POLICY CENTER FOR THE NEW SOUTH

THINK • STIMULATE • BRIDGE

RESEARCH PAPER

February 2020

Uneven Integration: The Case of Angola

Eduardo A. HADDAD
Fernando S. PEROBELLI
Inácio F. ARAÚJO
Tomás P. DENTINHO

RP-20/02

About Policy Center for the New South

Policy Center for the New South, formerly OCP Policy Center, is a Moroccan policy-oriented think tank based in Rabat, Morocco, striving to promote knowledge sharing and to contribute to an enriched reflection on key economic and international relations issues. By offering a southern perspective on major regional and global strategic challenges facing developing and emerging countries, the Policy Center for the New South aims to provide a meaningful policy-making contribution through its four research programs: Agriculture, Environment and Food Security, Economic and Social Development, Commodity Economics and Finance, Geopolitics and International Relations.

On this basis, we are actively engaged in public policy analysis and consultation while promoting international cooperation for the development of countries in the southern hemisphere. In this regard, Policy Center for the New South aims to be an incubator of ideas and a source of forward thinking for proposed actions on public policies within emerging economies, and more broadly for all stakeholders engaged in the national and regional growth and development process. For this purpose, the Think Tank relies on independent research and a solid network of internal and external leading research fellows.

One of the objectives of Policy Center for the New South is to support and sustain the emergence of wider Atlantic Dialogues and cooperation on strategic regional and global issues. Aware that achieving these goals also require the development and improvement of Human capital, we are committed through our Policy School to effectively participate in strengthening national and continental capacities, and to enhance the understanding of topics from related research areas.

Policy Center for the New South

Suncity Complex, Building C, Av. Addolb, Albortokal Street, Hay Riad, Rabat, Morocco.
Email : contact@policycenter.ma
Phone : +212 5 37 54 04 04 / Fax : +212 5 37 71 31 54
Website : www.policycenter.ma

©2020 Policy Center for the New South. All rights reserved
The views expressed in this publication are those of the authors and do not reflect those of their institutions.

Uneven Integration: The Case of Angola[1]

Eduardo A. Haddad
Fernando S. Perobelli
Inácio F. Araújo
Tomás P. Dentinho

1. We thank participants at the Workshop: "Modelos de Economia Regional Aplicados a Angola", held at Faculdade de Economia da Universidade José Eduardo dos Santos, Huambo, and participants at the conference "Os Desafios da Educação para o Desenvolvimento de Infraestruturas, Governança e Sustentabilidade Ambiental nos Países em Desenvolvimento", hosted by ISCED-Huambo, for useful comments and suggestions. We also thank Túlio A. Cravo, from the African Development Bank, for raising interesting issues on Angolan infrastructure and regional development.

About the Authors

EDUARDO A. HADDAD

Eduardo Amaral Haddad is Full Professor at the Department of Economics at the University of São Paulo, Brazil, where he directs the Regional and Urban Economics Lab (NEREUS). He also holds a position as Affiliate Research Professor at the Regional Economics Applications Laboratory – REAL – at the University of Illinois at Urbana-Champaign, USA. He is a Senior Fellow at the Policy Center for the New South, Rabat, Morocco, and President Elect of the Regional Science Association International (RSAI). Professor Haddad has published widely in professional journals on regional and interregional input-output analysis, computable general equilibrium modeling, and various aspects of regional economic development in developing countries; he has also contributed with chapters in international books in the fields of regional science and economic development. His research focuses on large-scale modeling of multi-regional economic systems, with special interest in modeling integration applied to transportation, climate change and spatial interaction. Professor Haddad received his B.A. in Economics from the Federal University of Minas Gerais, Brazil, in 1993 and his Ph.D. in Economics from the University of Illinois at Urbana-Champaign in 1997. In 1998 he held a post-doctoral position at the University of Oxford. He has served as the president of the Brazilian Regional Science Association (2008-2010), and as the first president of the Regional Science Association of the Americas (2008-2010). He was the Director of Research of the Institute of Economic Research Foundation – FIPE – from 2005 to 2013. He has spent the period January 2014 to June 2015 on sabbatical as a visitor at the Department of Economics (International Economics Section) at Princeton University, and at the Edward J. Bloustein School of Public Policy and Planning at Rutgers University.

FERNANDO S. PEROBELLI

Prof. Perobelli has a degree in Economics from Federal University of Juiz de Fora (1992), Master in Economics from Federal University Fluminense (1995) and PhD in Economics from the University of São Paulo (2004). He is currently an Associate Professor at Federal University of Juiz de Fora and Researcher at the Sectorial and Territorial Analysis Laboratory (LATES/UFJF). He has experience in economics, with an emphasis on regional economics, mainly on the following themes: regional development, input-output, computable general equilibrium models and sector analysis (Energy, Transport, Health and Services). He was the Coordinator of the Post-graduate Program in Economics (MSc/PhD) at UFJF from 2006 to 2011; President of the Brazilian Regional Science Association from 2011 to 2012 and Pro-rector of Pos-graduation studies at the Federal University of Juiz de Fora from 2011 to 2012. Council Member at the International Input-Output Association from 2017 to Present.

As a consultant he has experience in international projects - Inter-American Development Bank (IDB) as well as national projects - Federation of Industries of Minas Gerais (FIEMG), Energy Research Company (EPE), Amazon Development Superintendence (SUDAM), Minas Gerais Energy Company (CEMIG), Pernambuco Energy Company (CELPE), Institute of Applied Economic Research (IPEA)

INÁCIO F. ARAÚJO

Inácio Fernandes de Araújo is a Post-Doc researcher at the Department of Economics and the Regional and Urban Economics Lab (NEREUS) at the University of São Paulo, Brazil. His major research interests lie in the field of the regional analysis. He has experience in the implementation and application of economic models, especially input-output and computable general equilibrium models.

TOMÁS P. DENTINHO

Tomaz Ponce Dentinho, is SADF's Regional Co-operation Research Programme Director. He is also the Editor in Chief of the journal Regional Science Policy and Practice, coordinator of the Group for Nature Conservation and Management at the Azores University, in Angra, Portugal, and member of the Research Centre for Applied Economics of the Atlantic based in Ponta Delgada.

Abstract

Angola's prospects for reconstruction and development of its poor connectivity infrastructure are heavily dependent upon the export performance of its oil sector. Using an interregional input-output table for Angola, we estimate comprehensive measures of trade in value added revealing different hierarchies of interregional and international trade integration, with implications for regional inequality in the country. By encompassing the subnational perspective in the case study of an African country that shows a strong regional divide, we bring new insights to the existing literature on regional integration in the continent. The different hierarchies of interregional and international trade structures reveal a pattern of uneven integration of Angolan provinces, dominated by strong foreign linkages and weak domestic linkages. It also shows the primacy of Luanda in interregional trade, as this province is associated with the main trade flows involving provinces in the extended economic core of the country.

JEL: F15; R12; R15; O55
Keywords: Trade; networks; economic integration; input-output; Angola

Uneven Integration: The Case of Angola

1. Introduction

Almost two decades since the end of a 27-year civil war in 2002, followed independence from Portugal in 1975, Angola's prospects for reconstruction and development are overwhelmingly reliant on its oil sector. In spite of the efforts to rebuild its social and economic infrastructure damaged and mostly abandoned during the war period, supported by the increase in oil revenues associated with the commodity boom in the 2000s, the country still faces poor and undeveloped international and internal connectivity.

