



The revival of trade in the Arab Maghreb Union (AMU)

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1. Introduction

In general, transport infrastructure plays a leading role in the economic development of nations and the reduction of their poverty; Transport is the means of communication and of links between peoples. Well-developed and maintained infrastructure services - electricity, transport, ICT, water and sanitation - reduce the obstacles to economic growth and their transactions costs and contribute to the improvement of peoples' lives by facilitating their access to public and social services.

In particular, transport infrastructure can be seen as a lever for economic and social development, as it can be an important accelerator of the regional integration process in the southern Mediterranean. Several studies have shown that the improvement of infrastructure and the redevelopment of ports, airports, railways and roads have positive effects on economic growth, employment, industry and competitiveness. More importantly, improving the flow of goods and people illustrates a major indicator of regional integration. In many countries, economic recovery cannot begin without upgrades to the infrastructure

2. Review of the literature

The literature has shown that a positive relationship links infrastructure, trade and growth. This relationship proved to be ancient, beginning with the work of Adam Smith in the nineteenth century. Since then, this theorist has shown that infrastructure plays an important role in facilitating trade. This smithian idea was based on the following relationship: Infrastructure → Transport → Exchange → Growth. In 1990, the empirical work on endogenous growth has succeeded and become more numerous. They showed that there are many factors explaining growth (education, research and development, technological innovation, public capital, trade openness, etc.). The theoretical contribution of (Barro, 1990) consists in introducing a new factor: public spending, which leads to productivity gains and long-term growth.

In the same path of ideas, we find that the new theory of international trade (Krugman, 1991) has allowed us to go beyond traditional analysis to present other

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approaches. It confirms that the gains from the exchange come from the reduction of production costs.

(Aschauer, 1989, p.197) states that "considerable weight must be attached to public investment decisions when assessing the role of government in economic growth and productivity improvement ". When the rate of growth of the US public capital stock of infrastructure declined, during the period 1971-1985, this resulted in a decline in the rate of growth and total factor productivity.

Esfahani and Ramirez (2002) have demonstrated a relationship between public infrastructure and growth, concluding that investments in infrastructure would have an impact on growth but at a slow pace.

In addition, improving infrastructure could increase the volume of intra-regional trade and contribute to the success of regional integration. This result was demonstrated by Hummels and Skiba (2004): if trade flows are low due to other factors besides transport costs (high tariff barriers), this leads to a decline in investments for infrastructure improvements and therefore the reduction of transport costs.

Limao and Venables (2001) have shown that geographic characteristics and the quality of infrastructure are important determinants of the cost of transport between countries. Among these determinants are the mode of transport, the distance, the characteristics of the goods (weight, fragility, value, etc.), the quantity transported, the itinerary (quality of infrastructures, frequencies of passage, etc.). In the same context, Hummels and Skiba (2004) carried out a study in which they showed that transport costs fell by 12% due to a doubling of the quantities traded on a given route for all countries passing through.

3. Empirical analysis

Several studies have used the gravity model to conduct assessments of the potential of international trade flows. In particular, the empirically successful model is (Linneman, 1966). The factors used in this model to explain trade flows are the export offer of a country i , the import demand of a country j , and a factor of resistance to an exchange flow between these countries. The model of Bergstrand, based on the Linneman model, has advanced the theoretical foundations of the gravity equation. Under the assumption that each country has a single factor of production, it is considered as a model of the general equilibrium of world trade. In this study, Bergstrand designs price variables and exchange rates, and adds other variables such as capital and labor inputs and per capita income. It had been successful in the area of trade relations analysis and for this reason we chose to use it to study the impact of the transport sector on the trade flows of AMU countries.

3.1. The econometric model

Our estimate is based on a sample of five southern Mediterranean countries: UMA countries (Algeria, Libya, Morocco, Mauritania and Tunisia). The period of study

begins from the date of establishment of the union: 1989 to 2014. The database was compiled from UNCTAD's reports on foreign trade and shipping freight. Data on GDP / capita are from the World Bank's WDI database. From the World Perspective (www.perspective.usherbrooke.ca), we have collected data on air freight. The distance data were extracted from the CEPII database. The main dummy variables were constructed by the author.

