

An Empirical Estimation of Asia's Untapped Regional Integration Potential Using Data Envelopment Analysis

DOMINIK NAEHER*

This paper uses bilateral flow data on multiple dimensions of economic integration to construct a composite index of regional integration outcomes covering 19 regions in various parts of the world. As a first step, the multidimensional indicator is used to rank regions according to their current degree of regional integration, which allows for a direct comparison of Asia's regional integration performance with those of other regions of the world. As a second step, the constructed indicator of regional integration outcomes is used as the output variable in a data envelopment analysis to estimate Asia's untapped regional integration potential.

Keywords: Asia, composite index, data envelopment analysis, integration potential, regional integration

JEL codes: F02, F10, F13, F15

I. Introduction

Regional integration is at the center of the current debate on strategies for optimal growth and development policies. Many authors have stressed the role of regional integration in achieving economies of scale, improving market structures, and enhancing the forces of competition. These impacts drive technological change and foster higher productivity growth and investment activities, which are often viewed as eventually leading to higher benefits from trade and positive welfare gains (Krugman 1991a, Baldwin and Venables 1995, Fernandez and Portes 1998, Sapir 2011). Regional integration is also frequently seen as a possible building block for greater trade liberalization and multilateralism (Bhagwati 1993; Baldwin 2006; Calvo-Pardo, Freund, and Ornelas 2011). In addition, there may be important

*Dominik Naeher (naeher@econ.uni-frankfurt.de): Researcher and PhD candidate in Economics at Goethe University Frankfurt, Germany. This paper was written during my stay at the Asian Development Bank (ADB) as an intern and builds upon a preliminary analysis that was conducted as part of an ADB thematic evaluation study on regional cooperation and integration efforts in Asia. The author would like to thank Marco Gatti and his team at the Independent Evaluation Department for their support and discussions on this study, the anonymous referees, the Managing Editor, and the participants at the Economic Research and Regional Cooperation Department Seminar Series for their comments and suggestions. The usual disclaimer applies.

noneconomic benefits of regional integration that go beyond raising national income levels and reducing poverty (Bhattacharyay, Kawai, and Nag 2012).

While the academic debate on regionalism has also produced various studies arguing against regional integration efforts—when compared with multilateral trade liberalization within the World Trade Organization (see, for example, Krugman 1991b; Frankel, Stein, and Wei 1995)—the empirical evidence over the past 2 decades shows that the focus of trade policy has shifted toward regional approaches. The rising prominence and increasing number of preferential trade agreements and regional trade agreements are evidence of this (WTO 2011).

Compared to the sometimes euphoric perceptions of policy makers, the empirical evidence on regional integration outcomes is, however, rather limited. As De Lombaerde et al. (2008) argue, there is a need for quantitative measures and empirically verifiable analyses of regional integration outcomes, which this paper seeks to address. Most of the existing studies on regional integration can be classified into two groups. The first comprises papers that discuss regional integration at an institutional level, looking, for example, at subregional organizations or multilateral free trade agreements, and often referring to the stages of integration defined by Balassa 1961. Most of these studies focus on theoretical considerations and are based on qualitative arguments.

In the second group are studies that investigate effective degrees of economic integration using empirical data. Most of these papers investigate only a single dimension of integration, such as the large literature on trade, or studies on migration. This paper follows the empirical approach of the latter class of studies, but combines data on multiple areas of integration into a single indicator. This allows for an estimation of realized degrees of regional integration along various dimensions and enables the results for Asia's regions to be compared with those from other regions of the world. A constructed composite index of regional integration outcomes is then used as the output variable in a data envelopment analysis (DEA) to estimate Asia's untapped regional integration potential. The results suggest heterogeneous (but on average, large) possible increases in regional integration levels across Asia given the current status of institutional conditions and available resources.

The remainder of the paper is structured as follows. Section II introduces the data sources and explains the applied methods for the construction of a composite regional integration (CRI) index and the performance of DEA. The results are presented in Section III and tested for their robustness in Section IV. Section V concludes.

II. Data and Applied Methods

In order to estimate regional integration potential in Asia, as a first step a composite index of regional integration outcomes based on empirical data for

various areas of economic integration is constructed.¹ Any such composite index depends on the data used and the chosen aggregation methods. Although several authors have recently proposed procedures to construct such an index, no standard procedure has yet been established in the literature so far (De Lombaerde et al. 2008). The methods applied in this paper are specifically designed to capture integration outcomes along multiple distinct dimensions in a coherent and transparent way and to aggregate the data to ensure comparability of variables with different scales and units of measurement. Alternative measurement and weighting schemes are discussed as part of the robustness checks in Section IV.

A. Data Selection, Normalization, and Aggregation

Following Nardo et al. (2008), a first step in constructing composite indices is to select a set of empirically quantifiable subindicators that serve as proxies for the multiple dimensions of regional economic integration outcomes being considered. Different from composite indices in other contexts, the construction of a multidimensional index of regional integration outcomes requires data on bilateral cross-border flows, rather than on individual country-level stocks. Because of the limited availability of global bilateral datasets, the selection of variables to be included in the CRI index is restricted. However, for a number of relevant dimensions of economic integration such data do exist, including (i) cross-border mobility for migration and tourism, (ii) trade and investment, and (iii) monetary and financial integration.²

In order to keep the data comparable, intraregional shares of flow variables F_{ij} (for specific origin and destination) are used as a single measure for all considered dimensions of economic integration.³ Based on a bilateral data matrix containing information about these flows between economies i and j , the intraregional share is defined as the fraction of flows between the economies in region R (denoted F_{RR}) and total flows between those economies in R and all economies in the world W (F_{RW}), which can be calculated as