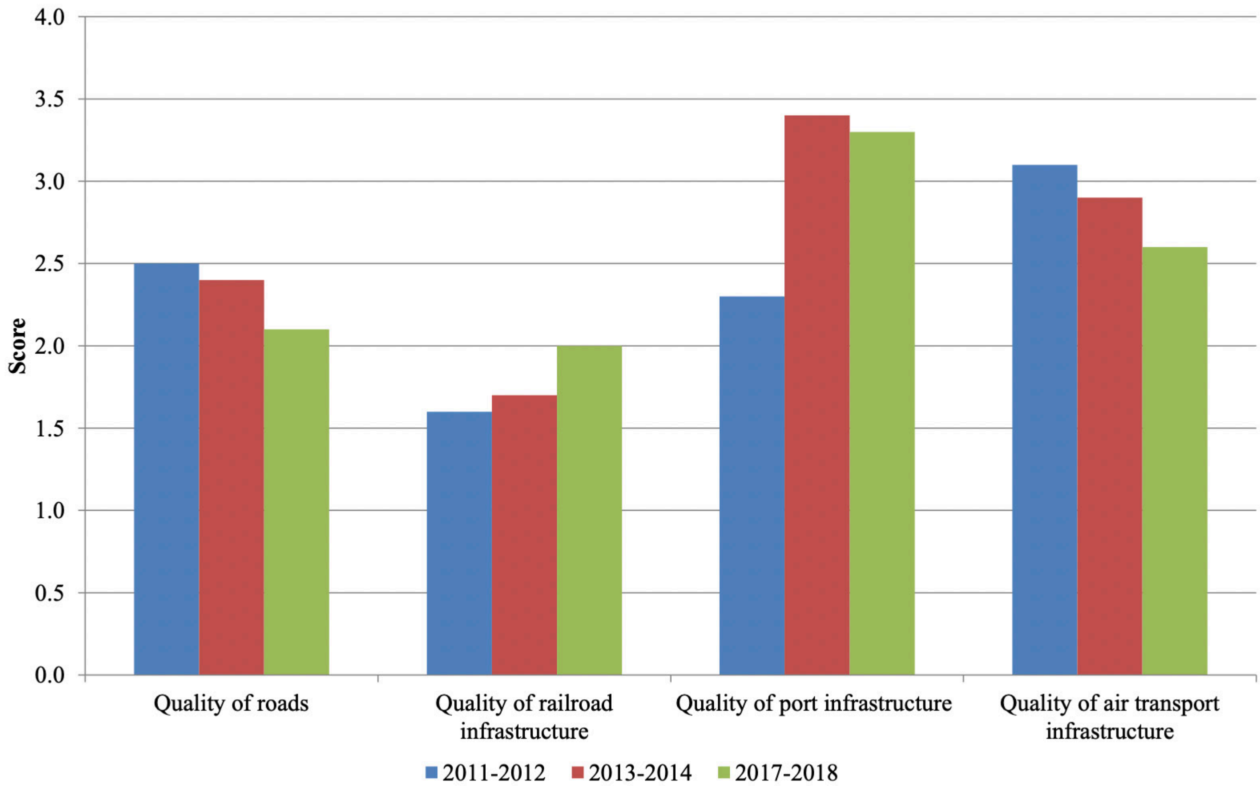
Angola presents pronounced regional disparities, whether in terms of concentration or inequality. With an area of 1.25 million square kilometers, the country is the seventh largest in Africa. Despite its long continental borderline (4,837 km), which marks the limits of the country with its neighbors, the Republic of the Congo and the Democratic Republic of the Congo (formerly Zaire) in the North, Zambia in the East and Namibia in the South, possible connections with other economies in the region are limited by poor land transportation infrastructure. The economies of the Provinces in the East, Central and Southwest regions of the country are either isolated or connected to the coastal areas many kilometers away, either with respect to foreign markets or the main population and internal market areas located in the Northwest of the country. Long distances and the poor quality of roads, and of a few existing railways that run west-east connecting the port cities with the hinterland, are important economic issues impairing the competitiveness of these regions. There are relatively good connections only in Greater Luanda, and from there to Benguela-Huíla-Namibe to the South; to Malange-Moxico to the East; and to Huambo-Bié-Cuando-Cubango to the Southeast; in the hinterland of those axes roads are very poor.

Both the business community's perception and empirical studies suggest that Angola lags behind in terms of overall competitiveness, in general, and transportation infrastructure standards, in particular. The overall score achieved by the country in the latest edition of the Global Competitiveness Report – GCR (Schwab, 2018) for the Global Competitiveness Index 4.0 was 37.1 (137th in the rank of 140 countries).[1] Ten years after the end of the civil war on, the scores achieved by the country in selected transportation indicators – "quality of roads", "quality of railroad infrastructure", "quality of port infrastructure" and "quality of air transport infrastructure" –, in different editions of the GCR, place Angola as one of the countries that face the most challenging problems in the sector. Comparing to other countries, the indicators presented in Figure 1 leave Angola in the bottom part of the rankings, especially for the "quality of roads" indicator (138th in the rank of 140 countries, in 2017-2018). As a recent trend, roads and air transport infrastructure did not follow the slight improvements seen in ports and, to a lesser extent in rail, showing a deteriorating trend in their indicators.

1. Covering 140 economies, the Global Competitiveness Index 4.0 measures national competitiveness – defined as the set of institutions, policies and factors that determine the level of productivity. http://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf

A study by the African Development Bank (2017) provided an examination of the key challenges Angola faces to pursue the government-promoted strategy of diversifying the economy's dependence on oil. Investments in transport were considered critical to reduce the current high logistical costs, and enhance regional integration in order to unlock the potential of local agriculture and manufacturing and boost trade. The available evidence collected for the report identified key sectoral constraints that impede achieving the goals of enhancing private sector efficiency and accelerating economic diversification, namely: (i) low road density, (ii) insufficient financial resources for infrastructure expansion, (iii) high transport and trade transaction costs, (iv) limited institutional capacity for management and maintenance of infrastructure, and (v) weak transport and logistics services. Accordingly, improving the transport infrastructure connectivity could potentially help reducing the costs of doing business in the country, opening local and regional markets and strengthening downstream linkages of economic development poles that could foster local and national growth.

Figure 1. Trends in selected infrastructure indicators: Angola (2011-2018)



Note: Scale of 1 (worst) to 7 (best)
Source: Global Competitiveness Report, different editions

As the main source of revenue for the country, oil exports have shaped the country not only geographically and economically (Rocha et al., 2018), but also socially and politically (Ovadia, 2013). The location of oil dwells, in the offshore of the northwestern Provinces of Cabinda, Zaire and Luanda, created the favourable natural conditions for the development of the oil industry in the region, further reinforcing the regional dualism, as we know it today. Priorities defined by the oil sector's needs heavily influenced post-war public and private investments in infrastructure in Angola. Foreign direct investments (FDI) in the period directly benefitted energy production and its distribution infrastructure, without generating reasonable scientific and technological research capabilities in the sector, with even more limited spillovers to other economic activities (Manyuchi, 2016).

As one of the top recipients of FDI in Africa, Angola attracted over USD 75 billion in FDI between 2003 and 2015, mainly targeting the oil and gas sectors (87.27%), and its supporting activities, located in the Northern part of the country. Only 2.30% of the FDI into Angola was observed in the manufacturing activities – beverages (1.12%), metals (0.65%) and food and tobacco (0.53%). This sectoral and regional concentration of private investments poses particularly difficult challenges for the achievement of broad-based development, since the extractive industries are capital intensive and translate into few employment opportunities (Mouzinho, 2016). Moreover, the regional allocation of public investments also concentrated in the rapidly developing oil-producing region, in order to meet the demands for public infrastructure by the export sector.

More recently, with the emergence of the oil sector crisis that reduced oil export revenues because of falling international oil prices, the country experienced a sharp reduction in public and private infrastructure spending, postponing actions to address structural bottlenecks on economic infrastructure that weakens connectivity linkages within the country.

In what follows, we look at the linkages structure of the Angolan economy ten years after the end of the civil war. It has been shown elsewhere (Limão and Venables, 2001) that poor transport infrastructure in Africa hampers trade flows in the continent. That is particularly relevant for international trade by land involving landlocked countries. Interregional trade within national borders faces similar problems. In the case of Angola, an inadequate connectivity infrastructure hampers productivity and trade.

We report the results of an application using an interregional input-output table for Angola.[2] We estimate, for each flow associated with each origin-destination pair, measures of trade in value added revealing different hierarchies of interregional and international trade integration, with implications for regional inequality in the country. We add to the existing literature on regional integration by encompassing the subnational perspective in the case study of a country that shows a strong regional divide. While a great part of the southern territory faces serious connectivity constraints, reinforced by destruction and deterioration of the infrastructure during the war years, the Northern part is relatively more privileged with access to oil and a connectivity infrastructure built to favor production and exports of this natural resource.