The general form of the gravity model is as follows:

$$\text{Log TC}_{ij} = \alpha_0 + \alpha_1 \log Y_{pi} + \alpha_2 \log Y_{pj} + \alpha_3 \log FM + \alpha_4 \log FA + \alpha_5 \log D + \alpha_6 \text{LC}_{ij} + \alpha_7 \text{FC}_{ij} + \varepsilon_{ij}. \quad (1)$$

For the series studied, they are non-stationary: $\log TC_{ij}$, $\log Y_{pi}$, $\log Y_{pj}$, $\log FM$ and $\log FA$, because the Student statistics are higher than the critical values (-3.41) of ADF. To render these series stationary, we shall resort to the first differences of the different series considered in order to render them stationary. So, we can estimate the model considered because the condition of the use of the linear regression is satisfied. Equation (1) becomes in the following form:

$$d \log TC_{ij} = \alpha_0 + \alpha_1 d \log Y_{pi} + \alpha_2 d \log Y_{pj} + \alpha_3 d \log FM + \alpha_4 d \log FA + \alpha_5 \log D + \alpha_6 \text{LC}_{ij} + \alpha_7 \text{FC}_{ij} + \varepsilon_{ij}. \quad (2)$$

3.2. The estimation of the commercial relations between the AMU partners

The estimation of the time series reveals the following results.

Table 3: The result of the regression of the Tunisia model and its partners

	Tunisia -Algeria		Tunisia -Libye	
	Coefficients	P -value	Coefficients	P-value
constante	40.88331822	0.00063134*	27.57710828	0.000000*
Y_{pi}	-0.60956051	0.717	2.08788513	0.00000004*
Y_{pj}	5.15707406	0.04**	0.41575512	0.0577922***
FM	0.00257923	0.0483393**	-0.00005162	0.49636353
FA	-0.04109547	0.058765***	0.00980323	0.50956442
D	0,5214704	0,00000254*	0,2341752	0,00014074*
LC	0,23657124	0,0000421*	0,3528417	0,0001241*
FC	0,5742153	0,000000215*	0,42852014	0,0015478*
R ²	0.892017		0.900097	
D-W	1.898210		0.915772	

	Tunisia -Morocco		Tunisia-Mauritania	
	Coefficients	P-value	Coefficients	P-value
constant	23.17544933	0.00059468*	55.17474975	.00000178*
Y_{pi}	6.52308210	0.01003827*	2.22086513	000033361*
Y_{pj}	-4.17660276	0.0125666**	4.56038464	.00384012*
FM	0.00297875	0.00040415*	0.00234607	.00856089*
FA	-0.01698940	0.057151***	-0.02305541	0.42930526
D	0.00216275	0.00007126*	0,6125478	0,014215**
LC	0.0628320	0.0154941**	0,20541017	0,0005472*
FC	-0.00478362	0.88713271	0,71254321	0,0014251*
R^2	0.808854		0.92343	
D-W	1.775087		1.969382	

*1% significance; ** significance at 5%; *** Significance at 10%. Source: The author.

According to this regression, the most important effect is that of Y_{pj} , value 5.15, the wealth of Algeria has a positive effect on Tunisian exports. Sea freight is significant at the 5% threshold and its positive coefficient. On the other hand, air freight is significant at the 5% threshold and it has a negative effect on trade between these two partners. Most of the goods traded are by the sea. Through the air route, trade is not too frequent, reflecting high costs relative to maritime transport. For the dummy variables, the assumptions about proximity and linguistic affinities are verified, they have positive coefficients.

The model of Tunisia-Libya is important considering the coefficient of determination R^2 (0.90), which tells us the importance of the trade relationship between Tunisia and Libya. The significance of the coefficients of the explanatory variables is important, since most of the coefficients are significant. The coefficient of the FM variable is negative and not significant. For the variable FA has a positive and not significant coefficient. The common border and the common language have positive coefficients; they contribute to improve the bilateral trade between Tunisia and Libya.

Variable D has a positive coefficient which justifies that the short distance between Tunisia and these two partners reduces transport costs, it positively affects trade. As demonstrated by (Disdier and Head, 2008), the greater geographical distance, the higher the costs borne by partners.

