, he found that GDP, population, colonial history and trade agreements have a positive impact on the level of trade, while geographic distance affects trade negatively. His results also pointed out that Brunei's trade potential is relatively low, indicating the presence of significant '*behind the border*' constraints, but these trade inefficiencies have been decreasing over time. In addition, Koh investigated whether free trade is trade creating or trade diverting in Brunei. His results indicated positive and significant trade creation effects. Moreover, his results suggested that '*behind the border*' inefficiencies for ASEAN as a whole are decreasing trend over time.

Recently, Ravishankar and Stack (2014) examined the trade integration between Eastern and Western European countries, using a stochastic frontier gravity model for a panel of 17 Western European countries and 10 new EU member countries during the transformation period of 1994–2007. Their analysis revealed that there was a high degree of East–West trade integration, with each new member state achieving on average two-thirds of frontier estimates over the 1994–2007 period. In addition, a comparison of the efficiency scores across the pre- and post-EU sub periods indicated a high efficiency scores were achieved. In the same vein, Bhattacharya and Das (2014) studied the intra-trade performance of South Asian Association for Regional Cooperation (SAARC). Employing a stochastic frontier gravity model, they investigated the presence of significant '*behind the border*' and '*beyond the border*' constraints and examined the potential synergy between trade and development goals in the context of SAARC. The paper indicated that there is a considerable potential for improvement of trade complementarities among SAARC members. Their results also revealed that the country-specific 'socio-political–economical–institutional' rigidities (i.e. behind the border constraints) are the main barriers to trade.

More recently, Tamini et al. (2016) analyzed the trade potential versus actual realized trade among North African trading partners over the period 2001-2012. Based on a stochastic frontier gravity model, their results indicated that Mauritania, as a country of both destination and origin has the least efficient trading relationship. The results also found that Tunisia, followed by

Morocco, faces the fewest behind- and beyond-the-border effects. Their analysis of market integration and trade efficiency at the disaggregated level indicated that trade efficiency scores exhibited high variability between categories of products. Moreover, the results revealed that trade efficiency for agricultural products was relatively low in MENA countries, indicating the existence of significant behind- and beyond-the-border inefficiencies.

Despite the intensive and diverse empirical literature on assessing intra-trade performance of trade blocs, the performance of intra-Arab has not been studied adequately. Moreover, most of previous studies on Arab countries (e.g. Abdmoulah, 2011 and Al-Atrash and Yousef, 2000) used the conventional gravity model that measures potential trade from the mean and neglecting *'behind the border'* and *'beyond the border'* constraints. Therefore, the distinguishing feature of this study is to use the stochastic frontier gravity model to assess the observed trade against a maximum level of feasible trade for the group of Arab countries. In particular, a trade frontier representing the maximum possible level of bilateral trade will be constructed, and then used as a benchmark for actual trade.

4. The Theoretical Model and Methodology

4.1 Gravity Model

To assess the intra-Arab trade performance, this study employs a stochastic frontier gravity model approach. The gravity model of bilateral trade is initially adopted by Tinbergen (1962) and Linneman (1966), and then it has been applied extensively in the analysis of bilateral international trade flows between countries. The gravity model of bilateral trade originally is derived from Newton's "law of Universal Gravitation", which proposes that the size of bilateral trade flows between two countries (X_{ij}) is proportional to the economic sizes of the two countries ($Y_i Y_j$), proxied by gross domestic product (GDP), and inversely proportional to the distance between countries (D_{ij}). Therefore, this can be expressed by the following physical distance equation:

$$X_{ij} = f\left(\frac{Y_i Y_j}{D_{ij}}\right) \qquad (1)$$

Following the existing literature on the international trade (e.g. Baldwin, 1994; Gros and Gonciarz, 1996; Nilsson, 2000), the standard gravity model of bilateral trade could be specified in the log-linear form as follows:

$$logTrade_{ijt} = B_0 + \beta_1\, logGDP_{it} + \beta_2 logGDP_{jt} + \beta_3 logPOP_{it} + \beta_4\, logPOP_{jt} + \beta_5\, logDIS_{ij} + \sum_{1=g}^{G} \gamma_g Z_{ij} + \sum_{1=k}^{K} \alpha_k X_{ij} + \varepsilon_{ijt} \quad (2)$$

Where $Trade_{ijt}$ is the bilateral trade between two countries i and j over a certain period of time t; GDP_{it} and GDP_{jt} reflect the economic sizes of both countries; POP_{it} and POP_{jt} are population of country i and j, respectively and DIS_{ij} is the distance between a pair of countries. The above equation also includes a vector of time-invariant explanatory variables, Z_{ij}; and a vector of time-varying trade-stimulating and trade resisting factors, X_{ijt}. Finally, ε_{ijt} is the error term.