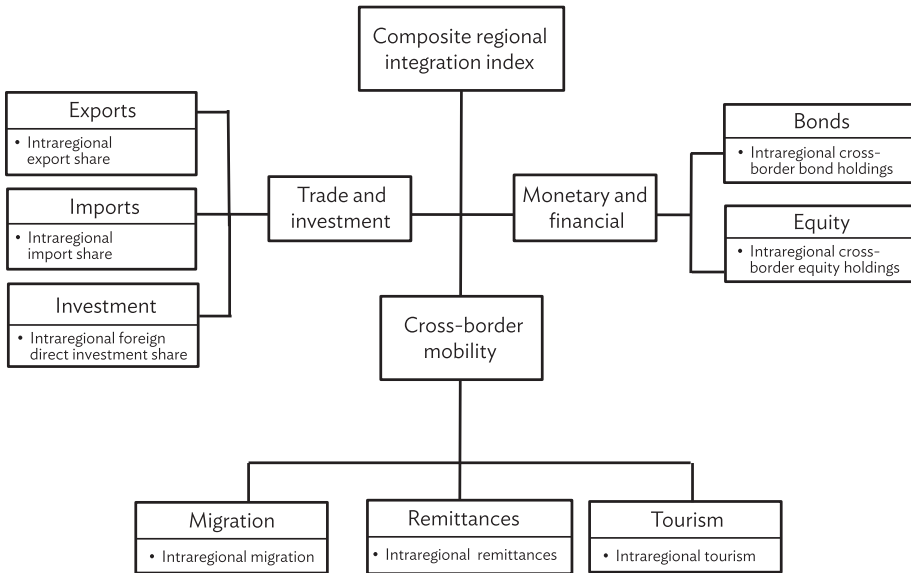
$$\frac{F_{RR}}{F_{RW}} = \frac{\sum_{i \in R} \sum_{j \in R, j \neq i} F_{ij}}{\sum_{i \in R} \sum_{j \in W, j \neq i} F_{ij}} \quad (1)$$

¹The term “region” is used in this paper to refer to a set of (mostly bordering) economies located in the same geographical area.

²The conceptual framework for the choice of subindicators is based on ADB’s regional cooperation and integration strategy framework (ADB 2006), particularly the four defined regional cooperation and integration pillars: (i) cross-border infrastructure, (ii) trade and investment, (iii) monetary and financial integration, and (iv) regional public goods. The selection of individual variables reflects important areas of integration within these dimensions for which data are globally available. For other areas than the ones considered, such as regional public goods, no adequate datasets could be identified.

³Other possible measures of regional integration outcomes include intraregional correlation coefficients and intensity indices.

Figure 1. Composite Regional Integration Index



Source: Author's illustration.

The CRI index is based on each region's performance along the considered variables and constructed as shown in Figure 1. At each aggregation level, equal weights are assigned to the respective subindicators. While this is in line with other studies that construct composite indices with the purpose of using them in data envelopment analysis (Afonso, Schuknecht, and Tanzi 2005; Herrera and Pang 2005), it introduces an additional assumption. The robustness of the results to different weighting schemes are discussed in Section IV.

All included variables are normalized such that higher values indicate a higher degree of regional integration and the range of possible values is between 0 and 1 for all variables. For indicator I , this is achieved by calculating the distance to the sample maximum, setting the normalized value for region i equal to

$$I_i^* = \frac{I_i}{\max_{i \in N}(I_i)} \tag{2}$$

For all variables that are measured according to a predefined scale (e.g., the Logistics Performance Index) the distance to the theoretically maximal attainable value is used, which is five in the case of the Logistics Performance Index.⁴ Most of the variables used in the analysis come from International Monetary Fund (IMF)

⁴Other normalization methods, such as standardization (z-scores) or rescaling, would either allow for differing ex-post ranges across variables (setting instead the first two moments equal) or force the smallest value in the sample to equal 0, which may not sufficiently capture cases where all regions are performing relatively well.

and World Bank datasets, as well as from ADB's Integration Indicators database. Table 1 provides a complete list of data sources.

B. Economy Groupings and Missing Data

The sample consists of 19 regions, comprising a total of 186 economies. Table A.1 in the Appendix lists the corresponding groupings. For some of the variables used, data on additional economies not listed in the Appendix are available. These economies are included in the calculation of total flows between individual regions and the world (F_{RW}) as part of W .

For all variables, data on some economies are missing and hence the affected regions are only a subset of the corresponding economies. The numbers of available economies are shown in Table A.2 in the Appendix. The average coverage across all variables is about 80% of each region's economies and with the exception of the IMF's Coordinated Portfolio Investment Survey dataset, the coverage is never below 50% for any variable or region. For the two variables on monetary and financial integration (cross-border bond and equity holdings), data are available for only 40% of the economies (e.g., many of the island states in the Pacific and Caribbean are missing) and only two African economies are included (Egypt and South Africa).

In order to correct for the bias that would occur for the African regions if this subindicator were simply excluded from the computation of the respective CRI index for these regions, an attempt was made to impute the missing values. This was done by using the average of the two available economies for the three African regions that do not have any observations. Although this procedure represents only a very rough approximation, it is likely to significantly reduce the bias that would otherwise occur.⁵ When the CRI index is computed without taking into account monetary and financial integration, the resulting ranking differs only slightly and none of the imputed regions are severely affected. This indicates that the imputed values are not driving the results for these regions.

C. Global Comparison of Composite Regional Integration Levels

The resulting values for the CRI index are shown in Table 2 (column 1), along with normalized intraregional shares for the three considered areas of economic integration (columns 2–4), and input-related variables (columns 5–7). The regions with the highest CRI levels are Western Europe, North America (Canada, Mexico, and the United States), and East Asia. The regions with the lowest CRI levels are Middle Africa and Northern Africa, and Central Asia and South Asia. Southeast Asia

⁵In the event that Egypt and South Africa are generally more financially integrated than the average African country, the imputed values would be too high. This, however, would not affect the overall resulting ranking according to the CRI index, given that the African regions are already at the lower end of the sample.