The model studied, Tunisia-Morocco, shows that the elasticities of GDP per capita are respectively 6.5 and - 4.17. We note that the wealth of Tunisia has a positive effect on the supply of goods. But, the wealth of Morocco has a negative effect on the demand for goods. Maritime freights have a positive and significant coefficient at 1%. Bilateral trade is more developed by sea which seems to be less costly. The FA variable has a negative effect on their bilateral trade, a 5% increase in air freight costs leads to a 1.6% decrease in trade. The FC has a negative and not significant coefficient. Variable D and

LC have positive coefficients. In fact, the proximity of Tunisia with its partners helps to increase their trade.

By explaining the commercial relationship between Tunisia and Mauritania, the significance of most of the parameters considered is assured, only the variable FA which is not significant. The global significance parameter is significant by 0.92. The most important parameters are indicated by Y_{pi} and Y_{pj} (2.22 and 4.56), the GDP per capita of both partners have positive effects on their total trade. Their trade takes place through the sea route which is cheaper than the air route. In this case, they are positively affected by the lower costs of maritime transport, although Mauritania does not have a considerable infrastructure for this mode of transport (a single international port). This positive impact should not obscure the maritime infrastructure problems of the two countries.

Table 4: The result of the regression of the Algerian model and its partners

	Algeria-Morocco		Algeria-Libya		Algeria -Mauritania	
	Coefficients	P-value	oefficients	P-value	Coefficients	P-value
constant	-0.4745408	0.000065*	70.218775	0.0000003*	78.5468862	0.0884***
Y_{pi}	0.18286	0.003541*	9.766966	0.000001*	2.6034753	0.627164
Y_{pj}	-0.803870	0.007990*	0.965596	0.004385*	8.1695324	0.012185**
FM	0.174485	0.0829***	0.000789	0.021163**	0.0145699	0.050064*
FA	0.4695173	0.003417*	0.005108	0.7963896	0.0622871	0.09091***
D	-0.007895	0.003086*	0.541785	0.0002145*	0.521472	0.001473*
LC	-0.5423694	0.000089*	-0.234175	0.0003542*	0.58124071	0.015324**
FC	0.8576219	0.007181*	0.251472	0.0000001*	-0.3274152	0.321742
R ²	0.973992		0.750515		0.85105	
D-W	1.833389		1.852988		1.791580	

* 1% significance; ** significance at 5%, *** significance at 10%. Source: The author.

If we observe the total trade between Algeria and Morocco, we note that all variables considered are significant (at the 1% threshold) except for the FM variable (significant only at 10%). Through this modeling, we observe that Y_{pj} has a positive coefficient; In fact, the GDP per capita of Algeria has a positive effect on the supply of goods. However, the GDP per capita of Morocco has a negative effect on their trade, it negatively affects the demand of the goods. FM and FA have positive effects on bilateral trade between Morocco and Algeria, both modes of transport are better than other members (especially Libya and Mauritania), freight costs are cheaper and both countries have a considerable number of international ports and airports.

Variable D has a negative effect on total trade despite the fact that these two partners are geographically closer; this effect is justified by the Algerian-Moroccan conflict over Western Sahara. The common border has a positive effect on trade flows between these two partners. The overall significance of the model is greater by 0.973.

For the Algeria-Libya model, all variables are significant at the 1% threshold, except for the FM variable, which is significant at the 5% threshold.

Based on the gravity model between Algeria and Mauritania, we observe that GDP per capita of Mauritania has a positive effect on total trade through the highest value of 8,169, while Algeria's GDP per capita has a positive coefficient is not significant. Both modes maritime and air transport have positive effects on the bilateral trade of both partners; but these effects are low and tend towards zero of respective values 0.014 and 0.06. The effects of the two variables D and LC are verified by respective values 0.52 and 0.58. However, the negative effect of FC through this model is coefficient -0.32. The overall significance of the model considered is low by 0.28, indicating the unreliability of trade between Algeria and Mauritania.

Table 5: Result of the regression of the Libya model and its partners

	Libya -Mauritania		Libya, Morocco	
	Coefficients	p-value	Coefficients	p-value
constant	-33.48728032	0.02252793**	2.450899467	0.45940567
Y_{pi}	-0.93985116	0.01868765**	0.730614520	0.01481140**
Y_{pj}	-4.56342013	0.02576534**	-2.037930742	0.00065052*
FM	0.00195443	0.00017855*	0.000271283	0.061774***
FA	-0.13041524	0.00881318*	-0.016067416	0.00414149*
D	0.412534	0.000053214*	-0.3412757	0.00012563*
LC	-0.8532147	0.000021457*	0.647158	0.0017452*
FC	0.02145236	0.3147214	0.682147	0.000012341*
R^2	0.792446		0.777161	
D-W	1.782942		1.75483	

* 1% significance; ** significance at 5%, *** significance at 10%.