Anderson (1979) was the first economist who attempted to develop a sound theoretical foundation for the gravity model based on demand function with constant elasticity of substitution (CES), hence he brought gravity model into mainstream economics. The Anderson' theoretical view yielded the following gravity equation:

$$X_{ij} = \frac{Y_i \Phi_i \Phi_j Y_j}{\sum_i Y_i\, \Phi_j} \frac{1}{f(d_{ij})} \left[\sum \frac{\Phi_j Y_j}{\sum_i Y_i\, \Phi_j} \quad \frac{1}{f(d_{ij})}\right]^{-1} \quad \varepsilon_{ijt} \qquad (3)$$

Where X_{ij} is the export from country i to country j; Y is the income in country i and j; d_{ij} is the distance between country i and j; Φ_i is the share of expenditure on all traded goods and services to the total expenditure of the country. According to Anderson (1979), the log-linear form of equation 3 resembles the standard gravity equation in equation 2, with an important difference, which is the bracket term in equation 3:

$$\left[\sum \frac{\Phi_j Y_j}{\sum_i Y_i\, \Phi_j} \quad \frac{1}{f(d_{ij})}\right]^{-1}$$

This term is often omitted from the conventional gravity model that used in the empirical work (Kalirajan, 2007). Anderson (1979) defined this term as "economic distance between i and j relative to a trade weighted average of the economic distance between i and all points in the system". Measuring this term is difficult because researchers do not know all the factors affecting economic distance. This economic distance can be influenced by many factors, including institutional, social, and political factors that exist in both home and partner country. It is worth to mention that, the traditional gravity model assumes that the relative economic distance is constrained by 'natural barriers' (e.g. geographical distance between regions) and exogenous policy constraints 'unnatural' or 'artificial' barriers in the form of high tariff and non-tariff barriers. However, beside natural and artificial constraints, there are other kind of constraints prevent the home country from reaching trade potential level, the so-called '*behind the border*' constraints; and/or also some rigidities in partner countries, which is called '*beyond the border*' constraints to trade (Gawande and Krishna, 2001; Newfarmer and Nowak, 2005; Wilson et al., 2004). Although, the conventional gravity model considers the importance of 'policy induced' constraints on home country's exports, usually, these factors are merged with the 'statistical random error term' with 'normal properties' by implying that they are randomly distributed across observations[3]. Therefore, most of the empirical trade analysis based on conventional gravity models do not incorporate these constraints into trade modeling; hence, results in 'incorrect estimates' of potential trade and does not also reflect actual trade potential (Kalirajan, 2007).

Moreover, the omission of this relative economic distance term in the empirical work of gravity model leads to the biasness of the estimation. This is because the term in the square brackets (i.e., economic distance term) of equation 3 affects the log-normal distribution of the error term. Therefore, the expected value of the error term is no longer zero ($E(\varepsilon_{ijt}) \neq 0$) and the normality assumption of OLS is violated. Thus, this omission leads to heteroskedastic error terms and the log-linearization of the empirical model in the presence of such a problem leads to inconsistent estimates because the expected value of the logarithm of a random variable depends on higher-order moments of its distribution (Santos Silva and Tenreyro, 2006). Therefore, the OLS estimation on such gravity equations will be biased.

[3] The conventional gravity model assumes that behind and beyond the border constraints to trade are not significantly affecting trade between two countries, implying that the effect of behind and beyond the border constraints to trade are merged with the statistical error term. However, such an assumption may be restrictive and may not be in line with reality (Kalirajan and Singh, 2008).

Beside the violation of the OLS normality assumption, the estimation of these conventional gravity models through OLS provides the values at the mean of the observation or sample countries. This is also problematic because with this approach the potential to boost trade is defined relative to the sample average rather than to a maximum feasible level for a given pair of trading partners. In addition, estimates based on the OLS procedure represent the centered values of the dataset. However, potential trade should measure free trade with no artificial trade frictions (Bahattacharya, 2014)[4]. In other words, the estimation of potential trade requires a procedure that represents the 'upper limits of the data' and 'not the centered values' of the dataset as in the case of conventional gravity model.

4.2. Stochastic Frontier Approach

To overcome the shortcomings of conventional gravity model, the study adopts stochastic production frontier analysis that introduced by Kalirajan (1999) to address the inherent bias of the conventional gravity model of trade and to estimate potential trade flows. In this case, trade potential is conceptually similar to a firm producing at the frontier. The stochastic frontier gravity model (SFGM) is further developed by (Kalirajan and Bhattacharya, 2008 and Kalirajan, 2007). The SFGM measures trade frontier as the maximum possible level of trade for a given bilateral trading pair that impacted by a random error term which can be a positive or negative, thereby allowing the stochastic frontier trade level to vary about the deterministic part of the gravity equation. The observed trade levels can then be compared against this frontier level for each bilateral trading pair to assess the scope for trade expansion between them.

The stochastic frontier analysis (SFA) has been used extensively in the assessment of the firm performance. In its conventional application, SFA identifies a production frontier representing the maximum output that can be produced from a given level of inputs. Fully efficient firms operate on the frontier such that both observed and frontier levels of output are coincided, while (technically) inefficient firms operate at a point under the frontier, signifying a shortfall between

[4] Based on the work of Kalirajan (2007) we define the potential trade between two countries as the maximum possible bilateral trade, given the 'natural' constraints, 'but without' the influence of any 'policy-induced' constraints to trade, that is, 'in the absence of' 'behind the border' and 'beyond the border' constraints.

the observed and the maximum possible levels of output. Analogously, SFA can be used to define a trade frontier whereby inefficient trade performance refers to the degree to which actual trade falls short of the maximal frontier level.

