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An indicator of the need for regional integration

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Because of the small demographic and economic size of most African countries, the great need for regional integration in Africa is widely recognised. The shortfall in regional infrastructure, be that in telecommunications, transport, or energy supplies, contributes to the low amount of transactions between African countries (even neighbouring countries), and to their relatively low economic growth rates. A recent study on the potential economic gains of more integration of countries within certain African country groupings evaluates these gains to be close to 2%¹.



1. Ferdi, Evaluation des gains attendus de l'intégration régionale dans les pays africains de la Zone franc, A report for the Ministry of Finance of the Franc area, September 2012

.../... In spite of fifty years of promoting regional integration as a key element for Africa's development, its progress remains stunted by several factors among which the insufficient funding dedicated to integration projects.

Consequently by allocating a significant part of their assistance to regional integration, development partners may increase the effectiveness of their integration support. But for doing this they need allocation criteria, both for equity and effectiveness reasons.

One criterion may be the need of regional integration. An other one, the commitment of a country to regional integration, that we can't discuss in this document.

Here we present only the first criterion indicator.

Components of an indicator of the need for regional integration

This paper calls for the establishment of an indicator of the need for regional integration whose relevance is crucial for promoting support to regional integration. It appears necessary that this indicator should include an indicator of *size of the domestic market*. Small countries have a greater need to increase their potential market in order to benefit from economies of scale. Moreover, small countries lack economic diversity and are more vulnerable to external shocks. They are therefore more dependent on a regional community through which they can undertake greater investments, better absorb shocks thanks to diversification, and share the burden of risks thanks to intraregional flows of private and public capital and migration. This is why the small size of the economy, resulting from the small size of the population and a low income per capita, measured by a low GDP, should figure predominantly in the indicator of the need for regional integration.

A second essential criterion when calculating the need for regional integration for each country is obviously *their distance from foreign markets*. This is not only related to a country's geographical remoteness and isolation, but

also to the condition of its infrastructure. These causes of reduced competitiveness can be addressed by projects of regional infrastructure. If a suitable indicator for infrastructure could be found, it should be integrated into the indicator of remoteness. The latter would in this way take into account not only the geographical remoteness but also the poor condition of infrastructure.

So the indicator of the need for regional integration would be based on two indicators reflecting :

- the size of domestic markets,
- the remoteness from foreign markets, by taking into account both the geographical isolation of the country and the state of infrastructure.

Besides deciding which elements should be taken into account when calculating the indicator of the need for regional integration, there is also the question of their standardisation as indicators through a min-max procedure, the question of the weight given to each factor (which will have to be arbitrary), and the question of the type of mean value used for the aggregation of the components. With the simpler option of using two criteria (size of domestic market and remoteness from foreign markets), equal weighting could be an acceptable solution. A method for calculating the need for regional integration¹ is presented in Annex.

In this document, the indicator of the need for regional integration (IBIR - the French acronym for "Indicateur du besoin d'intégration régionale") is defined as the geometric mean of two factors: the small size of the domestic market and the remoteness from the world market.

1. If countries' commitment to regional integration is to be taken into account, it could be measured through an indicator of regional integration policy such as is already used by the ADB's CPIA, and similar to that which is considered for the CPIA's new E cluster for ADF-13. In order to calculate the adjusted indicator of the (perceived) need for regional integration, the indicator of regional integration policy could be introduced with a variable weighting, depending on the importance it is given. A simple solution would be to make it a third major component of the indicator of the need along with size of market and remoteness, giving each one an equal weighting of a third each.

Indicator of smallness of the domestic market

The first is an index of the small size of the domestic market: this size is measured using the level of the Gross Domestic Product (GDP). This can be calculated in two ways. In the calculations below, $Ind(x)$ denotes an x variable graduated from 0 to 100 according to a max/ min calculation.