2. The Innis-North-Hirschman (INH) Linkages Framework

Despite its old-fashioned approach to economic growth theory, Harold Innis' staple theory (Watkins, 1963), together with Douglass North's economic base theory (North, 1955) and Albert Hirschman's approach to describe the mechanisms of transmission of growth in an interregional system (Hirschman, 1958), provides a framework for organizing our ideas, a way of looking at integrated economic systems and describing them around the concept of trade linkages. The INH linkages framework is in fact a descriptive model on how a country or a region develops from natural-resource intensive exports.

2. Detailed information on the estimation process of the interregional input-output systems for Angola is documented in Haddad et al. (2019), and, with the downloadable database used in this paper, is available online at http://www.usp.br/nereus/?txtdiscussao=matriz-de-insumo-produto-para-angola-2012-nota-tecnica.

This brief account of these authors' narratives sets the scene for our understanding of the static picture of the Angolan interregional system. Despite their interests in growth processes, we borrow from them the hierarchical structure of linkages as a fundamental concept that unifies their works (Altman, 2003). According to Hirschman (1984, p. 97), the linkage concept was devised for a better understanding of the industrialization process, and initially most applications were in this area. Fairly soon, however, the concept caught on even more in the analysis of the growth patterns of developing countries during the phase when their principal engine of growth was the export of primary products. The linkages permitted a more detailed look, yet stopped short of the wholly descriptive account that had been practiced by Harold Innis and other practitioners of the so-called staple thesis, summarized by Melville Watkins as follows:

> *The fundamental assumption of the staple theory is that staple exports are the leading sector of the economy and set the pace for economic growth. The limited (...) domestic market, and the factor proportions (...) create a comparative advantage in resource-intensive exports, or staples. Economic development will be a process of diversification around an export base. The central concept of a staple theory, therefore, is the spread effects of the export sector, that is, the impact of export activity on domestic economy and society (Watkins, 1963, p. 144).*

Insights from the staple theory of growth – idea that a small range of products (agricultural or resource base) generate export demand further generating a domestic multiplier or ripple effect – served as a basic starting point for reshaping the views on regional economic growth (North, 1955). If this process worked at the national level, could one not apply the same principles to explain the growth of regions? Accordingly, the success of the export base would be the determining factor in the rate of growth of regions. Therefore, in order to understand this growth, one must examine the locational factors that have enabled the staples to develop, generating a growth pole. One should devote attention to the importance of international and interregional trade in staple exports.

Bringing principles of location into this debate explicitly introduced the spatial dimension (seen as a network) in this debate, reinforcing the role of the connectivity infrastructure to understand the strength of the spread effects of the economic base. A growth pole connects to other areas through linkages between industries and firms, and its positive performance induces growth in other connected firms and regions (Perroux, 1950). Hirschman (1958) identified additional possible connectors (purchase of goods, hiring labor, competition, trade barriers) which may result positive or negative trickled-down effects in other regions given the growth of the pole.

The introduction of the concept of economic linkages, which is related to input-output analysis pioneered by Wassily Leontief, resulted in a richer and analytically more rigorous framework associated with the staple/economic base theories (Altman, 2003). Measurement of an existing linkage structure can be achieved through the use of input-output tables. The idea that a net increase in the rate of foreign exports (and other autonomous injections) propagates in the entire system generating higher-order effects is even more appealing in a multi-sectorial and multi-regional contexts.

Walter Isard further developed the notion of a foreign trade multiplier in the context of regions within a single country. As this notion worked for countries linked by trade flows, this could be applied for domestic trading regions as well. Thus, changes in regional income would result from (and as a multiple of) a change in regional investment, exports, or both. The key point is that, in complex economic structures, neither sectors nor regions are isolated entities. By employing a multi-sectorial interregional framework, one may learn something about the cyclical sensitivities of other regions and the ways in which their cycles may be spread to her own region. This type of study leads to a more precise formulation of multiplier effects and of the mechanisms by which cycles are spatially transmitted within the system of regions (Haddad et al., 2017). This is connected with the fact that governmental royalties from the rents of natural resources tend to be concentrated in bigger capital cities (Dentinho, 2017), may inform an active spatially redistributive policy that feeds the reconstruction and construction of effective connectivity within Angola and with neighbouring countries.

Table 1 presents a typology of input-output linkages associated with the interregional and intersectoral transmission of increased activity of the export sector. We use as an illustrative case study of a contemporary application of the INH linkages framework the influence of the oil industry in Angola.

Table 1. Typology of input-output linkages in export-led growth models

	Definition	Determinants	Example	Angola, 2012
Backward linkages	Measure the induced investment in the home-production of inputs, including capital goods, for the expanding export sector	Production function of the staple product; imports penetration	Activities related to the immediate production of the staple product; production of the infrastructure, such as transportation, necessary to make staple production economically viable	Low output multiplier of the oil sector associated with high import content due to its high capital-intensity nature; poor connectivity network does not stimulate further investment in other potential industries; localized infrastructure investments
Forward linkages	Measure the induced investment in industries which use the export industry's output as an input	Production function of other sectors	Further processing of the output from the export sector; output from processing sectors may be used domestically or exported	Oil refinery in Luanda supplies around 20% of the domestic market fuel needs

Final demand linkages	Measure the induced investment in domestic industries producing final and intermediate goods for the export sector	Size of domestic market; level of income (aggregate and average); income distribution; imports penetration; transportation costs	Development of new activities, in either the secondary or tertiary sectors of the economy, which serve to meet the needs of the staple producing population	Presence of high internal transportation costs and income concentration, both personally and regionally, precludes industrialization and economic diversification, deterring domestic trade and favouring the use of foreign imports

Source: Adapted from Boame (1998), Altman (2003)

3. The Big Picture: Regional Inequality in Angola

Angola is a country of sharp regional contrasts (see Figure 2 for location of Provinces). Table 2 summarizes estimates of regional data to illustrate the shape of regional disparities in the country. The capital city and main urban agglomeration, Luanda, hosted 26.9% of the national population and 35.2% of GDP. The oil-producing provinces in the North (Cabinda and Zaire), which together with Luanda constitute Angola's export-led growth pole, jointly accounted for 31.5% of GDP and only 5.1% of population. In contrast, all the remaining 15 provinces, where 68% of the population lived, contributed with only one-third of GDP.

The preceding indicators highlight the concentration of people and production, but disparities also can be expressed in terms of inequality. The final column of the Table 2 provides information on per capita GDP levels, in relation to the national average. Oil exports exert a large influence on the outcome. Cabinda (7.96) and Zaire (4.08) are well above the national average, followed by Luanda (1.31). Almost all the other provinces presented per capita GDP level less than half of the national average. Provinces in the South and East are among the poorest.

The level of inequality in Angola is extremely high for international standards. In Table 3, we compare two highly correlated regional inequality indicators, the Williamson's coefficient of variation and the Theil index, calculated for a sample of eight countries for which data are available. The regional settings in each country comprise subnational areas of comparable sizes among them, with the exception of Brazil and Greece. In terms of per capita GDP, the values range from as low as US$ 2,785 (Egypt) to US$ 23,055 (Greece). The values for both the Williamson's coefficient of variation and the Theil index for Angola are the highest.

Combining the inequality estimates with per capita GDP levels for each country allows examining whether the sample information is compatible with the Williamson's hypothesis, with his "inverted U-shaped curve" relating inequality and level of development (Williamson, 1965). Accordingly, the early stages of national development generate increasing regional income differentials, as the interregional linkages are very weak; somewhere during the course of development, as the forces for the centrifugal trickled-down effects are strengthened due to improved connectivity networks, the disequilibrating tendencies diminish, causing a reversal in the pattern of interregional inequality. Despite the small sample size, data seem to fit the Williamson's hypothesis, with the exception of Angola, for which the combination of extremely high level of regional inequality and low per capita GDP deviates from the general pattern (Figure 3).