Table 1. Data Descriptions and Sources

Variable	Description	Data Source (institution, year)
Outputs:		
Intraregional export share	Intraregional exports (% of total exports)	Direction of Trade Statistics (IMF, 2014)
Intraregional import share	Intraregional imports (% of total imports)	Direction of Trade Statistics (IMF, 2014)
Intraregional FDI share	Intraregional FDI inflows, net (% of total FDI inflows, net)	Foreign Direct Investment (UNCTAD, 2012)
Intraregional bond holdings	Intraregional cross-border bond holdings (% of total cross-border bond holdings)	Coordinated Portfolio Investment Survey (IMF, 2013)
Intraregional equity holdings	Intraregional cross-border equity holdings (% of total cross-border equity holdings)	Coordinated Portfolio Investment Survey (IMF, 2013)
Intraregional migration	Intraregional outbound migration (% of total outbound migration)	Trends in International Migrant Stock (UN, 2013)
Intraregional remittances	Intraregional remittances inflows (% of total remittances inflows)	Bilateral Remittances Matrix (World Bank, 2012)
Intraregional tourism	Intraregional outbound tourists (% of total outbound tourists)	Outbound Tourism (World Tourism Organization, 2012)
Inputs:		
Cross-border infrastructure	Overall Logistics Performance Index score based on (i) efficiency of customs clearance process; (ii) quality of trade and transport infrastructure; (iii) ease of arranging shipments; (iv) quality of logistics services; (v) ability to track and trace consignments; (vi) timeliness of shipments (1 = low to 5 = high); and (vii) export and import conditions measured as the distance to the “frontier,” representing the best performance observed for the following: documents (number), time (days), and cost (\$ per container) associated with exporting and importing a standardized cargo by sea (0 = lowest to 100 = highest)	Logistics Performance Index (World Bank, 2014); Doing Business database (World Bank, 2015)
Business regulation environment	Overall distance to the “frontier,” representing the best performance observed for the following: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, enforcing contracts, and resolving insolvency (0 = lowest to 100 = highest)	Doing Business database (World Bank, 2015)
FDI = foreign direct investment, IMF = International Monetary Fund, UN = United Nations, UNCTAD = United Nations Conference on Trade and Development. Note: For economies in which 2014 Logistics Performance Index data are missing, the next available year has been used. Source: Author's compilation.		

Table 2. Global Comparison of Regional Integration Levels

Region	CRI Index ^a (1)	Trade and Investment ^b (2)	Monetary and Financial ^b (3)	Cross-Border Mobility ^b (4)	Input Index ^c (5)	Doing Business ^d (6)	Logistics Perform. ^d (7)
Western Europe	0.89	1.00	1.00	0.68	0.76	0.75	0.76
Eastern Europe	0.33	0.33	0.18	0.47	0.61	0.63	0.60
Northern Europe	0.30	0.36	0.23	0.30	0.75	0.80	0.69
Southeastern Europe	0.13	0.13	0.00	0.25	0.58	0.62	0.55
North America	0.62	0.65	0.31	0.90	0.75	0.78	0.72
South America	0.27	0.28	0.06	0.46	0.57	0.58	0.56
Central America	0.23	0.22	0.08	0.40	0.57	0.61	0.54
Caribbean	0.12	0.15	0.06	0.14	0.55	0.61	0.48
East Asia	0.50	0.68	0.22	0.62	0.73	0.74	0.71
Southeast Asia	0.38	0.42	0.21	0.50	0.62	0.64	0.60
West Asia	0.34	0.20	0.33	0.48	0.62	0.64	0.59
Pacific and Oceania	0.23	0.12	0.09	0.47	0.60	0.63	0.57
South Asia	0.11	0.08	0.01	0.24	0.53	0.55	0.52
Central Asia	0.11	0.09	0.01	0.23	0.55	0.60	0.50
Western Africa	0.25	0.12	0.01	0.60	0.48	0.46	0.50
Eastern Africa	0.20	0.13	0.01	0.46	0.48	0.49	0.46
Southern Africa	0.18	0.00	0.01	0.53	0.60	0.62	0.57
Northern Africa	0.12	0.07	0.02	0.26	0.56	0.58	0.53
Middle Africa	0.09	0.01	0.01	0.25	0.43	0.41	0.46
<i>Average:</i>							
Europe	0.41	0.46	0.35	0.43	0.67	0.70	0.65
Americas	0.31	0.32	0.13	0.48	0.61	0.65	0.58
Asia	0.28	0.26	0.15	0.42	0.61	0.63	0.58
Africa	0.17	0.07	0.01	0.42	0.51	0.51	0.51

CRI = composite regional integration.

Note: Values in bold indicate regions with the highest CRI index for their respective continent.

^aAverage of aggregated indicator variables in columns 2–4 (see main text).

^bSimple average of normalized intraregional shares along corresponding subindicators (see Figure 1).

^cAverage of columns 6–7 (see main text).

^dNormalized economy averages based on corresponding variables described in Table 1.

Source: Author's calculations.

and West Asia achieve values that are higher than those obtained by Eastern Europe, South America, and all African regions. When looking at simple averages over continents, Europe has the highest result. Asia achieves a value only slightly below the average of the four American regions, while Africa lags behind. All continents are characterized by considerable heterogeneous regional integration levels.

In addition to the results based on the constructed CRI index, integration outcomes can also be compared separately for different areas of integration. The disaggregated results on individual dimensions of economic integration (columns 2–4) show that East Asia has the second highest value for trade and investment, ranking slightly above North America and below only Western Europe. While North America has the highest result for cross-border mobility, East Asia, Southeast Asia,

and West Asia all achieve values that place them within the range of values obtained by South America and Western Europe.

When comparing the Pacific and Oceania with the Caribbean, both regions obtain very similar results for trade and investment, and for monetary and financial integration, although the Pacific and Oceania have significantly higher values for cross-border mobility, which may be driven by Australia and New Zealand. The largest gap between Western Europe and all other regions appears to be in monetary and financial integration. As shown in Section IV, these results remain almost unchanged when different weighting schemes of subindicators are used, suggesting that the findings are relatively robust against moderate changes in the construction of the CRI index.