The stochastic frontier approach was first developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977), recognizing that technical inefficiencies exist in firms' production. Hence realized output falls short of its potential on the production frontier, and showed that the error term can be decomposed into a non-negative term which captures the production inefficiencies and a random term reflecting measurement errors and exogenous shocks. Since SFGM approach allows measurement of distance from the frontier, the framework is therefore turn out to be best in measuring trade potential as the maximum possible using the most efficient trade policies observed. This is more appropriate compared to the estimation of trade potential in conventional gravity.

Accordingly , the stochastic frontier gravity model combines the gravity model and the stochastic frontier approach, with the non-negative error term representing '*behind the border*' inefficiencies in the exporting country that prevents it from reaching its trade frontier, and the random term captures all other disturbances including '*beyond the border*'. Thus, the above conventional gravity model (equation 2) can be modified to SFGM version as in the following form:

$$Trade_{ijt} = f(GDP_{it}, GDP_{jt}, POP_{it}, POP_{jt}, DIS_{ij}, \boldsymbol{Z}_{ij}, \boldsymbol{X}_{ijt}) \exp(V_{ijt} - u_{ijt}) \qquad (4)$$

Where $Trade_{ijt}$ is the bilateral trade flow and its determinants on right hand side as defined in equation (2). The ε_{ijt} in equation (2) is now decomposed into two parts error terms: the two sided (V_{ijt}) and one sided error term (u_{ijt}). The two-sided error element V_{ijt} captures the influence on trade flows of other variables, including measurement errors and the implicit *beyond the border* constraints that are not under the control of the exporting country and are randomly distributed across observations in the sample. It is independently and identically distributed (iid) error term with a normal distribution of mean zero and variance σ_v^2. While u_{ijt} is the one-sided disturbance term (inefficiency element), is non-negative iid term with a truncated half-normal distribution with mean μ and variance σ_u^2. This one-sided error term shows the combined effects of '*behind the border*' constraints on trade and can identify the degree to which observed trade levels deviate from the maximal possible. These deviations from the maximal trade level can occur due to multilateral resistances as well as socio-political-institutional factors that prevents trade level from reaching its potential (Anderson and van Wincoop, 2003), which are often unobservable or difficult to quantify.

To estimate the above SFGM, the study uses the Maximum Likelihood Estimation (MLE) following Aigner et al. (1977), to verify the importance of the '*behind the border*' constraints in realizing the potential trade[5]. However, the literature indicates many advantages for SFGM over the conventional gravity model. First, unlike the conventional OLS estimation, there is no loss of estimation efficiency (Kalirajan, 2007). Second, the SFGM estimates the effect of '*behind the border*' constraints by separating these from '*beyond the border*' constraints and the statistical error term. This 'isolating' property will enable us to examine how effective are the influence of '*behind the border*' constraints on potential trade. Third, the SFGM approach estimates potential trade as a maximum level of trade given the current level of the determinants of trade and (given) the least level of restrictions within the system. Finally, the SFGM provides strong theoretical and trade policy implications towards finding ways to improve the performance of the socio-political-institutional factors to achieve free trade (Kalirajan, 2007 and Kalirajan and Singh, 2008).

Beside estimation of the gravity model parameters, the SFGM analysis provides some supplementary estimators to evaluate the estimated model and to identify the effect of '*behind the border*' and '*beyond the border*' constraints. Therefore, based on the above specified model, the SFGM analysis estimates the *Sigma-squared* (σ^2), which is a measure of the mean of total variation in the model. The significance of σ^2 indicates that the potential trade over the time have shown a significant variation about its asymptotic mean (Kalirajan, 2007 and Kalirajan and Singh, 2008). To understand the nature of the variations in potential trade, the SFGM analysis also estimates the *gamma* coefficient. The *gamma* coefficient measures the total variation in trade that is due to the influence of country specific socio-political institutional factors (i.e.

[5] The model was estimated using the 'sfrontier' command of STATA 14.

behind the border)[6]. The significance of *gamma* implies that the influence of '*behind the border*' constraints are responsible for the gap between potential and actual trade. For further insight concerning the temporal behavior of *gamma* coefficient, we rely on *eta* coefficient. This is equivalent to examining whether the impact of '*behind the border*' constraints towards achieving potential trade level has been increasing from one period to another or not. If the *eta* coefficient is positive and significant, then the constraining impact of '*behind the border*' effects on achieving potential trade would be decreasing over time. On the other hand, if *eta* coefficient is zero or not significant, then the impact would be fixed over time (Kalirajan, 2007 and Bhattacharya and Das, 2014).

After estimating the parameters, the point estimates of technical efficiency can then be measured using Battese and Coelli (1988)' formula:

$$TE\left[-u_{ijt}|\varepsilon_{ijt}\right] = \left[\frac{1-\Phi\left(\sigma_* - u*_{ijt}/\sigma_*\right)}{1-\Phi\left(-u*_{ijt}/\sigma_*\right)}\right] exp\left(-u*_{ijt} + \frac{1}{2}\sigma_*^2\right) \qquad (5)$$

Where $u*_{ijt} = \varepsilon_{ijt} - \sigma_v^2/\sigma_u$ and $\Phi(.)$ is the standard normal density function. The technical efficiency estimates for each country-pair range between zero and unity. A TE value of unity would imply that the actual and potential trade levels coincide, while values tending towards zero would indicate scope to raise actual trade levels.