Figure 2. Provinces in Angola

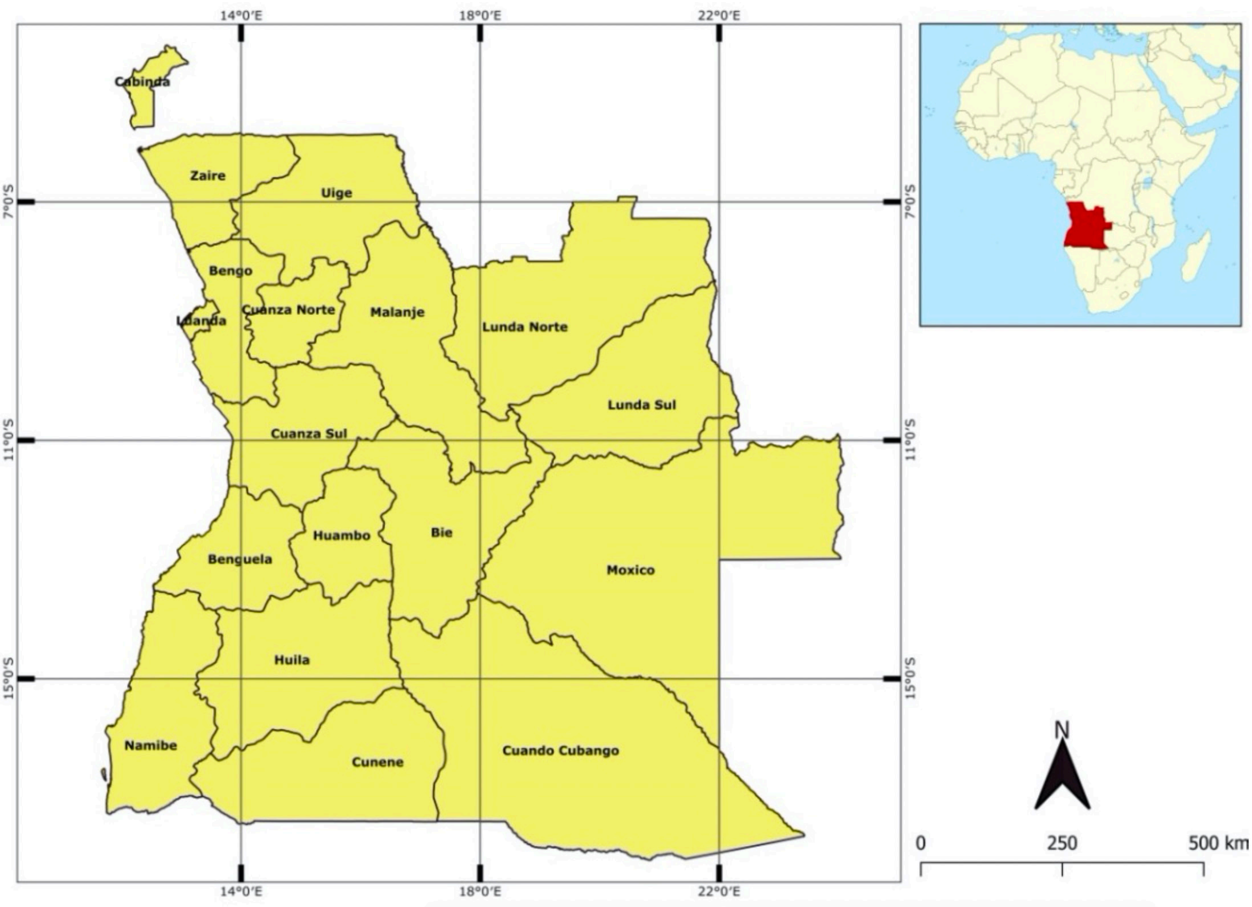


Table 2. Regional disparity indicators

		Shares of national totals		
		Population (%)	*GDP (%)*	*Per capita GDP*
R1	Cabinda	2.8	22.1	7.96
R2	Zaire	2.3	9.4	4.08
R3	Uíge	5.8	2.8	0.49
R4	Luanda	26.9	35.2	1.31
R5	Cuanza Norte	1.7	1.2	0.67
R6	Cuanza Sul	7.3	3.9	0.53
R7	Malanje	3.8	2.1	0.55
R8	Lunda Norte	3.3	1.4	0.42
R9	Benguela	8.7	5.7	0.66
R10	Huambo	7.8	3.5	0.45
R11	Bie	5.6	2.1	0.38
R12	Moxico	2.9	1.1	0.36
R13	Cuando Cubango	2.1	1.1	0.51
R14	Namibe	1.9	1.4	0.73
R15	Huila	9.7	4.0	0.42
R16	Cunene	3.8	1.3	0.33
R17	Lunda Sul	2.1	0.8	0.40
R18	Bengo	1.4	0.9	0.67
TOTAL		*100.0*	*100.0*	*1.00*

Source: Own estimates

Table 3. Regional inequality indicators: international comparison

	Area (km2)	*GDP (2010 US$)*	*Population (000)*	*Per capita GDP (2010 US$)*	*Williamson's coefficient of variation*	*Theil index*	*Number of regions*	*Average area (km2)*
Angola	**1,246,700**	**101,673**	**29,784**	**3,414**	**1.333**	**0.456**	**18**	**69,261**
Brazil	8,358,140	2,284,133	209,288	10,914	0.454	0.100	27	309,561
Chile	743,812	271,896	18,055	15,060	0.454	0.081	15	49,587
Colombia	1,038,700	373,471	49,065	7,612	0.644	0.155	33	31,476
Egypt	995,450	271,710	97,555	2,785	0.375	0.061	27	36,869
Greece	130,647	247,927	10,754	23,055	0.295	0.043	13	10,050
Morocco	446,300	119,347	36,292	3,289	0.281	0.037	12	37,192
Mexico	1,943,945	1,284,253	129,163	9,943	0.682	0.164	32	60,748