D. Data Envelopment Analysis

Data envelopment analysis (DEA) is a nonparametric approach for estimating production frontiers and can be used to measure relative efficiency rates across a set of comparable units of observation. The method has been applied to a wide range of fields, including an assessment of the efficiency of health and education expenditures in developing countries (Herrera and Pang 2005) and public sector efficiency in Europe (Afonso, Schuknecht, and Tanzi 2005). In estimating production inefficiencies, the DEA approach assumes the existence of a convex production frontier defined by the maximum attainable output for a given input level. Efficiency is measured as the distance from the observed input–output combination to the efficient frontier. In particular, a unit is considered to be relatively inefficient if another unit uses less or an equal amount of inputs to generate more or the same amount of output. The range of possible values is from 0 to 1, and all economies located on the frontier are assigned the maximum value of 1.

In the specific context of this study, the underlying intuition behind the applied DEA is that regions that feature the same enabling environment for economic integration—the quality of cross-border infrastructure and institutional arrangements that facilitate multinational private sector activities—should in general also be able to attain similar levels of regional integration outcomes. Any estimated inefficiencies are interpreted as untapped potential in regional integration. This highlights the empirical character of the analysis in which untapped regional integration potential is defined as the distance between the currently achieved level of regional integration (measured by the CRI index) and the theoretically possible level (corresponding to the estimated integration frontier).

It is important to note that the resulting values are based on currently available resources and conditions rather than on potential future developments. The study therefore does not seek to generate forecasts of further integration potential corresponding to possible scenarios of enhancements in economic conditions or political changes. Instead the analysis is designed to compare levels of integration outcomes

across different regions and to identify those regions that, relative to others, seem to achieve lower levels of regional integration than their potential suggests.

Since all resulting values are estimated relative to the performance of other regions, the corresponding estimates for a specific region are dependent on the set of other regions included in the analysis. This feature can be used to derive different results for the Asian regions corresponding to a lower and upper bound of regional integration potential. For the derivation of a lower bound, regional integration potential is estimated using only the Asian regions in the analysis. This approach compares input–output combinations across the considered Asian regions and estimates the frontier based on the most integrated regions in Asia only. Including additional regions in the analysis moves the frontier outwards (e.g., as highly integrated European regions become additional possible benchmarks), which increases the resulting estimates for Asia. The inclusion of all 19 regions leads to the estimation of a current upper bound.⁶

In order to apply this approach to estimate untapped regional integration potential, the CRI index constructed above is used as the output variable in the DEA. The considered input variables are chosen as proxies for two relevant dimensions of the enabling environment for regional integration: the quality of cross-border infrastructure, and institutional arrangements that facilitate private sector activities leading to increased economic integration.⁷ The data come from the World Bank's Logistics Performance Index and the Doing Business database. A complete list of the considered variables and data sources is shown in Table 1.

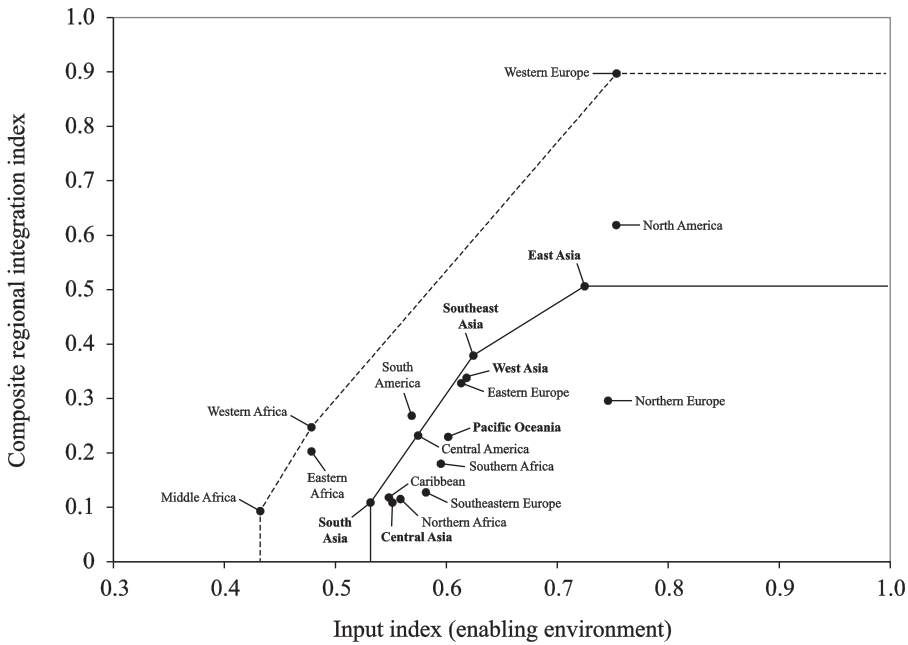
While there are many other possible drivers of regional integration outcomes, ranging from geographical features (e.g., distance and natural characteristics) to cultural factors (e.g., common language), this study focuses on conditions that are substantially determinable by governments and policy makers. In addition, the included indicators of cross-border infrastructure (time and cost associated with exporting and importing) may also partially capture geographic conditions as they represent *de facto* distances between economies in terms of transportation time and cost.⁸ The inclusion of variables from the Doing Business database is based on the view that private sector activities constitute an important driving force of regional integration outcomes (see, for example, Peng 2002, Yoshimatsu 2002). All input variables are normalized and aggregated to a single input index using the same methods as described above.

⁶Note that the upper bound is likely to be underestimated by the DEA approach, since regions located on the frontier have reached 100% of their potential by definition even though they may have scope for further enhancement.

⁷Both dimensions have been argued to be important drivers of the areas of integration considered in the CRI index (see, for example, Francois and Manchin 2013, Lewer and Van den Berg 2008, Khadaroo and Seetanah 2008).

⁸Following a similar line of reasoning, the measures of customs clearance efficiency, cost, and documents associated with cross-border transportation are likely to also represent the scope of institutional integration achieved in terms of trade agreements and other forms of regional cooperation. Since the outcomes for cross-border trade and mobility are more likely to depend on the actual conditions than those agreed upon in free trade and similar agreements, no additional measure of the institutional conditions is included.