A first method for defining the narrowness indicator for the domestic market would be to use the complement to 1 (or to 100) of an index of the log of Y (or GDP), knowing that this indicator can be specific to the range of countries sampled (and therefore to the min and max number of African countries). However, although Y is expressed as log values, as their distribution can be misrepresentative owing to the presence of very small GDP values (e.g. São Tomé and Príncipe), it might be useful to set a lower limit for GDP values :

$$IM_1 = [100 - Ind(\log Y)]$$

Another way to calculate the indicator could be :

$$IM_2 = Ind(Y^a)$$

Given that Y represents the GDP, we have $Y = y.P$, where y stands for the GDP per capita, P stands for the population and $-a$ ($-1 < a < 0$) is a coefficient representing the intensity of the handicap resulting from the smallness of the market for the sample countries.

NB: to prevent the relative levels of GDP from being artificially influenced by exchange rates, values are expressed in PPP.

Adjusted indicator of remoteness : landlockness and infrastructure taken into account

The second component of the IBIR is an index of remoteness from foreign markets.

This index is calculated following a method developed by the *Fondation pour les études et les recherches sur le développement international* (Ferdinand) and the *Centre d'études et de recherches sur le développement international* (Cerdic)², and used by the UN DESA³ to measure economic vulnerability and identify LDCs. It is based on the calculation of the average distance to reach $x\%$ of the world market of imports of goods and services. (e.g. $1/3$ with UN DESA), called D . To take into account the decrease in marginal shipping costs with relation to distance, the latter can then be treated in two different ways : either it is expressed as logs (method used by Ferdinand and UN DESA), or it is raised to a power less than 1 (for example 0.5, which means taking its square root). In both cases, the calculated value then has to be converted into an index.

Following the same method developed by Ferdinand, this index itself is adapted to take into account the possible landlockness of the country, captured below by a dummy variable (L) using a weighting (r) reflecting the way landlockness increases the costs of shipment related to distance. With regard to distance, it is assumed (as is done in the Ferdinand-UN DESA method), that landlockness increases remoteness in an additive way, and not in a multiplicative way. If the distance is expressed in logs to take into account the decrease of the marginal cost of distance, the adjusted remoteness indicator is :

$$IR_1 = Ind [(1 - r) \cdot Ind(\log D) + r.L]$$

with $L=100$ if the country is isolated and 0 if not. and for example: $r = 0.15$ or 0.30

2. P.Guillaumont « A Retrospective EVI: Methodological Aspects » Ferdinand, Document de travail série « Indicateurs de développement innovants », June 2007

3. Committee for Development and United Nations, Department of Economic and Social Affairs, *Handbook on the Least Developed Country Category: Inclusion, Graduation and Special Support Measures*, November 2008.

If an appropriate infrastructure index (U) is then introduced to take into account the fact that poor infrastructure increases the costs involved to reach foreign markets and thereby increases remoteness (once more, this is an additive and not a multiplicative increase), one can obtain a doubly adjusted measure of remoteness : taking into account a country's possible landlockness and the weakness of its infrastructure (1-U) :

$$IR'_1 = Ind[(1-r \cdot s) \cdot Ind(\log D) + r \cdot L + s \cdot (1-U)]$$

with for example $r=0.2$ et $s=0.3$

4 This additional adjustment to the original Ferdi/UN DESA method seems necessary in the present exercise, both because of the great importance of the weakness of infrastructure on the remoteness of many African countries and the priority given to the improvement of infrastructure in the ADB's strategy.

If one now decides to measure remoteness in a multiplicative way, each element is assigned an exponent representing the elasticity of remoteness with respect to each of them, namely the distance to be crossed to reach a certain proportion of foreign markets (D), the condition of infrastructure (U), and the degree of geographical isolation (L') (which in this case replaces the dummy value L, inoperable in exponential form) measured by an index of distance from the coast with a minimum value of 1. If this measure is called IR_2 ou IR'_2 :

$$IR_2 = Ind [D^b \cdot L^{k'}]$$

$$IR'_2 = Ind [D^b \cdot L^{k'} \cdot U^v]$$

With $0 < b < 1$; $0 < k' < 1$; $-1 < v < 0$

If the landlockness cannot be expressed in the continued form of a degree of isolation, it is possible to resort to a hybrid index of remoteness, which would again associate all the elements multiplicatively, but based on a hypothesis which at first glance may seem less relevant as concerns landlockness, if it is assumed that landlockness is an obstacle to trade in direct relation to distance and D is replaced by $D'=D(1+k'L)$,

where $k' > 0$. However it is preferable to suppose that landlockness is an obstacle to exchange directly dependent on the weakness of infrastructure, and if U is replaced by $U'=U(1+k''L)$, where $k'' < 0$. One can then write⁴

$$IR''_2 = Ind [D^b \cdot U^v] = Ind [D^b \cdot (U(1+k''L))^v]$$

With $0 < b < 1$; $-1 < k'' < 0$; $-1 < v < 0$

In this formulation, the index of remoteness from foreign markets (IR''_2) corresponds to the geometric mean of the average distance to reach an important share of the world market and of an indicator of the structural obstacles limiting access to this market, regardless of distance.