Source: Own estimates

Figure 3. Cross-section relating regional inequality and per capita GDP

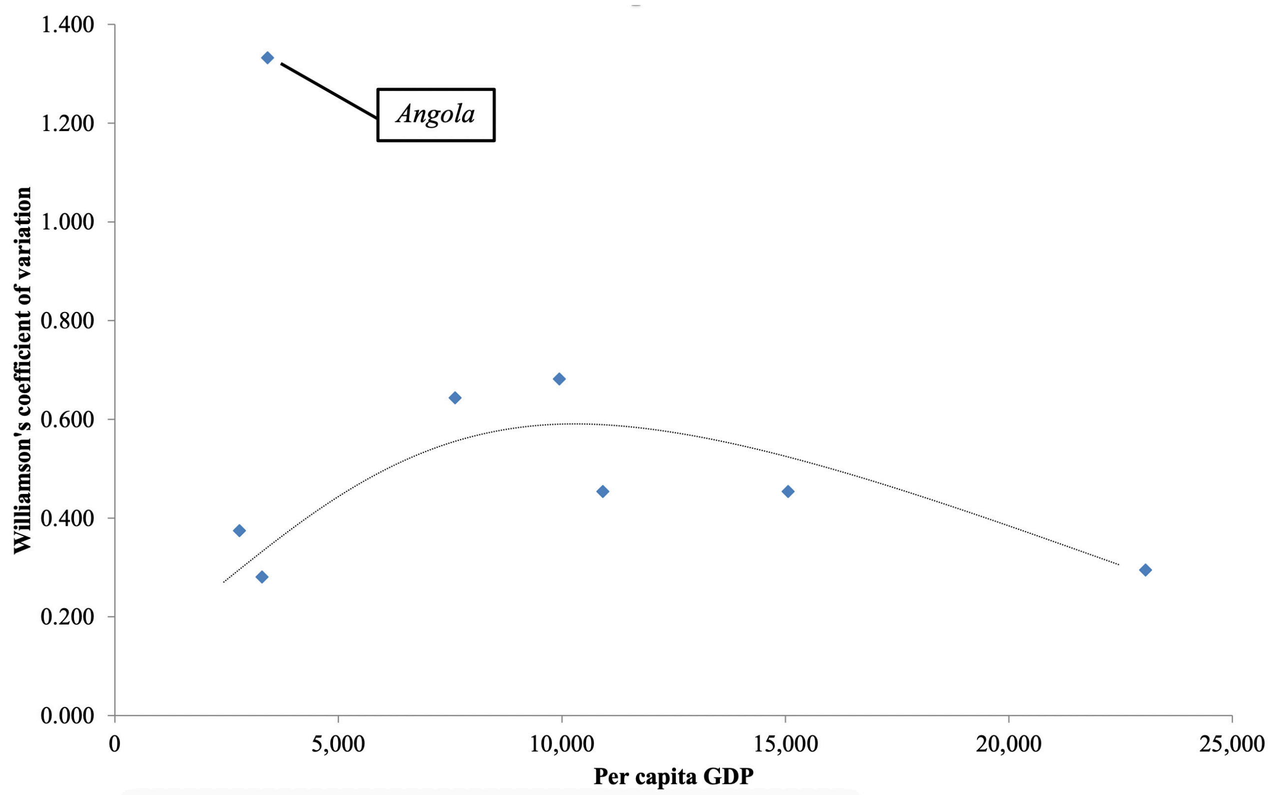


Table 4 presents the regional output shares for the provinces in Angola. Luanda dominates the national production, with a share of 39.6% in total output, followed by Cabinda (18.5%) and Zaire (8.1%), heavily influenced by the oil production. Benguela (6.0%) is the non-oil province with the highest share in total output, followed by Cuanza Sul and Huíla (4.1% each), and Huambo (3.6%). Altogether, these seven provinces, all of them located in the western portion of the country, are responsible for 84.0% of Angola's total production, revealing a West-East divide in the country's economic system. Given poor connectivity and the strong dependence on international trade, a coastal (and nearby highlands) effect seems to prevail in the spatial configuration of the national economy.

The regional output shares by sectors in Angola present further evidence of spatial concentration of staple products. While total oil and natural gas output is concentrated in three provinces – Cabinda (45.8%), Luanda (26.7%) and Zaire (17.5%) –, with oil refinery, benefitted by localized forward linkages fully concentrated in Luanda, output from diamond extraction and other mining activities locates mainly in Lunda Norte, Uíge and Malange, in the Northeast border of the country. Other sectors present a less concentrated regional pattern: agriculture in Cuanza Sul (15.0%), Huíla (14.5%), Benguela (11.4%) and Huambo (10.9%), benefitting from more favorable climate and soil conditions; fishing in the coastal provinces of Cuanza Sul (42.9%) and Benguela (32.8%); and manufacturing in Luanda (48.3%).

Table 5 shows the sectoral shares in regional output, revealing the dominant role of oil and gas in Cabinda (89.1% of total regional output) and Zaire (78.1%). There is no other sector that dominates any of the other region's economic structure, which shows non-specialized production compositions in the non-oil producing provinces. High internal transportation costs help explaining this pattern of non-specialized regions.

Furthermore, we can assess relative regional specialization looking at the sectoral location quotients (Table 6). The highlighted cells identify sectors relatively more concentrated in specific regions, i.e. sectors for which their share in total regional output is greater than the respective shares in national output (location quotient greater than unit). With the exceptions of fishing (relatively concentrated in the coastal provinces), mining activities (oil and gas in the Northwest, and diamonds in the Northeast), and telecommunications (in the extended economic core in the West), the remaining sectors present a similar relative importance in the regional economic structures outside the oil-producing region.

Table 4. Regional structure of sectoral output: Angola, 2012 (in %)

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	Angola
1 Agriculture, forestry, hunting, related services	0.7	3.2	8.5	1.7	2.6	15.0	6.9	3.0	11.4	10.9	8.5	3.1	2.4	1.5	14.5	4.1	0.7	1.4	100.0
2 Fishing, aquaculture	2.0	9.1	0.0	4.8	0.0	42.9	0.0	0.0	32.8	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	4.1	100.0
3A Oil and natural gas extraction	45.8	17.5	0.0	36.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3B Oil refining and other energy products	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
4 Diamonds and other mining	1.2	0.6	21.7	6.3	0.2	0.6	15.0	26.4	1.0	0.5	9.6	5.1	0.1	0.2	0.5	0.1	10.8	0.2	100.0
5 Manufacturing, excluding petroleum refining	8.9	4.5	3.1	48.3	1.5	4.2	2.1	3.8	7.5	3.5	1.4	0.7	0.9	1.6	3.9	0.8	1.6	1.5	100.0
6 Electricity and water	5.3	2.0	2.5	56.0	2.2	3.3	2.7	1.7	7.1	3.7	0.9	0.5	0.7	2.7	4.6	1.2	1.3	1.5	100.0
7 Construction	3.3	3.4	3.5	41.2	2.1	5.3	3.4	1.1	9.9	6.3	3.5	1.3	1.8	2.6	6.3	2.3	1.0	1.8	100.0
8 Trade	1.9	2.3	3.4	41.2	0.8	5.6	2.3	2.0	15.0	7.0	3.4	0.9	0.8	3.0	7.4	1.2	1.0	0.9	100.0
9 Transport	2.7	2.6	2.9	50.3	1.1	4.9	2.2	1.2	11.9	5.9	2.0	0.7	0.7	2.2	5.1	1.3	1.0	1.2	100.0
10 Post and telecommunications	4.5	1.6	2.9	62.5	1.6	2.6	1.1	1.2	7.2	3.8	1.0	0.9	0.6	1.3	4.1	0.9	1.2	0.9	100.0
11 Financial activities and insurance	3.5	2.3	2.3	54.3	1.4	3.4	2.2	1.7	7.2	3.8	1.8	1.2	1.1	2.0	5.9	2.7	1.2	1.9	100.0
12 General public administration and social security	3.5	2.6	6.6	34.7	3.2	4.2	3.5	2.1	7.6	5.8	3.1	3.0	3.5	3.3	6.5	2.8	2.0	2.0	100.0
13 Real estate, renting and services to enterprises	6.0	3.1	1.9	54.4	1.3	3.3	2.7	1.8	7.9	3.9	1.7	1.0	1.0	1.9	4.2	1.3	1.3	1.5	100.0
14 Other services	2.1	2.6	5.7	25.6	2.0	9.5	4.6	2.5	10.5	8.0	5.5	2.2	1.9	2.1	10.0	2.8	1.1	1.4	100.0
Angola	18.5	8.1	2.8	39.6	1.1	4.1	2.1	1.4	6.0	3.6	2.1	1.0	1.0	1.4	4.1	1.3	0.8	0.9	100.0

Source: Calculations by the authors

Table 5. Sectoral structure of regional output: Angola, 2012 (in %)