Figure 2. Regional Integration Frontier



Notes: Plotted lines represent production possibility frontiers for the sample consisting of the six Asian regions (solid line) and the full sample of 19 regions (dashed line). See Table 2 and main text for details on the composite regional integration index and input index.

Source: Author's calculations.

III. Estimation Results

An output-oriented DEA is performed using the software tool DEAP 2.1 to estimate each region's untapped integration potential (Coelli 1996, Coelli et al. 2005). Figure 2 shows the resulting production possibility frontier for the six Asian regions (solid line) and for the full sample of 19 regions (dashed line), corresponding to the lower and upper bound, respectively. The resulting estimates for untapped integration potential are presented in Table 3, along with each region's rank. Larger ranks correspond to smaller estimated values and indicate higher potential for increased integration levels. An estimated value of 1 indicates the region is located on the corresponding frontier.

Based on the results for the global sample, South Asia and Central Asia have the largest unused integration potential among the six Asian regions. Their scores are both around 0.3, suggesting that the two regions are currently only achieving about 30% of their possible integration levels, based on the specification corresponding to an upper bound estimate. East Asia, Southeast Asia, and West Asia all achieve scores of around 0.6, indicating they are relatively nearer to the estimated frontier, but there is still considerable scope for increases in integration levels.

Table 3. Data Envelopment Analysis Estimates of Untapped Integration Potential

Region	CRI Index	Full Sample		Asia	
		Score	Rank	Score	Rank
Western Europe	0.893	1.00	1		
Eastern Europe	0.328	0.59	8		
Northern Europe	0.296	0.34	12		
Southeastern Europe	0.127	0.26	16		
North America	0.619	0.70	3		
South America	0.269	0.59	7		
Central America	0.231	0.49	9		
Caribbean	0.118	0.29	14		
East Asia	0.504	0.61	5	1.00	1
Southeast Asia	0.379	0.65	4	1.00	1
West Asia	0.338	0.59	6	0.93	4
Pacific and Oceania	0.229	0.43	10	0.73	5
South Asia	0.109	0.30	13	1.00	1
Central Asia	0.108	0.26	16	0.65	6
Western Africa	0.246	1.00	1		
Eastern Africa	0.202	0.83	2		
Southern Africa	0.180	0.35	11		
Northern Africa	0.115	0.27	15		
Middle Africa	0.093	1.00	1		
<i>Average:</i>					
Europe	0.411	0.55			
Americas	0.309	0.52			
Asia	0.278	0.47			
Africa	0.167	0.69			

CRI = composite regional integration.

Notes: Columns 3–6 report data envelopment analysis scores and corresponding ranks based on output-oriented analysis and variable returns to scale. The input variable is the index based on variables from the Doing Business and Logistics Performance Index databases (Table 2, column 5). The output variable is the composite regional integration index (Table 2, column 1).

Source: Author's calculations.

The estimation based solely on the Asian regions yields additional results. With the exception of South Asia, the order of obtained ranks is qualitatively the same. But as expected, the absolute estimated scores are much higher as very integrated regions such as Western Europe are no longer serving as benchmarks. Based on South Asia's input values and currently achieved integration level, the region is at the lower-end of the corresponding frontier (with an assigned score of 1). This result highlights that, according to the DEA approach, the regions located at the frontier are assumed to achieve their full potential by definition mainly because no other regions exist in the sample that can serve as a corresponding benchmark. In order to overcome this limitation, the results for the full sample and the Asian specification can be combined to derive a rough assessment of the magnitude of untapped integration potential corresponding to the range between the lower and upper bounds. For East and Southeast Asia, this yields values between 0 and around

40% of unused potential, while for South Asia, the upper bound of untapped potential is 70%.

Based on the results in Table 3, all continents feature regions with considerable untapped integration potential. On average, Europe and the Americas achieve scores slightly above 0.5, which indicates there is still considerable scope for increased integration, in particular in Southeastern Europe and the Caribbean. Asia's level of regional integration is found to be slightly below half of its estimated potential, representing the largest scope for a further increase in regional integration levels in the sample. The results for Africa suggest that the continent is achieving around 70% of its current integration potential.⁹

IV. Robustness Checks

As described in Section II, the construction of a CRI index involves decisions on a number of possible normalization and aggregation methods that may crucially affect the obtained results. In order to test the robustness of the CRI index to different specifications in aggregation, Table 4 shows the resulting CRI values and rankings for different weighting schemes, including principal component analysis. The reported Spearman correlation coefficients represent a measure of the similarity between rankings, where a value of 1 indicates that both rankings are identical, and smaller values imply less agreement. (A value of 0 indicates that the rankings are completely independent.)

For most regions, the respective rank changes only very slightly when different weighting schemes are used. Both the standard Pearson correlation coefficient and the Spearman correlation coefficient for rankings are always close to 1 and significant at the 1% level, suggesting that the results are relatively robust against moderate changes in the construction of the CRI index. Analogous results for the constructed input index are shown in Table 5. The resulting rankings are found to be a bit more sensitive to different aggregation methods, but correlation coefficients between the absolute values are always very close to 1. Based on these results, the presented findings in Section III are unlikely to be driven by the specific aggregation methods underlying the construction of the CRI and input indexes.

V. Conclusion

The empirical findings presented in this paper are able to provide answers to two important questions: How integrated are Asian regions compared with other

⁹Note that the presented estimates are based on currently available resources and institutional conditions, and thus do not allow for an interpretation of how close Africa is to its general integration potential, i.e., when economic or political conditions improve in the future. In addition, the analysis focuses exclusively on integration potential corresponding to effective levels of economic integration along the areas captured by the CRI index and does not provide any results on welfare or growth effects. Implications of economic integration in this direction are discussed in other studies (e.g., Baldwin and Venables 1995, Sapir 2011).