4.3 Empirical Model

Based on existing literature and above discussion, the full gravity model specification of determinants of intra-Arab trade performance could be specified as follows:

$$\begin{aligned} Ln\,Trade_{ijt} = {} & \alpha_{ij} + \beta_1 Ln\,GDP_{it} + \beta_2 Ln\,GDP_{jt} + \beta_3 Ln\,POP_{it} + +\beta_4 Ln\,POP_{jt} \\ & + \beta_5 Ln\,DIS_{ij} + \beta_6 Ln\,REX_{it} + \beta_7 Ln\,REX_{jt} + \beta_8 lnINFR_{it} + \beta_9 lnINFR_{jt} \\ & + \beta_{10} LnINS_{it} + \beta_{11} LnINS_{jt} + \beta_{12} CB_{ij} + \beta_{13} Sub_{ij} + v_{ijt} - u \qquad (6) \end{aligned}$$

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[6] The gamma coefficient is an average over the time period, which can be measured as:

$$\gamma = \left[\left(\sum_t \sigma_{ut}^2\right) \Big/ \left(\sum_t \sigma_{ut}^2 + \sigma_{vt}^2\right)\right] / T$$

Where, σ_{ut}^2 is the variance of the one sided error term at period t; is the variance of the random error term at period t; and T is the total number of time periods, that is 18 years, (i.e. 1998-2015)

Where $Trade_{ijt}$ is the trade flow as is defined previously. GDP_{it}, GDP_{jt} , POP_{it} , POP_{jt} *and* DIS_{ij} as defined above. The gravity model is extended by two dummies variables, CB_{ij} and Sub_{ij}, which represent the vector of time-invariant explanatory variables, $\boldsymbol{Z}_{ij}$, that indicated in equation (3). CB_{ij} captures the common border, taking value of 1 if the two countries share a common land or sea borders, and zero otherwise. Sub_{ij} is dummy variable that reflects the membership of a sub-regional integration, it takes a value of one if the reporting and partner countries are members in the same sub-regional trade integration. Based on the previous discussion, we disaggregated the sample into three main sub-regional integrations namely, GCC, AMU and AGADIR. In addition, the model is extended by a vector of time-varying explanatory variables, $\boldsymbol{X}_{ijt}$, which includes, real exchange rate, REX , level of infrastructure, $INFR$ and institutional quality for both reporting and trading partner. Finally, $v_{ijt} - u$ is the error term as defined previously. All the variables are expressed in natural logarithms except dummy variables.

According to the theory, the coefficient of GDP and population are expected to be positive, as an increase of national income and population size stimulate imports and exports. In addition, a country with large income and population size implies a large domestic market and more progress in specialization and division of labor and increase of the production, which are generally associated with a larger need for trading. The coefficient of distance is expected to be negative, as the larger physical distance between two countries' economic centers, the higher is the cost of transporting goods between them. The impact of infrastructure would be positive as an improvement in the level of infrastructure improves the flow of trade between countries. The coefficient of bilateral real exchange rate is expected to be positive since depreciation of the real exchange rate enhances the competitiveness of the domestic goods, hence increase exports. On the other hand, an appreciation of real exchange rate reduces the competitiveness of home goods in international markets. The coefficient of institutional quality measured by polity index is expected to be positive as a country exhibits good institutions tends to trade more. The common border variable CB_{ij} is expected to be positive, as sharing borders, indicate geographical closeness and better information. Finally, the effect of sub-regional integration would be positive as belonging to same sub-integration body may enhance bilateral trade between reporting and partner countries.

For the purpose of robustness check, equation 6 is estimated for different specifications. First, to understand the effect of sub-regional Arab integrations on bilateral trade performance, we estimated two models: one includes sub-regional integration bodies (i.e., GCC, AGADIR and AMU) and the other one keep out these sub-regional integrations. Second, to gain further insight into the effect of global financial crisis, the full sample period (i.e. 1998-2015) is divided into two sub-periods: the first period covers the period (1997-2007), which precedes the global financial crisis and the second one for the period after financial crisis (i.e. 2008-2015).

4.4 Data Sources

The data used in the gravity model concerning 17 Arab countries over the period 1998-2015. This period is selected because in 1998 the greater Arab free trade area (GAFTA) came into the operation[7]. This period also registers very few zero or missing trade observations, hence our data is a nearly balanced panel. The trade data for Arab countries are extracted from UN COMTRADE international trade data and International Monetary Fund' Direction of Trade Statistics (DOTS). The data about GDP, population size, exchange rate and infrastructure is obtained from the World Bank's Development Indicators. Data on distance in kilometers between countries is calculated from the following website: http://www.distancefromto.net/countries.php. Information about common border will be sourced from the CIA World Fact-book. Finally, institutional quality is proxied by polity index which gathered from Marshall et al. (2016) database. Polity index varies from -10 to 10. The index is based on sub-scores for constraints on the chief executive, the competitiveness of political participation, and the openness and competitiveness of executive recruitment. Higher values denote more democratic institutions[8]. The definition and source of variables used in the analysis along with their descriptive statistics are presented in Appendix I and II, respectively.

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7 The countries are chosen according to the availability of data.