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	Angola
1 Agriculture, forestry, hunting, related services	0.1	1.4	10.9	0.2	8.3	13.4	12.0	7.6	6.9	11.1	14.6	10.8	8.5	3.8	12.9	11.8	3.1	5.5	3.6
2 Fishing, aquaculture	0.2	1.6	0.0	0.2	0.0	15.1	0.0	0.0	7.8	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	6.2	1.4
3A Oil and natural gas extraction	89.1	78.1	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
3B Oil refining and other energy products	0.0	0.0	0.0	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
4 Diamonds and other mining	0.1	0.1	7.2	0.1	0.2	0.1	6.8	17.5	0.2	0.1	4.2	4.5	0.1	0.1	0.1	0.1	12.1	0.2	0.9
5 Manufacturing, excluding petroleum refining	2.3	2.6	5.2	5.8	6.4	4.9	4.9	12.7	5.9	4.6	3.1	3.3	4.1	5.4	4.6	3.0	8.8	7.8	4.7
6 Electricity and water	0.3	0.2	0.8	1.4	1.9	0.8	1.3	1.2	1.1	1.0	0.4	0.5	0.6	1.8	1.1	1.0	1.5	1.6	1.0
7 Construction	1.9	4.4	13.0	11.0	19.3	13.8	17.5	8.2	17.3	18.7	17.3	13.2	17.8	18.9	16.3	19.3	13.0	20.0	10.6
8 Trade	0.7	1.9	7.7	6.7	4.2	8.8	7.1	8.9	15.9	12.4	10.2	5.5	4.9	13.5	11.7	5.9	7.4	6.0	6.4
9 Transport	0.3	0.7	2.3	2.8	2.1	2.6	2.3	1.9	4.3	3.6	2.1	1.6	1.4	3.4	2.8	2.3	2.7	2.9	2.2
10 Post and telecommunications	0.7	0.5	2.7	4.2	3.6	1.7	1.5	2.3	3.2	2.8	1.3	2.2	1.5	2.4	2.6	1.9	3.9	2.5	2.7
11 Financial activities and insurance	0.3	0.5	1.3	2.2	2.0	1.3	1.7	1.9	1.9	1.7	1.3	1.9	1.7	2.2	2.3	3.4	2.3	3.2	1.6
12 General public administration and social security	2.2	3.7	26.7	10.1	32.0	11.8	19.4	16.8	14.5	18.5	17.0	33.3	38.8	26.3	18.2	25.9	27.6	24.7	11.5
13 Real estate, renting and services to enterprises	0.8	1.0	1.7	3.5	2.8	2.0	3.4	3.2	3.3	2.8	2.1	2.4	2.3	3.4	2.6	2.6	4.0	4.0	2.6
14 Other services	1.1	3.2	20.4	6.5	17.3	23.6	22.3	17.9	17.7	22.6	26.4	20.9	18.4	14.5	24.8	22.8	13.6	15.4	10.1
Angola	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculations by the authors

Table 6. Location quotients: Angola, 2012

		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	Angola
1	*Agriculture, forestry, hunting, related services*	0.04	0.39	3.00	0.04	2.28	3.68	3.30	2.10	1.89	3.05	4.02	2.97	2.33	1.04	3.56	3.25	0.87	1.51	1.00
2	*Fishing, aquaculture*	0.11	1.13	0.00	0.12	0.00	10.57	0.00	0.00	5.44	0.00	0.00	0.00	0.00	2.98	0.00	0.00	0.00	4.35	1.00
3A	*Oil and natural gas extraction*	2.48	2.17	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
3B	*Oil refining and other energy products*	0.00	0.00	0.00	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
4	*Diamonds and other mining*	0.06	0.07	7.69	0.16	0.18	0.14	7.23	18.67	0.16	0.13	4.51	4.86	0.11	0.15	0.13	0.08	12.90	0.22	1.00
5	*Manufacturing, excluding petroleum refining*	0.48	0.56	1.10	1.22	1.34	1.04	1.04	2.68	1.25	0.98	0.65	0.70	0.87	1.13	0.96	0.64	1.85	1.65	1.00
6	*Electricity and water*	0.29	0.24	0.88	1.41	1.95	0.81	1.31	1.23	1.17	1.05	0.43	0.52	0.64	1.85	1.14	0.99	1.51	1.62	1.00
7	*Construction*	0.18	0.42	1.23	1.04	1.83	1.30	1.65	0.77	1.64	1.76	1.64	1.25	1.68	1.79	1.54	1.82	1.23	1.89	1.00
8	*Trade*	0.10	0.29	1.21	1.04	0.66	1.37	1.11	1.40	2.49	1.95	1.60	0.85	0.76	2.11	1.82	0.93	1.16	0.94	1.00
9	*Transport*	0.15	0.32	1.04	1.27	0.97	1.20	1.05	0.86	1.97	1.66	0.96	0.71	0.63	1.54	1.25	1.05	1.23	1.29	1.00
10	*Post and telecommunications*	0.25	0.20	1.03	1.58	1.36	0.64	0.55	0.87	1.19	1.05	0.48	0.84	0.55	0.92	0.99	0.73	1.46	0.95	1.00
11	*Financial activities and insurance*	0.19	0.29	0.83	1.37	1.25	0.85	1.07	1.18	1.20	1.05	0.84	1.17	1.06	1.39	1.44	2.13	1.45	2.01	1.00
12	*General public administration and social security*	0.19	0.32	2.33	0.88	2.78	1.03	1.69	1.46	1.26	1.61	1.48	2.89	3.38	2.28	1.59	2.25	2.41	2.15	1.00
13	*Real estate, renting and services to enterprises*	0.32	0.38	0.66	1.38	1.10	0.80	1.31	1.25	1.31	1.08	0.82	0.93	0.92	1.33	1.03	1.03	1.57	1.58	1.00
14	*Other services*	0.11	0.32	2.02	0.65	1.71	2.33	2.20	1.77	1.75	2.24	2.61	2.06	1.82	1.44	2.45	2.26	1.35	1.53	1.00
Angola		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Calculations by the authors

4. Domestic and International Integration

As a first approach to assess the importance of trade flows in Angola, we computed trade-to-GDP ratios for both international and interregional aggregate values of imports and exports. For the sake of comparison, we calculated similar indicators for different countries (Table 7), showing the relative importance of foreign and domestic trade flows in the economy of each one. For almost all of them, international trade linkages involving domestic regions tend to be of the same order of magnitude of interregional trade linkages. For some countries, such as Brazil, Colombia and Egypt, the level of domestic trade is higher, while for others (Chile, Greece and Morocco), foreign trade prevails. The exception is Angola, for which international trade outpaces interregional trade in a factor of more than 3, i.e., for each USD 1 that Angolan regions trade with other regions in the country, they trade USD 3.24 with other countries.

Table 7. International and interregional trade-to-GDP ratio

	International trade to GDP ratio (% of GDP)	*Interregional trade to GDP ratio (% of GDP)*	*International trade / Interregional trade*
Angola	**93.7%**	**29.0%**	**3.24**
Brazil	26.7%	47.3%	0.56
Chile	64.6%	47.1%	1.37
Colombia	33.9%	47.7%	0.71
Egypt	49.2%	62.4%	0.79
Greece	54.3%	45.5%	1.19
Morocco	71.6%	54.8%	1.31
Mexico	60.2%	60.9%	0.99

Source: Own estimates

4.1. Trade in Value Added

Is the pattern of trade similar for Angolan regions? The analysis in the previous section has revealed distinct spatial regimes associated with the geography of economic activity in Angola. On one hand, the presence of offshore oil wells in the northwestern part of the country creates regionally differentiated comparative advantage favoring the natural-resource-intensive export sector. On the other hand, the regional distribution of economic activity and population creates a complex structure of supply and demand in space that helps shaping the geography of trade flows and domestic value chains, heavily influenced by a poor connectivity infrastructure.

In a context in which interregional physical transfers of goods are hampered by high transportation costs, what role does trade play in generating value added in the regions? Thus, in this section, we revisit the work by Los et al. (2016) whose proposal for decomposing gross exports is based on the “hypothetical extraction” methodology, which allows verifying how much domestic value added is included in a country’s exports. They have provided a measurement of domestic value added in exports based on global and national input-output tables.

We calculate regional value added in exports based on a national interregional input-output system with exports to the RoW exogenously specified. It takes into consideration important elements of the Angolan interregional system, namely information on the adopted technology by different sectors in the form of input-output linkages, the specific regional economic structures, and the structure of interregional and international trade flows.[3]

4.2. Results

Trade in value added is defined as the value added embodied in the goods and services that are imported and exported. It is possible to trace a region’s participation in the domestic value chain adapting the methodology proposed in Los et al. (2016) to evaluate global supply chains. We compare actual value added in a region with hypothetical value added in case there are no production activities related to exporting. The difference is defined as regional value added in interregional sales and international exports.

We have calculated total traded regional value added, originating in each of the 18 Angolan provinces. For completeness, we have also computed value added in foreign imports entering each of the provinces. Table 8 shows the structure of traded value added embedded in the interregional input-output table for Angola. When considering all transactions involving Angolan provinces, foreign exports from oil-producing provinces and foreign imports to Luanda dominate, followed by foreign imports, mainly into the provinces in the extended economic core. In summary, the hierarchy of interregional flows is dominated by foreign trade.