Regarding the commercial relationship between Libya and Mauritania, the model is globally significant except for the variable FC which is not significant (the variables are significant at the 1% and 5% threshold). The GDP per capita of the two countries have negative effects on their bilateral trade. The FM variable has a positive effect since the maritime mode is the most used for these two countries; it costs less than the air mode, which suffers from major failures for both countries. The effects of D and FC are verified. While the LC variable produces a negative effect, even if the two countries have a long common, this does not improve their commercial relationship.

Considering now the trade relationship between Libya and Morocco, Libya's GDP per capita has a positive effect on the bilateral trade of the two partners, while the GDP per capita of Morocco does not contribute to increase this flow. Maritime freights have a positive coefficient indicating that the seaway seems better and contributes to improving trade between the two countries; the air freights have a negative coefficient reflecting higher costs this is due to the insufficient situation of the airports of Libya. The variables LC and FC have positive effects on our explained variable; while variable

D has a negative effect, so proximity has not contributed to improving bilateral trade between them.

Table 6: Result of the regression of the Morocco-Mauritania model

	Morocco -Mauritania	
	Coefficients	P-value
constant	18.989134	0.00023591*
Y_{pi}	-0.134450	0.021517198**
Y_{pj}	1.172584	0.12760428
FM	0.8952413	0.000024157*
FA	0.425147	0.00025147*
D	0.235741	0.2145621
LC	-0.004157	0.00047507*
FC	-0.009897	0.08016742***
R^2	0.904141	
D-W	2.491313	

* Significance at 1%, ** Significance at 5%, *** Significance at 10%.

The table above shows the trade relations between Morocco and Mauritania. We have proved that the global significance of the model is important since R^2 tends to 1 (0.904). Y_{pj} has a positive and not significant effect. Y_{pi} has a negative and significant effect; The GDP per capita of Morocco does not improve trade with Mauritania. Sea and air freight have positive effects on the bilateral trade of the two partners, we observe that the maritime effect is double that of the air because Mauritania doesn't have an infrastructure developed for both modes. Distance has a positive and not significant effect. The two variables LC and FC have negative coefficients on the explained variable; these two variables do not have a great influence on the bilateral trade of the two partners.

As shown by Limão and Venables (2001), a poor and inefficient transport infrastructure leads to higher transport costs and longer delivery times. Improving the infrastructure of a country can significantly reduce trade costs. Since the AMU countries are geographically close, distance has a positive effect on their trade flows; this is shown by (Disdier and Head, 2008); In other words, this distance creates negative effects on trade, so the greater the geographical distance, the higher the costs bore by the partners. But this is not the case of Libya and Morocco and also the case of Algeria and Morocco, in realities the political problems between these partners negatively influence the improvement of their bilateral trade. The majority of the results are in line with the literature: an increase in the merchant fleet develops trade flows between the partner countries as mentioned by Nordas and Piermartini (2004). The common language favors bilateral trade flows within the group as demonstrated by (Zhang and Jensen, 2007). The common border has positive effects on trade and helps reduce transport costs as demonstrated by (Gil-Pareja and Al, 2007).

Despite the few efforts made by the countries of the Central AMU, the situation doesn't seem to change especially following the various revolutions that have changed the data. These partner countries will have to put a new strategy on transport infrastructure. There is an urgent need to begin the restructuring of transport infrastructure for the two most used modes (maritime and air) within the group to achieve satisfactory results.

4. The evolution of trade of AMU

The following graphs show the evolution of bilateral trade between AMU members during the study period. Trade within AMU varies among member countries and their reforms, as well as their basic conditions and infrastructure.

4.1. Bilateral trade between Tunisia and Algeria



Fig.1. Bilateral trade between Tunisia and Algeria.

According to this graph, we note that the trade flow between Tunisia and Algeria is significant over the last 12 years; it is in increasing form during this period. With regard to the first period (1989-1999), we observed a significant drop in 1998 during the Asian crisis, which had a negative effect on the trade relationship between the two neighboring countries.