Indicator of the need for regional integration

The Indicator of the need for regional integration (IBIR) can then be calculated by aggregating the index of narrowness of the domestic market and the index of remoteness from foreign markets according to an arithmetic or geometric mean. The first option would be more traditional, and more adapted to the first method of defining the narrowness index (IM_1) and the remoteness index (IR_1). The second option allows us to capture the interaction between the two main components of the need for integration, represented by these two indices. It is also closer to the second method of defining these two indices, the narrowness index (IM_2) and the remoteness index (IR_2). This second option, as demonstrated below, in certain situations allows simplification of the method of calculation of the regional drawing rights. This leads to formulation of two measures of the IBIR, depending on whether one chooses to use arithmetic (A) or geometric (B) averages⁵, and in the second

4. Another solution would be to consider the impact of isolation as proportional to the multiplication $D \cdot U \cdot v$ and have $IR'''_2 = Ind [D^b \cdot U^{v(1+k''L)}]$
 5. Although in this second case, one can use the measure (IR_1) of the index of remoteness according to an arithmetic mean, thus: $IBIR(G)' = (IM_1 \cdot IR_1)^{0.5} = [Ind(Y^a)]^{0.5} \cdot Ind[(1-r \cdot s) \cdot Ind D^b + r \cdot L + s \cdot U]^{0.5}$

case depending on the selected method of calculating remoteness; for the sake of homogeneity and coherence, we choose to keep the measure IR''_2 :

$$IBIR(A) = \frac{1}{2} [IM_1 + IR_1] = \frac{1}{2} [100 - Ind(\log Y)] + \frac{1}{2} Ind[(1-r-s) \cdot Ind(\log D) + r \cdot L + s \cdot U]$$

$$IBIR(G) = (IM_2 \cdot IR''_2)^{0.5} = [Ind(Y^a)]^{0.5} \cdot [Ind(D^b \cdot U^v)]^{0.5}$$

with $U' = U(1+k'L)$

If, in this last formula, it is decided to give the same absolute value to the exponents of GDP and of remoteness from foreign markets, ($b = -a = 1$), and if the elements Y and D of IBIR(G) had not been initially transformed into indices, one would obtain (knowing $a < 0$ et $b > 0$): $IBIR(G) = Ind[(D/Y) \cdot U^v]^{0.5}$

4) An adjusted indicator of the need for regional integration or indicator of the “perceived” need for regional integration can also be calculated, depending on the country’s commitment to regional integration. In fact, if it appears advisable to take this commitment into account, this could be done by correcting the IBIR by the means of an Index of Commitment to Regional Integration (ICRI)⁶. This index could be introduced either through the arithmetic mean, IBIR(A) or with the geometric mean IBIR(G), which seems more logical in this case. Either way this implies reducing the importance given to the indicators IN and IR and transferring it to the ICRI. It would then seem reasonable to award each of these indicators a third of the total weight. For practical reasons related to the need of simplicity in later formulations, and to the unavailability of the necessary data to calculate the ICRI, it is not taken into account in what follows.

6. The design of such an index is in preparation at Ferdi.

Annex

Calculating the indicator for regional integration needs of African countries. Some illustrations using the different approaches considered⁷

Details on the method, values and data sources used in calculating IBIR can be found in «For a new instrument supporting regional integration in Africa to be implemented by the African Development Bank» by Patrick Guillaumeont and Sylviane Guillaumeont Jeanneney, *Ferdi Working paper* P83, January 2014 (also available in French).

Let us recall that the indicator of the need for regional integration is defined as being the arithmetic or geometric average of two components: the index of small domestic market size and the index of distance from foreign markets.