The aggregate results for regional traded value added embodied in regional exports can be observed by summing across rows of Table 8. Overall, the amount of total value added embodied in international export flows surpasses that of interregional exports in the Angolan case in a ratio of 2.23 to 1. Nonetheless, this ratio varies across exporting regions, ranging from 0.02 in Bengo, and 0.03 in Cuanza Norte and Cuanza Sul, to 2.51 in Luanda, 6.57 in Zaire, and 8.91 in Cabinda, the three oil-rich

3. We provide technical details in the Appendix.

provinces in Angola.

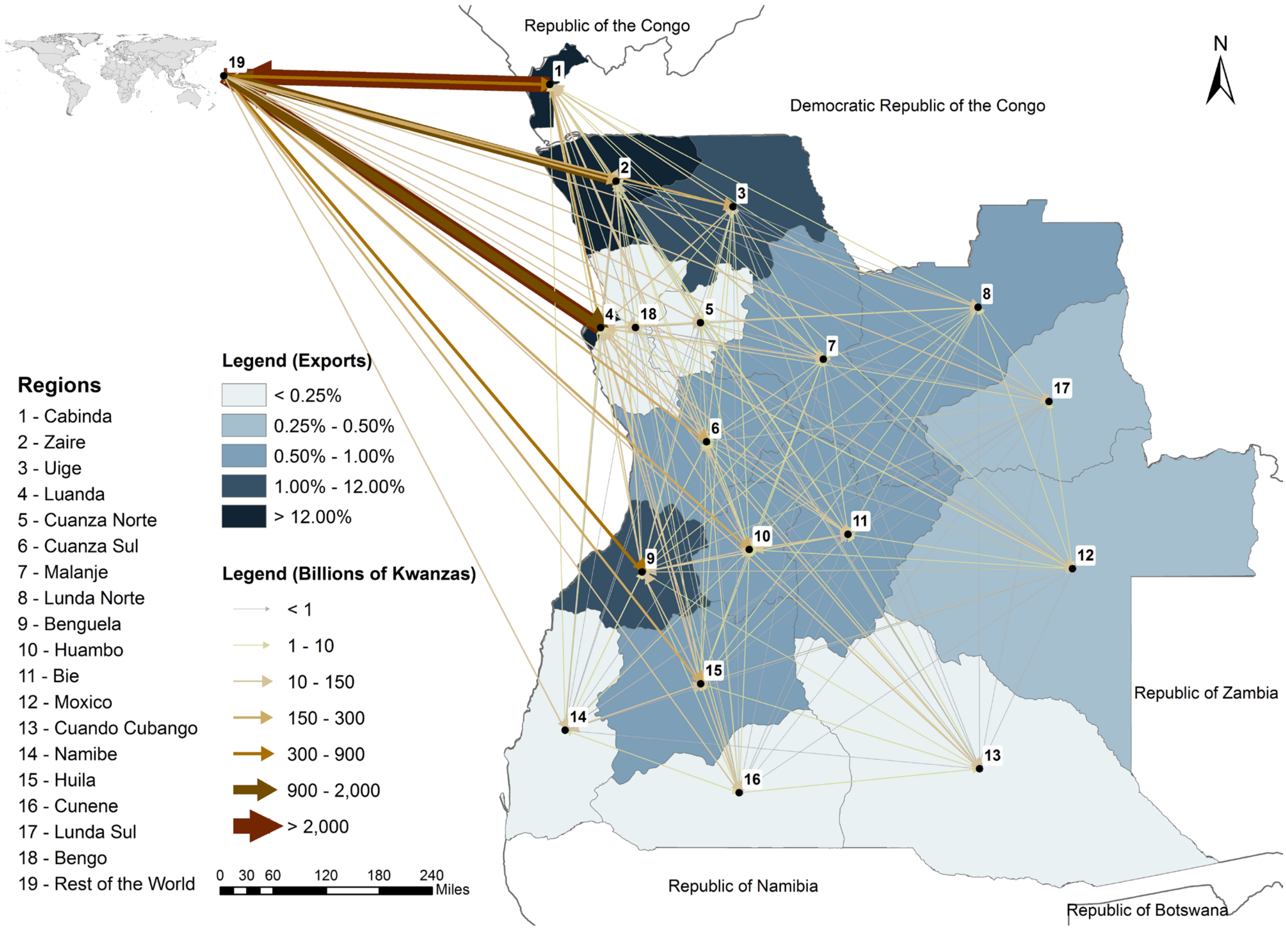
We can map the results obtained from Table 8 to visualize the geography of regional traded value added in Angola. Figure 4 depicts the "shipments" of value added from each origin to all destinations, both domestic and foreign. It also shows the magnitude of the flows with lines of proportional thickness. The different hierarchies of interregional and international trade structures reveal a pattern of uneven integration of Angolan provinces, dominated by strong foreign linkages and weak domestic linkages. It also shows the primacy of Luanda in interregional trade, as this province is associated with the main trade flows involving provinces in the extended economic core of the country.

Table 8. Regional total traded value added in trade flows: Angola, 2012 (in billions of Kwanzas)

O | D	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	ROW
R1	0.0	8.1	3.2	221.3	0.3	2.4	1.3	1.0	3.6	3.1	2.3	1.1	1.1	0.7	4.4	1.5	0.2	0.1	2,279.9
R2	20.6	0.0	4.0	99.5	0.5	1.0	1.3	0.6	1.2	1.2	0.9	0.5	0.4	0.2	1.3	0.5	0.2	0.3	882.0
R3	14.4	7.8	0.0	44.7	1.7	1.1	3.6	0.3	1.2	1.4	0.9	0.3	0.4	0.2	1.0	0.4	0.1	0.9	32.0
R4	158.3	99.9	64.7	0.0	32.0	107.1	50.1	10.9	83.7	60.6	35.7	13.0	15.5	13.1	54.5	16.8	5.0	41.5	2,161.5
R5	2.5	1.2	1.8	26.1	0.0	0.7	3.2	0.1	0.5	0.9	0.5	0.1	0.2	0.1	0.4	0.1	0.0	0.2	1.1
R6	15.6	6.1	4.8	120.2	2.5	0.0	5.3	2.0	16.5	10.5	6.6	2.2	2.2	0.8	6.5	2.2	1.0	1.2	6.1
R7	7.9	3.1	4.2	39.9	3.7	1.3	0.0	0.4	1.2	1.5	1.5	0.4	0.5	0.1	0.9	0.3	0.2	0.4	22.2
R8	6.2	1.6	0.8	8.8	0.2	0.7	1.0	0.0	1.4	1.6	1.6	3.9	0.7	0.3	1.4	0.7	5.7	0.1	37.8
R9	31.2	10.2	4.4	65.0	1.8	29.4	4.4	2.3	0.0	21.8	11.8	4.2	5.3	3.9	30.9	7.5	1.2	0.6	9.8
R10	17.9	6.1	2.1	46.3	1.3	6.4	2.0	0.6	10.6	0.0	24.4	1.9	3.2	0.8	5.8	1.4	0.4	0.5	5.5
R11	12.2	3.9	1.2	28.0	0.7	3.0	1.6	0.5	3.5	16.8	0.0	1.6	3.3	0.3	1.7	0.6	0.5	0.4	15.5
R12	5.0	1.4	0.3	7.7	0.1	0.6	0.4	1.3	0.9	1.1	1.4	0.0	0.4	0.1	0.6	0.2	2.6	0.1	7.8
R13	4.2	1.2	0.3	7.0	0.1	0.6	0.3	0.1	1.1	1.7	2.7	0.4	0.0	0.2	1.2	0.8	0.1	0.1	1.0
R14	5.3	1.4	0.4	5.3	0.1	1.0	0.4	0.2	2.9	1.1	0.7	0.4	0.7	0.0	19.8	2.6	0.1	0.1	1.9
R15	25.4	7.0	1.6	43.3	0.7	4.9	1.2	0.5	17.3	6.2	2.6	0.9	2.2	16.1	0.0	11.2	0.4	0.5	6.5
R16	8.3	2.1	0.5	10.7	0.2	0.9	0.3	0.2	2.0	1.0	0.7	0.2	1.1	1.0	7.3	0.0	0.1	0.1	1.5
R17	2.1	0.6	0.3	2.8	0.1	0.2	0.4	4.3	0.8	0.8	0.8	4.3	0.3	0.1	0.5	0.2	0.0	0.0	15.3
R18	1.2	0.8	0.7	42.4	0.2	0.3	0.3	0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.9
ROW	308.5	181.4	151.0	1,428.5	67.0	238.5	125.3	65.4	348.4	225.7	136.3	56.4	59.9	81.3	254.1	79.1	39.9	54.4	0.0