[8] Marshall et al. (2016) define a polity within the range [6,10] as a coherent democracy, one in the range [-10,-6] as a coherent autocracy, and one in the range [-5,5] as an incoherent regime. Formally, it is computed as the difference between a democracy index and an autocracy index, each ranging from 0 to 10. See Table 1 for summary statistics for our dataset.

The descriptive statistics in Appendix II shows some variations regarding the economic indicators of Arab countries. Appendix II reveals that the standard deviation of real GDP is very big implying that there is a considerable disparity in economic level in Arab region. This heterogeneity supports the results in Table 1, as Kuwait and Qatar enjoy very highest per capita GDP, while countries like Comoros, Djibouti and Mauritania registered very low GDP per capita. The descriptive statistics also indicates that population has high standard deviation, suggesting that Arab countries exhibit a high rate of disparities. This was clear from Table 1 as Egypt hosts about 94 million in 2015, while some countries like Djibouti and Comoros host less than one million of inhabitants. These discrepancies in the real GDP and population size reflect the disparities in market size in Arab countries, hence affecting the intra-regional trade performance. Regarding the trade variables, the descriptive statistics show that the mean of exports, imports and total trade is relatively low with high standard deviation. Moreover, the relatively high standard deviation of real exchange rate reflects the variation regarding exchange rate regimes and control. Finally, the political stability index reports low mean of -4 and ranges widely from -10 to +7, implying the low institutional quality in the Arab region.

5. Empirical Results and Discussion

This section presents the empirical results and discussion. The section is divided into two sub sections: the first one presents the estimation results of SFGM pertaining to the determinants of trade flow between Arab countries using Maximum Likelihood Estimation (MLE). The second section outlines the efficiency scores of trade flow among Arab countries.

5.1 SFGM Estimation Results

Based on methodology outlined above, the frontier stochastic gravity model specified in equation 6 is estimated using MLE for four specifications as presented in Table 2. Column 2 and Column 3 report the estimation results of the gravity equation for without and with sub-regional Arab integration, respectively. In addition, column 4 and 5 presents the MLE results for pre and post global financial crisis, respectively.

Table 2: Maximum Likelihood Estimates of Stochastic Frontier Gravity Model for Trade (Exports +Imports) among Arab Countries- 1997-2015

Variable	Without sub-regs	With sub-regs	1st period	2nd period
Exporter’ GDP	1.280***	1.301***	1.175***	1.032***
	(0.086)	(0.079)	(0.159)	(0.109)
Partner’ GDP	0.907***	1.025***	0.478***	0.732***
	(0.103)	(0.092)	(0.142)	(0.117)
Exporter’ population	0.774***	0.764***	1.063***	0.511***
	(0.072)	(0.066)	(0.105)	(0.100)
Partner’ population	0.652***	0.736***	0.820***	0.496***
	(0.086)	(0.085)	(0.109)	(0.091)
Exporter’ infrastructure	0.152***	0.111***	0.036	0.150
	(0.063)	(0.058)	(0.097)	(0.102)
Partner’ infrastructure	0.191***	0.205***	0.196***	0.328***
	(0.59)	(0.057)	(0.097)	(0.088)
Exporter’ RER	0.008	0.002	0.172**	0.030
	(0.026)	(0.023)	(0.071)	(0.046)
Partner’ RER	0.010	0.057	0.106*	0.014
	(0.048)	(0.040)	(0.061)	(0.060)
Exporter’ polity index	-0.003	-0.009	0.050***	-0.013
	(0.008)	(0.008)	(0.015)	(0.011)
Partner’ polity index	-0.019***	-0.019***	0.006	0.008
	(0.007)	(0.007)	(0.015)	(0.010)
Distance	-0.608***	-0.590***	-0.788***	-0.348**
	(0.178)	(0.121)	(0.222)	(0.162)
Common border	0.754**	0.333	1.127***	0.983***
	(0.310)	(0.258)	(0.353)	(0.339)
GCC		0.064		
		(0.354)		
AGADIR		0.972***		
		(0.365)		
AMU		1.342***		
		(2.255)		
Intercept	-19.148***	-16.165***	-18.689***	-10.510***
	(2.820)	(0.348)	(4.162)	(2.919)
Sigma-squared	2.196***	2.527***	1.449***	1.861***
	(0.221)	(0.277)	(0.122)	(0.225)
gamma	2.345***	2.700***	1.668***	2.503***
	(0.242)	(0.296)	(0.152)	(0.245)
Mu	2.430***	0.692	3.943***	2.616***
	(0.782)	(1.257)	(0.607)	(0.653)
eta	0.022***	0.024***	0.023***	0.010***
	(0.002)	(0.002)	(0.003)	(0.003)
Log Likelihood	-5110.49	-5100.91	-2397.87	-2491.52
Wald chi2	1013.01(0.000)	1141.55(0.000)	382(0.000)	404.57(0.000)
No. of Observations	4649	4649	2527	2122

- Standard errors are reported in parentheses
- ***, ** and * denotes significance at the 1, 5 and 10 percent level, respectively

First, the findings of the full sample period in column 2 and 3 indicate that most of the estimated coefficients carry their expected signs, and in line with the theory. The Table also points out that all the variables are statistically significant, except real exchange. Specifically, the coefficients of real GDP for both reporting and trading partner are positive and statistically significant, implying that an increase in national income of exporters and importers encourages trade flow between them. The results also reveal that the impact of population size in both reporting and trading partner is found to be positive and significant, suggesting that population size exerts a positive effect on intra-Arab trade flow. Expectedly, the coefficient of geographical distance is negative and significant, implying that the far distance between trade partners increase transportation cost, hence negatively affect trade flow. These findings are consistent with most of previous studies (e.g. Ravishankar and Stack, 2014 and Bhattacharya and Das, 2014).