4.2. Bilateral trade between Tunisia and Libya

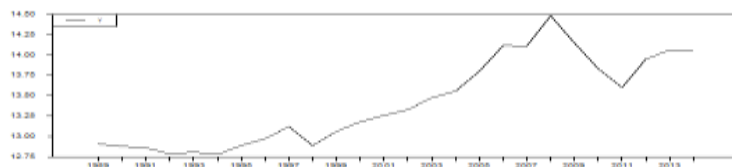


Fig 2. Bilateral trade between Tunisia and Libya

Concerning trade flows between Tunisia and Libya, they have grown significantly in the last years between 1998 and 2009 in an increasing way. During the first period their commercial relationship is low and constant value of 12.80 between 1989 and 1994.

4.3. Bilateral trade Tunisia-Morocco

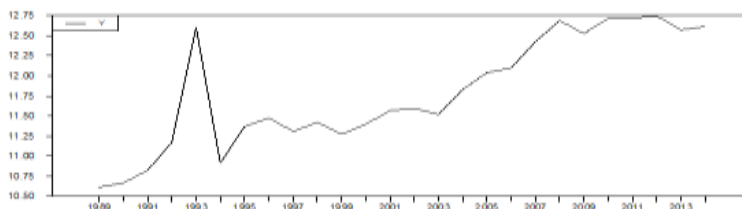


Fig 3 Bilateral trade Tunisia-Morocco

There is a growing trade relationship during the period 1995 and 2011; this trade relationship indicates a very large peak which reached 13 during 1994. These values reflect a strong relationship between these two partners.

4.4. Bilateral trade between Tunisia and Mauritania

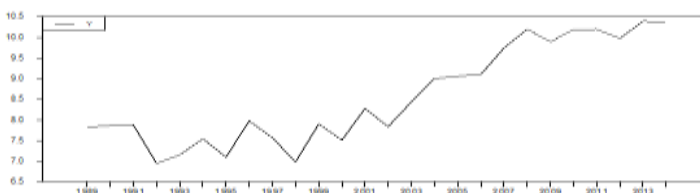


Fig 4. Bilateral trade between Tunisia and Mauritania.

Between Tunisia and Mauritania there is a growing monotonous commercial relationship during the period 1996-2013, with the first period 1989-1996 indicating an almost increasing average value of 7.5.

4.5. Bilateral trade between Algeria and Morocco

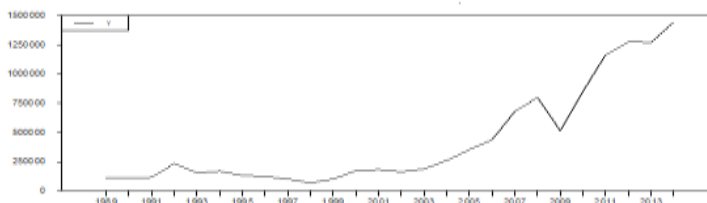


Fig.5 Bilateral trade between Algeria and Morocco

We note a trade relationship between Algeria and Morocco which is constant and low between 1989 and 2003 of average value 12.5; this is due in large part to their conflict over Western Sahara. But during the period between 2003 and 2013 we see an improvement in their trade which has reached a maximum value.

4.6. Bilateral trade between Algeria and Libya

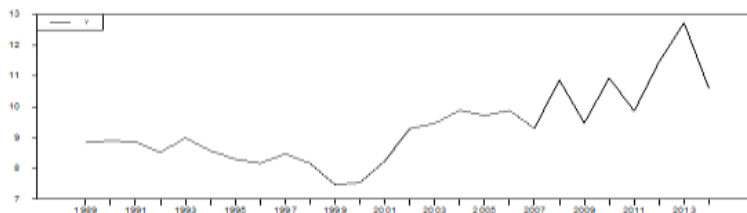


Fig 6: Bilateral trade between Algeria and Libya.

Regarding the evolution of total trade between Algeria and Libya, it is almost constant during the first period between 1989 and 2002, indicating a minimal fall in 2000. The second period between 2002 and 2013 indicates a relationship almost increasing. These modest flows are justified by the hostile relations between the two partners.