Table 4. Composite Regional Integration Index—Different Weighting Schemes

Region	Weighting of Subindicators with Emphasis on									
	Baseline ^a		Trade and Invest. ^b		Monetary and Financial ^c		Cross-Border Mobility ^d		Principal Component Analysis	
	Rank	Rank	Rank	Rank	Rank	Rank	Rank	Rank	Rank	Rank
Western Europe	0.89	1	0.92	1	0.92	1	0.84	1	4.56	1
Eastern Europe	0.33	6	0.33	5	0.29	6	0.36	6	0.34	6
Northern Europe	0.30	7	0.31	6	0.28	7	0.30	9	0.05	7
Southeastern Europe	0.13	14	0.13	14	0.10	15	0.16	14	-1.21	14
North America	0.62	2	0.63	2	0.54	2	0.69	2	2.59	2
South America	0.27	8	0.27	8	0.22	8	0.32	8	-0.11	8
Central America	0.23	10	0.23	9	0.19	10	0.27	11	-0.39	11
Caribbean	0.12	15	0.12	15	0.10	14	0.12	19	-1.30	16
East Asia	0.50	3	0.55	3	0.43	3	0.53	3	1.65	3
Southeast Asia	0.38	4	0.39	4	0.34	4	0.41	4	0.71	4
West Asia	0.34	5	0.3	7	0.34	5	0.37	5	0.43	5
Pacific and Oceania	0.23	11	0.20	11	0.19	9	0.29	10	-0.38	10
South Asia	0.11	17	0.10	18	0.08	17	0.14	16	-1.34	17
Central Asia	0.11	18	0.10	16	0.08	18	0.14	17	-1.34	18
Western Africa	0.25	9	0.22	10	0.19	11	0.33	7	-0.22	9
Eastern Africa	0.20	12	0.19	12	0.16	12	0.27	13	-0.59	12
Southern Africa	0.18	13	0.14	13	0.14	13	0.27	12	-0.72	13
Northern Africa	0.12	16	0.10	17	0.09	16	0.15	15	-1.28	15
Middle Africa	0.09	19	0.07	19	0.07	19	0.13	18	-1.45	19
Pearson correlation	1.000	-	0.997	-	0.993	-	0.989	-	0.999	-
Spearman correlation ^e	-	1.000	-	0.988	-	0.991	-	0.972	-	0.997

Notes:

^aSimple average; that is, equal weights assigned to each subindicator (one-third) as in Table 2, column 1.

^bOne-half is assigned to Trade and Investment and one-quarter to each of the two other subindicators.

^cOne-half is assigned to Monetary and Financial and one-quarter to each of the two other subindicators.

^dOne-half is assigned to Cross-Border Mobility and one-quarter to each of the two other subindicators.

^eThe Spearman correlation coefficient ranges inside the interval [-1, 1] and takes the value 1 if the agreement between two rankings is perfect (the two rankings are identical), the value 0 if the rankings are completely independent, and the value -1 if one ranking is the reverse of the other.

Source: Author's calculations.

Table 5. Input Index—Different Weighting Schemes

Region	Weighting of Subindicators with Emphasis on							
	Base-line ^a		Doing Business Index ^b		Logistics Performance Index ^c		Principal Component Analysis	
	Rank	Index	Rank	Index	Rank	Index	Rank	Index
Western Europe	0.76	1	0.75	1	0.76	1	2.39	1
Eastern Europe	0.61	7	0.62	5	0.61	6	0.25	6
Northern Europe	0.75	3	0.76	6	0.73	7	2.18	7
Southeastern Europe	0.58	10	0.59	14	0.57	15	-0.24	14
North America	0.75	2	0.76	2	0.74	2	2.32	2
South America	0.57	12	0.57	8	0.57	8	-0.40	8
Central America	0.57	11	0.59	9	0.56	10	-0.34	11
Caribbean	0.55	15	0.57	15	0.53	14	-0.77	16
East Asia	0.73	4	0.73	3	0.72	3	1.92	3
Southeast Asia	0.62	5	0.63	4	0.62	4	0.41	4
West Asia	0.62	6	0.63	7	0.61	5	0.32	5
Pacific and Oceania	0.60	8	0.61	11	0.59	9	0.07	10
South Asia	0.53	16	0.54	18	0.53	17	-0.96	17
Central Asia	0.55	14	0.57	16	0.54	18	-0.71	18
Western Africa	0.48	17	0.47	10	0.49	11	-1.70	9
Eastern Africa	0.48	18	0.48	12	0.47	12	-1.75	12
Southern Africa	0.60	9	0.60	13	0.59	13	-0.03	13
Northern Africa	0.56	13	0.57	17	0.55	16	-0.58	15
Middle Africa	0.43	19	0.43	19	0.44	19	-2.38	19
Pearson correlation	1.000	-	0.997	-	0.997	-	0.999	-
Spearman correlation ^d	-	1.000	-	0.837	-	0.844	-	0.830

Notes:

^aSimple average; that is, equal weights assigned to each subindicator (one-half) as in Table 2, column 5.

^bTwo-thirds are assigned to Doing Business Index and one-third to Logistics Performance Index.

^cTwo-thirds are assigned to Logistics Performance Index and one-third to Doing Business Index.

^dThe Spearman correlation coefficient ranges inside the interval [-1,1] and takes the value 1 if the agreement between two rankings is perfect (the two rankings are identical), the value 0 if the rankings are completely independent, and the value -1 if one ranking is the reverse of the other.

Source: Author's calculations.

regions in the world when looking at multiple dimensions of economic integration? And, how large is the untapped potential of Asia's regions for further integration based on currently available resources and institutional conditions?