Moreover, and as expected, the results of column 2 and 3 points out that the impact of infrastructure in both reporting and trading partner is positive and significant. This finding implies that infrastructure plays a significant role in facilitating trade among Arab countries. Unexpectedly, the coefficients of real exchange rate are not significant, suggesting that exchange rate policy has no role in influencing trade between Arab counties. This may be justified by the fact that most of Arab countries, particularly GCC members adopt pegged exchange rate policy for a long time. Unexpectedly, the impact of institutional quality in trading partner is found to be negative and significant, contradicting empirical studies. That is, improvement in political quality of trading partners reduces bilateral trade. This can be explained by the distorted political and institutional situation in Arab countries, as most of the largest trading partners in the region lack democracy and institutional quality. The coefficient of the dummy variable of common border is positive and statistically different from zero as expected. This result suggests that countries share common border has more opportunity to trade with each other.

Regarding the impact of sub-regional trade arrangements, the results of column 3 show that the dummy variable of GCC is insignificant, suggesting that GCC integration has no important role in facilitating trade among members. This result could be explained by the fact that the members of GCC are oil-exported countries and trade mainly out the region; hence the level of bilateral trade among GCC members is relatively low. However, the coefficients of AGADIR and AMU integrations are positive and significant, implying that being a member of AGADIR and AMU integration has a positive and significant impact on intra-trade among member countries.

Regarding the SFGM estimation for the sub-sample periods, column 4 and 5 present the results of estimation for before and after global financial crisis, respectively. The results of the two periods reveal that most of the variables carry the expected signs and statistically significant. That is, the coefficients of real GDP, population size, partner' infrastructure and common border are positive and significant, supporting the results of full sample of column 2 and 3. On the other hand, the impact of distance is negative and significant as expected. Unlike the results of full sample, the first period model (i.e. 1998-2007) shows that the effect of bilateral real exchange rate of both reporting and trading partners is positive and statistically significant. This also indicates that that deprecation exchange rate encourages trade among Arab countries. Moreover, the coefficient of institutional quality of reporting country in the first period is positive and significant, contradicting the results of full sample models. Interestingly, the empirical results reveal that the intercept term for the first period (i.e. 1998-2007) is larger than that for the second period (i.e. 2008-2015) implying that the intra-Arab trade has declined after the financial crisis, as this period witnessed many transformations such as, Arab spring and reduction in international capital inflows.

Furthermore, the coefficient of *Sigma-squared* is found to be positive and statistically significant in all model specifications. As σ^2 measures the mean of total variation in trade level over time period; this indicates that the potential trade over time has shown significant variation about its asymptotic mean. This also suggests that the potential trade of Arab countries during the period under study have been changing and is not constant over the period. This variation in potential trade can be due to just random factors or due to the influence of country specific characteristics between Arab countries. Moreover, the significance of *Sigma-squared* justifies the use of the SFA approach to estimating the gravity model. This also suggests that all deviations from the frontier are due to noise and due to trade inefficiency.

The results in Table 2 also points out that the coefficients of *gamma* are positive and statistically significant different from zero in all the estimated models. The large magnitude of *gamma* coefficients implies that the influence of '*behind the border*' constraints are responsible for a considerable proportion of the total variation in the model. It is interesting to see how do the *gamma* coefficients vary over time. Thus, the results indicate that the coefficient of *eta* is positive and statistically significant in all estimated models. This implies that the constraining impact of country specific effects (i.e. the behind border) on achieving potential trade level would be decreasing over time (i.e. 18 years). This finding indicates that the potential trade between Arab countries changes over time during the period under study. This also suggests that the impact of country specific socio-political-institutional factors on trade flows between countries may change over time due to both bilateral and multilateral negotiations, and regional cooperation. These findings support many empirical studies that used SFGM analysis such as, Kalirajan (2007), Abdmoulah (2011) and Bhattacharya and Das (2014).

Overall, these results imply that beside the core variables of conventional gravity model, the influence of country specific socio-political-institutional factors concerning Arab countries is responsible for a large portion of the mean of total variation in the trade level. This confirms the significant impact of the so called '*behind the birder*' constraints. Moreover, the influence of country specific trade constraining effects on potential trade has been decreasing during the period under study, suggesting some improvement in intra-Arab trade over time. However, this may also infer the sluggish improvement in intra-Arab trade. Furthermore, the sub-regional integration enhances trade among member countries, implying the importance role of sub-regional and bilateral arrangements in supporting trade among Arab countries.

5.2 Estimating Trade Efficiency Scores

Having estimated the SFGM of intra-Arab trade, the next step is to derive the trade efficiency scores by applying the coefficients of SFGM estimation of column 3 of Table 3 to the sample of Arab countries, over the period 1998-2015. The efficiency scores for each country pair are presented in Table 3 below.