4.7. Bilateral trade between Algeria and Mauritania

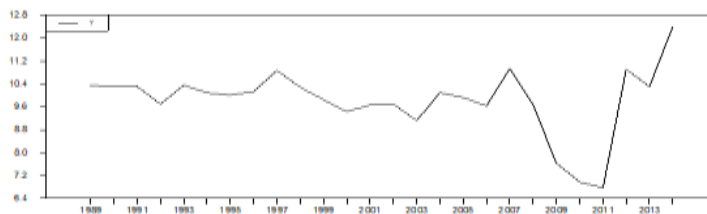


Fig 7 : Bilateral trade between Algeria and Mauritania.

Unlike other previous trade relations, we observe a hyperbolic function between 2009 and 2013; it means a decreasing relationship between 2009 and 2010 that connects Algeria and Mauritania and a growing relationship between 2011 and 2013. During the first twenty years we see an approximately constant relationship of value 10.2. The poor state of Mauritania's infrastructure hampers the development of its trade with Algeria.

4.8. Bilateral trade between Libya and Morocco

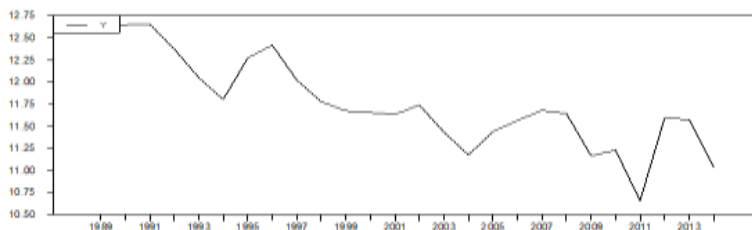


Fig 8: Bilateral trade between Libya and Morocco.

This relationship is roughly decreasing throughout the period considered, between 1989 and 2014, indicating a fall in 2011 during the recent financial crisis. That is, the latest crisis has a negative effect on the trade relationship between Libya and Morocco. Diplomatic relations between the two countries do not appear to be good, which negatively affects their trade relations.

4.9. Bilateral trade between Libya and Mauritania

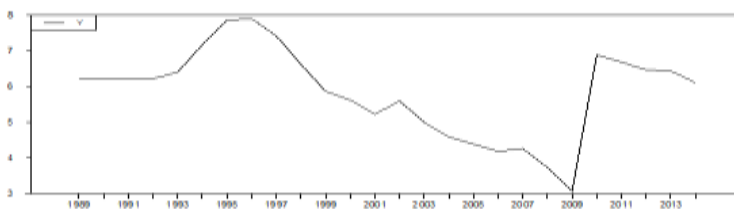


Fig 9. Bilateral trade between Libya and Mauritania.

The total trade between Libya and Mauritania is characterized by a hyperbolic relationship between 1992 and 1999, with a maximum value of 8, and then we see a decreasing relationship up to a peak in 2009, the negative effect of the crisis International financial relationship on that trade relationship. After 2009, we notice a significant increase between 2009 and 2013.

4.10. Commerce bilatéral entre Maroc-Mauritanie

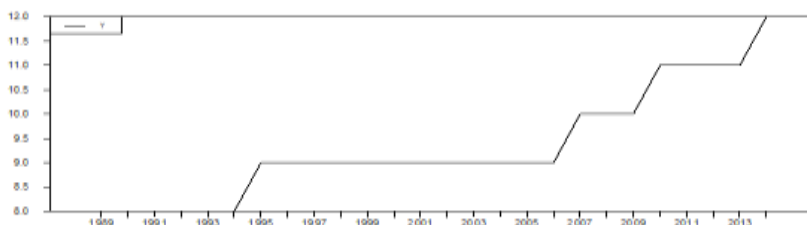


Fig 10 Commerce bilatéral entre Maroc-Mauritanie

Finally, the trade relationship between Morocco and Mauritania was not stable during 1989 and 2014; we note a curve in the form of a staircase: a growing and a constant part, the longest period is constant and it spreads between 1995 and 2005 and the trade flow between these two countries does not exceed 9.

Conclusion

In this Communication, we have shown the important role of the transport sector and its major contribution to improving intra-AMU trade. The results show that the transport factor in the southern region is still weak and unable to advance its integration process. This weakness will encourage these countries to pursue an adequate strategy that will advance the process of regional integration and the development of production capacities and infrastructure in order to achieve the objectives of their economic growth.

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