The index of small size of the domestic market (IM) is calculated using two methods (depending on the average used for calculating the IBIR arithmetically or geometrically):

$$IM_1 = 100 - Ind(\log Y)$$

and $IM_2 = Ind(Y^a)$

The index of distance from foreign markets (IR), in a similar way as for the IM, is calculated in two different ways :

$$IR'_1 = [(1-r-s) \cdot Ind(\log D) + r \cdot L + s \cdot (100 - Ind(U))]$$

With $L=100$ if the country is landlocked isolated and $L=0$ if it is not.

$$IR''_2 = Ind(Ind(D)^b \cdot Ind(U)^v)$$

$$= Ind[Ind(D)^b \cdot Ind(U(1+k'' \cdot L'))^v]$$

With $U'=U \cdot (1+k'' \cdot L')$ and $k'' = -0.5$; $L'=1$ if the country is landlocked and $L'=0$ if it is not.

Depending on the values attached to the coefficients of the index of distance from foreign

7. Calculation was done by Benjamin Coudert who is strongly acknowledged.

markets, three definitions are considered to calculate the index of the needs for regional integration.

IBIR(A) corresponds to the arithmetic mean of the elements IM_1 and IR'_1 :

$$IBIR(A) = \frac{1}{2} (IM_1 + IR'_1)$$

thus

$$IBIR(A) = \frac{1}{2} [(100 - Ind(logY)) + [(1-r-s). Ind(logD) + r.L + s.(100-Ind(U))]]$$

Three options are proposed to calculate this index depending on the values attached to the coefficients :

Option 1	Option 2	Option 3
$(1-s-r) = 0.6$	$(1-s-r) = 0.5$	$(1-s-r) = 0.4$
$s = 0.2$	$s = 0.2$	$s = 0.2$
$r = 0.2$	$r = 0.3$	$r = 0.4$

IBIR (G) is the indicator for the geometric mean of the elements IM_2 et IR''_2 . It is calculated as follows :

$$IBIR(G) = (IM_2 \cdot IR''_2)^{0.5}$$

thus

$$IBIR(G) = [Ind(Y^a) \cdot Ind(Ind(D)^b \cdot Ind(U')^v)]^{0.5}$$

As is the case in the first IBIR above, different options were considered, depending on the value of the various coefficients :

Option 1	Option 2	Option 3
$a = -1$	$a = -1$	$a = -1$
$b = 1$	$b = 1$	$b = 1.5$
$v = -1$	$v = -0.5$	$v = -0.5$

Finally, an IBIR (G') is calculated by finding the geometric average of the two elements used when calculating the arithmetic IBIR (A):

$$IBIR(G') = (IM_1 \cdot IR'_1)^{0.5}$$

Three options were again chosen to calculate the IBIR(G'), which correspond to the three options previously used to calculate the IBIR (A) :

Option 1	Option 2	Option 3
$(1-s-r) = 0.6$	$(1-s-r) = 0.5$	$(1-s-r) = 0.4$
$s = 0.2$	$s = 0.2$	$s = 0.2$
$r = 0.2$	$v = -0.5$	$r = 0.4$

The IBIR(A) and (G') – calculated using the same indices of small size of domestic markets and of distance from foreign markets – have similar values whether one chooses to use an arithmetic or a geometric mean. Similar results are obtained when ordering African countries according to IBIR(A) and (G'). On the other hand, the values obtained when calculating the IBIR(G) are very different to those obtained with the two other calculation methodologies. However all three IBIR rankings remains very similar (with a few exceptions).

Tentative results are given in the following table giving the top ten IBIR (relatively to population) for all African countries.