Table 3: Efficiency Score Estimates from the SFGM (1998 – 2015)

	Algeria	Bahrain	Egypt	Iraq	Jordan	Kuwait	Lebanon	Libya	Mauritania	Morocco	Oman	Qatar	Saudi	Sudan	Tunisia	UAE	Yemen
Algeria		0.61	0.65	0.58	0.66	0.53	0.65	0.53	0.65	0.62	0.51	0.52	0.62	0.54	0.67	0.61	0.45
Bahrain	0.61		0.62	0.53	0.66	0.63	0.63	0.59	0.43	0.63	0.63	0.62	0.67	0.58	0.64	0.64	0.58
Egypt	0.65	0.61		0.61	0.64	0.63	0.69	0.64	0.65	0.61	0.58	0.60	0.64	0.66	0.64	0.64	0.66
Iraq	0.54	0.53	0.61		0.71	0.36	0.53	0.65	0.68	0.41	0.62	0.53	0.61	0.45	0.58	0.60	0.56
Jordan	0.67	0.69	0.66	0.72		0.71	0.71	0.64	0.65	0.54	0.66	0.65	0.69	0.72	0.65	0.69	0.69
Kuwait	0.51	0.62	0.63	0.31	0.63		0.68	0.39	0.61	0.43	0.62	0.57	0.62	0.55	0.60	0.63	0.65
Lebanon	0.62	0.65	0.67	0.62	0.67	0.66		0.63	0.67	0.64	0.61	0.64	0.67	0.68	0.65	0.68	0.63
Libya	0.51	0.59	0.64		0.61	0.43	0.62		0.62	0.48	0.53	0.50	0.56	0.52	0.68	0.61	0.49
Mauritania	0.65	0.44	0.59	0.40	0.50	0.47	0.60	0.40		0.77	0.50	0.49	0.61	0.48	0.66	0.66	0.50
Morocco	0.67	0.63	0.67	0.72	0.67	0.62	0.69	0.67	0.69		0.58	0.63	0.72	0.56	0.71	0.65	0.61
Oman	0.54	0.63	0.62	0.60	0.65	0.62	0.62	0.60	0.55	0.57		0.61	0.63	0.63	0.59	0.71	0.67
Qatar	0.53	0.62	0.60	0.60	0.66	0.57	0.64	0.46	0.65	0.70	0.61		0.60	0.60	0.75	0.62	0.60
Saudi	0.63	0.69	0.65	0.60	0.68	0.62	0.66	0.57	0.61	0.68	0.63	0.63		0.64	0.65	0.66	0.64
Sudan	0.56	0.62	0.68	0.48	0.72	0.59	0.69	0.54	0.39	0.55	0.62	0.60	0.69		0.65	0.70	0.67
Tunisia	0.71	0.61	0.66	0.60	0.65	0.61	0.65	0.71	0.68	0.68	0.69	0.59	0.65	0.67		0.63	0.58
UAE	0.60	0.63	0.63	0.62	0.67	0.62	0.69	0.61	0.61	0.74	0.58	0.62	0.64	0.67	0.61		0.68
Yemen	0.51	0.60	0.68	0.55	0.69	0.69	0.64	0.51	0.51	0.63	0.63	0.57	0.66	0.67	0.57	0.71	

Table 3 shows that the efficiency scores for most of the country pairs are far less than one, indicating that the actual trade between Arab counties is below the potential level that determined by the frontier. This indicates the presence of both '*beyond the border*' and '*behind the border*' constraints to trade flow among Arab countries. However, most of country pairs exhibit a relatively high degree of trade integration. The higher integrated efficiency scores are reported by country pairs that are close to each other, hence confronting few behind and beyond the border rigidities. One striking result is that Morocco has higher efficiency scores with all Arab countries, despite its far distance from some members like Gulf states. This implying that Morocco faces the fewest behind and beyond the border rigidities; also reflecting the effective trade relations between Morocco and other Arab countries.

The results also point out that UAE, Morocco, Jordan, Saudi Arabia and Egypt achieve highest efficiency scores among other Arab countries, suggesting that these countries perform close to their frontier trade level. This result reflects the efforts in these countries regarding trade liberalization and removing trade restrictions, as these courtiers are members of the world trade organization (WTO).

Moreover, the results indicate that Iraq and Libya registered the lowest efficiency scores and their performance is less than two-thirds of frontier trade level. This indicates that these countries are less integrated and face the most behind and beyond the-border constraints to trade in the Arab region. This could be explained by political instability and inefficiency of trade institutions in these countries. In addition, Iraq-Kuwait efficiency scores are lower reflecting the bad relationship between the two countries.

Furthermore, the table shows that sub-regional trade arrangements have significant impact on the efficiency scores of intra-Arab trade. For example, the trade integration among Arab Mashreq Union (AMU) members is very high, implying that these countries realizing most of their potential. Likewise, the integration efficiency scores among the member of AGADIR agreements (i.e. Morocco, Tunisia, Egypt and Jordan) are relatively high, supporting the success of this agreement. Furthermore, the efficiency scores among GCC members are around two thirds of maximum bilateral levels.

Overall, the above results reveal that the level of trade integration in Arab countries is far from potential level, as all efficiency scores are less than one. This indicates that behind- and beyond-the-border inefficiencies face all Arab countries. This also signifies the geographical and/or institutional constraints to trade efficiency. However, the high scores for some country pairs, particularly those belonging to the sub-regional groups, means that the efforts of bilateral and multilateral arrangements adopted in the last three decades have resulted in a relative improvement in bilateral trade among Arab countries.