Although quantitative magnitudes should be interpreted with caution, as data quality and availability for the considered areas of integration are limited, the resulting relative levels of regional integration outcomes indicated by the constructed composite index seem to be both plausible in comparison to the findings of other studies and robust to moderate changes in the applied construction methods. The presented results provide empirical evidence for the view held by many authors that Europe, in particular the Western European countries belonging to the European Union, constitutes the highest level of integration worldwide (see, for example, Freund and Ornelas 2010, Baldwin and Wyplosz 2006). While currently prevailing

stages of institutional integration (Balassa 1961) may be considerably lower in Asia than in the European Union, the findings based on the CRI index indicate that East Asia and Southeast Asia are achieving effective levels of economic integration that are comparable to those achieved by European regions, and for most areas of integration are higher than any region in Africa or Latin America.

Including the constructed CRI index as an output variable in a DEA suggests that most parts of the world seem to have considerable scope for further integration that is not based on possible future changes in economic conditions or political reforms, but on the current status of available resources and institutions. On average, Asia is estimated to achieve around half of its current potential in regional integration outcomes and South Asia and Central Asia are found to have the largest untapped potential among the Asian regions.

In addition to the purely descriptive results based on the CRI index that allow for a global comparison of currently achieved levels of regional economic integration outcomes, several possible conclusions for Asia can be derived from the presented findings. First, East Asia and Southeast Asia are achieving considerably higher integration outcomes than other Asian regions and may be considered as Asian benchmarks for future policies directed at increasing regional integration levels. However, based on the current level of cross-border infrastructure, institutional environment, and observed integration outcomes, the regions that are facing more similar conditions with the other Asian regions seem to be Northern Africa and Southern Africa, and Central America and South America.

Asian regions are achieving comparable levels of integration for cross-border mobility, trade, and investment, but monetary and financial integration seems to be lower than for those regions that feature similar CRI levels overall. South Asia and Central Asia achieve particularly low levels, while the outcomes for East Asia and Southeast Asia appear to constitute the largest gap across areas of economic integration compared with Western Europe. This highlights the importance of financial and monetary integration in achieving similar composite integration levels as those obtained by the most integrated regions in the sample.

While the analysis has focused exclusively on effective levels of economic integration, the findings may also be used as a basis for discussions on further advances in integration at an institutional level, for example, by informing decision makers about currently achieved levels of economic integration and contributing to the design of policies addressing the identified magnitudes of currently untapped integration potential.

References

- Afonso, A., L. Schuknecht, and V. Tanzi. 2005. Public Sector Efficiency: An International Comparison. *Public Choice*. 123 (3–4). pp. 321–47.
- Asian Development Bank (ADB). 2006. *Regional Cooperation and Integration Strategy*. Manila.
- Balassa, B. 1961. *The Theory of Economic Integration*. Homewood, IL: Richard Irwin.

- Baldwin, R. E. 2006. Multilateralising Regionalism: Spaghetti Bowls as Building Blocs on the Path to Global Free Trade. *World Economy*. 29 (11). pp. 1451–1518.
- Baldwin, R. E. and A. J. Venables. 1995. Regional Economic Integration. In G. M. Grossman and K. Rogoff, eds. *Handbook of International Economics*. Amsterdam: Elsevier.
- Baldwin, R. E. and C. Wyplosz. 2006. *The Economics of European Integration*. London: McGraw-Hill.
- Bhagwati, J. 1993. Regionalism and Multilateralism: An Overview. In J. de Melo and A. Panagariya, eds. *New Dimensions in Regional Integration*. Cambridge, UK and New York: Cambridge University Press.
- Bhattacharyay, B. N., M. Kawai, and R. M. Nag. 2012. *Infrastructure for Asian Connectivity*. Cheltenham, UK: Edward Elgar Publishing.
- Calvo-Pardo, H., C. Freund, and E. Ornelas. 2011. The ASEAN Free Trade Agreement: Impact on Trade Flows and External Trade Barriers. In R. Barro and J. Lee, eds. *Costs and Benefits of Economic Integration in Asia*. New York: Oxford University Press.
- Coelli, T. J. 1996. A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program. CEPA Working Paper No. 96/08. Armidale, Australia: University of New England.
- Coelli, T. J., D. S. Rao, C. J. O'Donnell, and G. E. Battese. 2005. *An Introduction to Efficiency and Productivity Analysis*. Berlin: Springer Science & Business Media.
- De Lombaerde, P., E. Dorrucci, G. Genna, and F. P. Mongelli. 2008. Quantitative Monitoring and Comparison of Regional Integration Processes: Steps towards Good Practice. CRIS Working Paper No. W-2008/9. Tokyo: United Nations University.
- Fernandez, R. and J. Portes. 1998. Returns to Regionalism: An Analysis of Nontraditional Gains from Regional Trade Agreements. *The World Bank Economic Review*. 12 (2). pp. 197–220.
- Francois, J. and M. Manchin. 2013. Institutions, Infrastructure, and Trade. *World Development*. 46 (June). pp. 165–75.
- Frankel, J., E. Stein, and S. J. Wei. 1995. Trading Blocs and the Americas: The Natural, the Unnatural, and the Super-Natural. *Journal of Development Economics*. 47 (1). pp. 61–95.
- Freund, C. L. and E. Ornelas. 2010. Regional Trade Agreements. World Bank Policy Research Working Paper No. 5314. Washington, DC: World Bank.
- Herrera, S. and G. Pang. 2005. Efficiency of Public Spending in Developing Countries: An Efficiency Frontier Approach. World Bank Policy Research Working Paper No. 3645. Washington, DC: World Bank.
- Khadaroo, J. and B. Seetanah. 2008. The Role of Transport Infrastructure in International Tourism Development: A Gravity Model Approach. *Tourism Management*. 29 (5). pp. 831–40.
- Krugman, P. 1991a. The Move toward Free Trade Zones. *Economic Review*. 76 (6). pp. 5–25.
- . 1991b. Is Bilateralism Bad? In E. Helpman and A. Razin, eds. *International Trade and Trade Policy*. Cambridge, MA: MIT Press.
- Lewer, J. J. and H. Van den Berg. 2008. A Gravity Model of Immigration. *Economics Letters*. 99 (1). pp. 164–67.
- Nardo, M., M. Saisana, A. Saltelli, and S. Tarantola. 2008. *Handbook on Constructing Composite Indicators: Methodology and User Guide*. Paris: OECD Publishing.
- Peng, D. 2002. Subregional Economic Zones and Integration in East Asia. *Political Science Quarterly*. 117 (4). pp. 613–41.
- Sapir, A. 2011. European Integration at the Crossroads: A Review Essay on the 50th Anniversary of Bela Balassa's Theory of Economic Integration. *Journal of Economic Literature*. 49 (4). pp. 1200–29.