Top 10 relative IBIR for all African countries using the different options

IBIR (A)					
Option 1		Option 2		Option 3	
<i>Sao Tome and Principe</i>	2,01 (1)	<i>Sao Tome and Principe</i>	1,98 (1)	<i>Lesotho</i>	1,56 (1)
<i>Comoros</i>	1,95 (2)	<i>Comoros</i>	1,89 (2)	<i>Madagascar</i>	1,53 (2)
<i>Lesotho</i>	1,84 (3)	<i>Lesotho</i>	1,78 (3)	Botswana	1,52 (3)
<i>Guinea-Bissau</i>	1,73 (4)	<i>Guinea-Bissau</i>	1,72 (4)	<i>Zambia</i>	1,50 (4)
Swaziland	1,72 (5)	<i>Central African Republic</i>	1,66 (5)	<i>Zimbabwe</i>	1,49 (5)
<i>Zimbabwe</i>	1,69 (6)	Swaziland	1,65 (6)	Swaziland	1,48 (6)
<i>Central African Republic</i>	1,67 (7)	<i>Zimbabwe</i>	1,65 (7)	<i>Malawi</i>	1,47 (7)
Seychelles	1,67 (8)	<i>Burundi</i>	1,62 (8)	<i>Comoros</i>	1,40 (8)
<i>Cape Verde</i>	1,65 (9)	<i>Cape Verde</i>	1,61 (9)	<i>Uganda</i>	1,39 (9)
<i>Burundi</i>	1,65 (10)	Seychelles	1,56 (10)	<i>Burundi</i>	1,39 (10)

IBIR (G)					
Option 1		Option 2		Option 3	
<i>Sao Tome and Principe</i>	5,89 (1)	<i>Sao Tome and Principe</i>	6,80 (1)	<i>Sao Tome and Principe</i>	6,81 (1)
<i>Central African Republic</i>	5,01 (2)	<i>Comoros</i>	3,77 (2)	<i>Comoros</i>	3,98 (2)
<i>Guinea-Bissau</i>	3,71 (3)	<i>Central African Republic</i>	3,64 (3)	<i>Central African Republic</i>	3,61 (3)
<i>Niger</i>	3,12 (4)	<i>Guinea-Bissau</i>	3,57 (4)	<i>Guinea-Bissau</i>	3,49 (4)
<i>Somalia</i>	3,02 (5)	<i>Lesotho</i>	2,90 (5)	<i>Lesotho</i>	3,14 (5)
<i>Eritrea</i>	3,01 (6)	<i>Liberia</i>	2,86 (6)	<i>Liberia</i>	2,85 (6)
<i>Lesotho</i>	2,75 (7)	<i>Somalia</i>	2,70 (7)	<i>Somalia</i>	2,77 (7)
<i>Liberia</i>	2,59 (8)	<i>Eritrea</i>	2,69 (8)	<i>Eritrea</i>	2,61 (8)
<i>Comoros</i>	2,53 (9)	<i>Niger</i>	2,13 (9)	<i>Zimbabwe</i>	2,21 (9)
<i>Chad</i>	2,39 (10)	<i>Burundi</i>	2,11 (10)	<i>Burundi</i>	2,17 (10)

IBIR (G')					
Option 1		Option 2		Option 3	
<i>Sao Tome and Principe</i>	2,40 (1)	<i>Sao Tome and Principe</i>	9,93 (1)	<i>Sao Tome and Principe</i>	2,44 (1)
<i>Comoros</i>	2,35 (2)	<i>Comoros</i>	9,50 (2)	<i>Comoros</i>	2,35 (2)
<i>Lesotho</i>	2,17 (3)	<i>Lesotho</i>	8,83 (3)	<i>Lesotho</i>	2,17 (3)
<i>Guinea-Bissau</i>	2,08 (4)	<i>Guinea-Bissau</i>	8,66 (4)	<i>Guinea-Bissau</i>	2,13 (4)
Swaziland	2,02 (5)	<i>Central African Republic</i>	8,30 (5)	<i>Central African Republic</i>	2,04 (5)
Seychelles	2,00 (6)	Swaziland	8,14 (6)	<i>Cape Verde</i>	2,02 (6)
<i>Central African Republic</i>	2,00 (7)	<i>Cape Verde</i>	8,12 (7)	Swaziland	2,01 (7)
<i>Cape Verde</i>	1,99 (8)	<i>Zimbabwe</i>	8,11 (8)	<i>Zimbabwe</i>	2,00 (8)
<i>Zimbabwe</i>	1,99 (9)	<i>Burundi</i>	8,06 (9)	<i>Burundi</i>	1,99 (9)
<i>Burundi</i>	1,96 (10)	Seychelles	7,84 (10)	Seychelles	1,98 (10)



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