6. Conclusion

This study investigates the performance and potential of trade flows among Arab countries, over the period 1998-2015. Following the theoretical background on production theory, this study employs a stochastic frontier gravity model (SFGM), measuring trade performance against a maximum possible level of potential trade defined by a stochastic frontier. The emphasis of this approach is to address other factors affecting bilateral trade between Arab countries such as, '*beyond the border*' and '*behind the border*' inefficiencies, which have been overlooked by the conventional gravity model adopted in the previous studies.

The empirical results indicate that the core variables of gravity model such as real GDP, population size and distance have significant impact on trade flow among Arab countries, supporting previous studies. The analysis also reveals that '*behind the border*' constraints have significantly contributed to gaps between potential and actual trade among all Arab members, despite the fact that these countries have initiated many trade arrangements to promote intra-trade during the last one-and-a-half decade. In addition, the results suggested that the influence of country specific socio-political-institutional factors (i.e. behind the border) is responsible for a large proportion of the mean total variation in the model. The results also pointed out that the impact of country specific socio-political-institutional factors on trade flows between countries have been decreasing over time. This can be attributed to the efforts of bilateral and multilateral negotiations, and regional cooperation in Arab countries.

Moreover, the results reveal that Arab-countries exhibit some low degree of trade integration with each other, indicating the existence of both '*beyond the border*' and '*behind the border*' constraints to trade flow among Arab countries. However, countries with common borders perform close to it potential frontier level. The results also show that sub-regional trade arrangements have significant impact on intra-Arab trade performance. That is, country-pairs who are a member of same integration perform better than those without integration. In particular, country-pairs belonging to AMU and AGADIR arrangements have relatively high efficiency scores compared to GCC members.

The policy implication arising from the existence of behind the border constraints as well as the variation in the realization of trade potential among Arab countries is that the country specific socio-political-institutional factors need a serious attention from policy makers so as to eliminate the *'behind the border'* constraints. That is, without removing or reducing such trade rigidities (i.e. behind the constraints) enhancing the intra-Arab trade performance will not achieve the expected trade creation goals. In addition, the significant role of multilateral, bilateral and sub-regional trade arrangements like GCC, AGADIR and AMU request more efforts to enhance the levels of integration among Arab countries.

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Appendices:

Appendix I: Definition and Sources of the variables used in the Analysis

Variable Name	Definition	Source
Trade	Total trade (Exports+ Imports) in million dollar	UN COMTRADE international trade data and International Monetary Fund' Direction of Trade Statistics (DOTS)
Real GDP	GDP at constant prices (2010)	World Bank's World Development Indicators
Population	Total population in millions	World Bank's World Development Indicators
Exporter' infrastructure	Measured by number of fixed telephone lines (per 100 people)	World Bank's World Development Indicators
Real Exchange Rate	bilateral real exchange rate, defined as $\frac{e_t * P_{US}}{P_t}$, where e_t is nominal exchange rate (local currency by US$), P_{US} is US wholesale price index, and P_t is local price index.	Central Bank of Sudan (CBOS)
Institutional quality	Measured by polity index	Marshall et al. (2016) database,
Distance	Distance in kilometers between country pair	http://www.distancefromto.net/countries.php.
Common border	Dummy variables (1= if the trading partners share common border and zero otherwise)	CIA World Fact-book
GCC	Dummy variable (1= if the trading partner is a member of GCC integration one and zero otherwise).	
AGADIR	Dummy variable (1= if the trading partner is a member of AGDAIR integration one and zero otherwise).	
AMU	Dummy variable (1= if the trading partner is a member of AMU integration one and zero otherwise).	

Appendix II: Summary statistics of the variables used in the Analysis

Variable	Mean	Std. Dev.	Min	Max	Obs
Trade (millions USD)	408	1410	0.0001	28500	4649
Exports (millions USD)	231	987	0	21400	4649
Imports (millions USD)	176	598	0	11100	4649
Exporter' GDP (millions USD)	29805.91	32881.63	1960.65	129349.90	4649
Partner' GDP (millions USD)	29036.25	32180.02	1960.65	129349.90	4649
Exporter' population	17.2	19.7	0.513	93.8	4649
Partner' population	17.2	19.7	0.513	93.8	4649
Exporter' infrastructure	12.17	8.18	0.25	33.92	4649
Partner' infrastructure	12.09	8.08	0.25	33.92	4649
Exporter' RER	137.34	450.11	0.27	5343.22	4649
Partner' RER	74.28	231.64	0.27	1566.24	4649
Exporter' polity index	-4.42	4.24	-10.00	7.00	4649
Partner' polity index	-4.31	4.44	-10.00	7.00	4649
Distance	3098.16	2196.06	462.88	12016.30	4649
Common border	0.23	0.42	0.00	1.00	4649

Appendix III: List of Countries Used in the Analysis

Algeria	Morocco
Bahrain	Oman
Egypt	Qatar
Iraq	Saudi Arabia
Jordan	Sudan
Kuwait	Tunisia
Lebanon	UAE
Libya	Yemen
Mauritania	

- Djibouti, Comoros, Palestine, Somalia and Syria have been excluded from the sample, due to the lack of data.