World Trade Organization (WTO). 2011. *World Trade Report 2011—The WTO and Preferential Trade Agreements: From Co-Existence to Coherence*. Geneva.

Yoshimatsu, H. 2002. Preferences, Interests, and Regional Integration: The Development of the ASEAN Industrial Cooperation Arrangement. *Review of International Political Economy*. 9 (1). pp. 123–49.

APPENDIX: Data and Economy Groupings

Table A.1. **Regional Economy Groupings**

Europe (38)	America (37)
<p>Western Europe (12): Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Switzerland, United Kingdom</p> <p>Northern Europe (8): Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, Sweden</p> <p>Eastern Europe (12): Belarus, Bulgaria, Croatia, Czech Republic, Hungary, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, Ukraine</p> <p>Southeastern Europe (6): Albania, Bosnia and Herzegovina, Greece, Macedonia, Montenegro, Serbia</p>	<p>North America (3): Canada, Mexico, United States</p> <p>Central America (7): Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama</p> <p>Caribbean (15): Antigua and Barbuda, Aruba, Bahamas, Barbados, Cuba, Curacao, Dominican Republic, Grenada, Haiti, Jamaica, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, United States Virgin Islands</p> <p>South America (12): Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela</p>
Asia (63)	Africa (48)
<p>Central Asia (8): Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan</p> <p>East Asia (7): People's Republic of China; Hong Kong, China; Japan; Republic of Korea; Macau, China; Mongolia; Taipei, China</p> <p>South Asia (8): Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka</p> <p>Southeast Asia (10): Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam</p> <p>Pacific and Oceania (16): Australia, Cook Islands, Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu</p> <p>West Asia (14): Bahrain, Cyprus, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen</p>	<p>Western Africa (15): Benin, Burkina Faso, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo</p> <p>Northern Africa (6): Algeria, Egypt, Libya, Morocco, Sudan, Tunisia</p> <p>Eastern Africa (14): Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Somalia, Tanzania, Uganda, Zambia, Zimbabwe</p> <p>Middle Africa (8): Angola, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Congo, Equatorial Guinea, Gabon</p> <p>Southern Africa (5): Botswana, Lesotho, Namibia, South Africa, Swaziland</p>

Note: Number of economies in parentheses.

Source: Author's compilation.

Table A.2. Variables and Data

Region	Export (1)	Import (2)	FDI (3)	Debt (4)	Equity (5)	Migration (6)	Remittances (7)	Tourism (8)	Doing Business (9)	Logistics Performance (10)
Western Europe	0.560	0.540	0.503	0.635	0.557	0.470	0.584	0.644	75.0	3.81
Eastern Europe	0.231	0.269	0.042	0.146	0.076	0.355	0.325	0.487	63.1	2.98
Northern Europe	0.222	0.246	0.116	0.173	0.099	0.274	0.283	0.206	80.2	3.45
Southeastern Europe	0.097	0.053	0.060	0.001	0.000	0.188	0.095	0.327	61.7	2.73
North America	0.494	0.354	0.206	0.237	0.133	0.861	0.888	0.546	78.4	3.61
South America	0.189	0.196	0.076	0.051	0.028	0.313	0.217	0.589	57.8	2.80
Central America	0.144	0.137	0.072	0.057	0.036	0.120	0.072	0.754	60.5	2.72
Caribbean	0.145	0.096	0.000	0.004	0.067	0.071	0.051	0.226	61.3	2.42
East Asia	0.358	0.309	0.414	0.088	0.163	0.362	0.388	0.770	74.4	3.54
Southeast Asia	0.250	0.220	0.209	0.149	0.106	0.342	0.176	0.700	64.5	3.02
West Asia	0.106	0.148	0.065	0.230	0.169	0.374	0.274	0.541	64.3	2.97
Pacific and Oceania	0.069	0.068	0.064	0.037	0.067	0.562	0.444	0.206	63.0	2.87
South Asia	0.067	0.048	0.010	0.016	0.000	0.298	0.187	0.121	54.8	2.58
Central Asia	0.069	0.069	0.004	0.000	0.008	0.105	0.144	0.315	60.0	2.52
Western Africa	0.089	0.098	0.015	-	-	0.700	0.147	0.633	45.9	2.51
Eastern Africa	0.144	0.067	0.011	-	-	0.390	0.327	0.428	49.4	2.32
Southern Africa	0.002	0.001	0.000	0.006	0.001	0.457	0.370	0.501	62.0	2.85
Northern Africa	0.067	0.042	0.001	0.020	0.007	0.013	0.077	0.516	58.5	2.66
Middle Africa	0.007	0.016	0.000	-	-	0.351	0.252	0.045	40.9	2.29
Average	0.174	0.157	0.098	0.116	0.095	0.348	0.279	0.450	61.9	2.88
Maximum	0.560	0.540	0.503	0.635	0.557	0.861	0.888	0.770	80.2	3.81
Minimum	0.002	0.001	0.000	0.000	0.000	0.013	0.051	0.045	40.9	2.29
N (economies)	181	181	153	70	70	185	182	184	173	150

FDI = foreign direct investment.

Notes: Values in columns 1–8 are intraregional shares based on origin/destination bilateral flow data (author's computations).

Columns 9 and 10 represent index scores based on scales ranging from 1 = lowest to 100 = highest (Doing Business) and 1 = lowest to 5 = highest performance (Logistics Performance Index). Many datasets record values only if they exceed a certain threshold (e.g., for cross-border bond and equity holdings, 0 indicates a value of less than \$500,000).

Source: Author's calculations.