R1 – Cabinda; **R2** – Zaire; **R3** – Uíge; **R4** – Luanda; **R5** - Cuanza Norte; **R6** - Cuanza Sul; **R7** – Malanje; **R8** - Lunda Norte; **R9** – Benguela; **R10** - Huambo; **R11** – Bie; **R12** – Moxico; **R13** - Cuando Cubango; **R14** – Namibe; **R15** – Huila; **R16** – Cunene; **R17** - Lunda Sul; **R18** –Bengo; **ROW** –

Figure 4. Total trade in regional value added: Angola, 2012



Finally, Figures 5 and 6 present the balance of traded value added by Angolan regions. The only regions with positive net transfers of value added in international trade (surplus with other countries) are Cabinda, Zaire and Luanda, heavily influenced by the trade surplus generated by the sales of the staple product. On the other hand, the regions with the largest positive net transfers of value added in interregional trade (surplus with other domestic regions) are in the direct area of influence of the country's larger urban agglomerations and port cities, namely the provinces of Luanda, Cuanza Sul and Benguela.

Figure 5. Net balance of traded value added in international trade (in billions of Kwanzas)

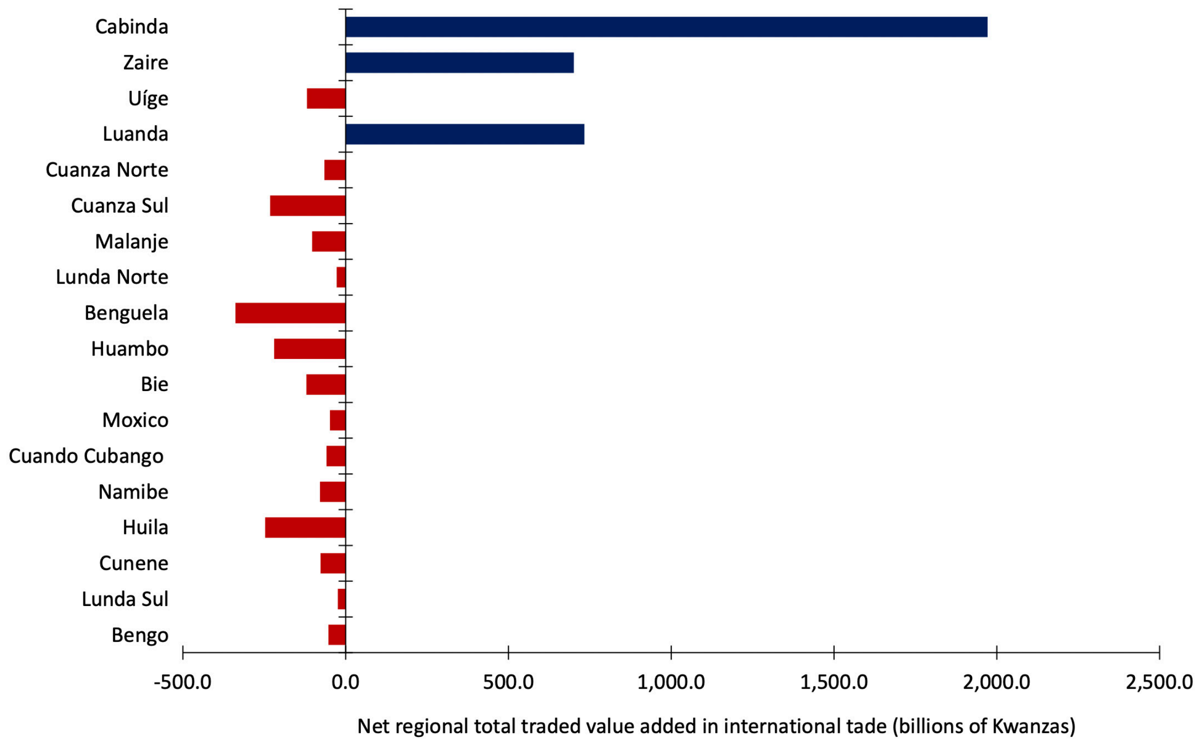
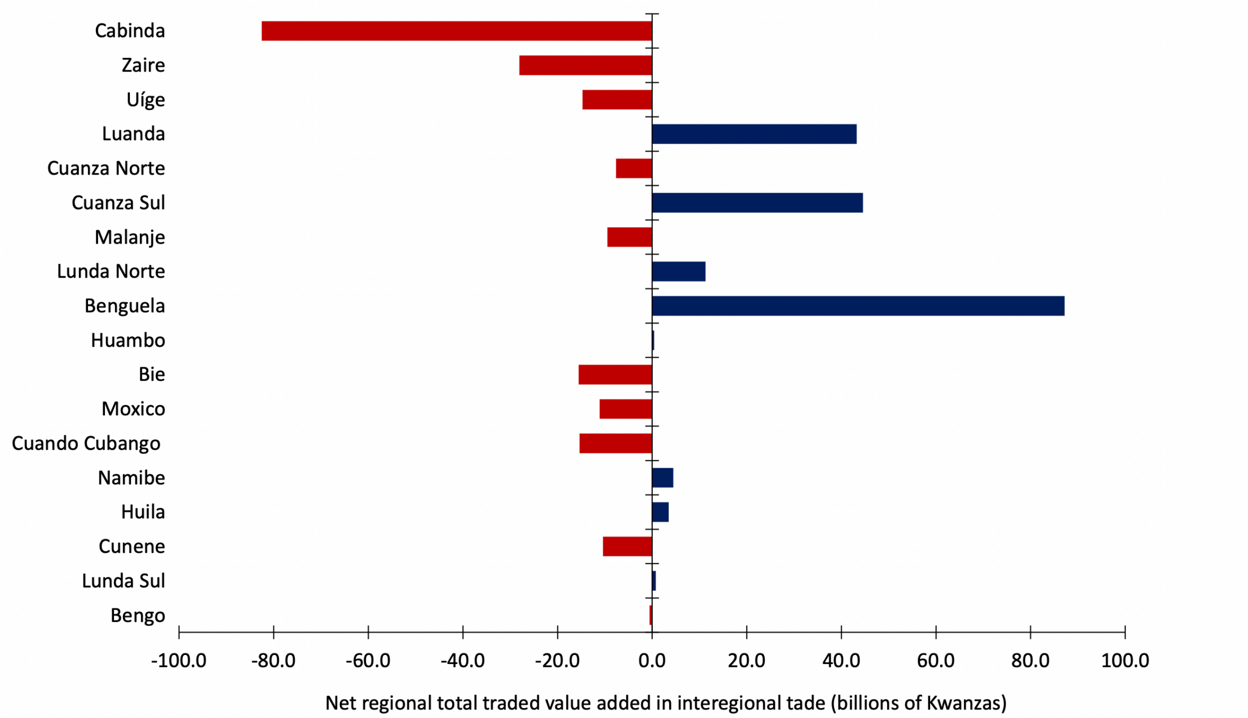


Figure 6. Net balance of traded value added in interregional trade (in billions of Kwanzas)



5. Final Remarks

The civil war that lasted from1975 until 2002 isolated most of Angola's hinterland. The increasing dependence of the Angolan economy on oil exports favored the concentration of the related income in the non-isolated part of the country, mostly limited to Luanda until 2002, but slowly expanding with the rehabilitation of the road network. Prospects for a wider and broader integration of the country include the interconnection with its neighboring countries, not only potentially triggering the development of the provinces in the borders, but also stimulating the potential of more central provinces, such as Huambo, Bié and Huíla. The modernization of the ports of Lobito (in the province of Benguela) and Namibe, associated with the planned recovery and promotion of the railways that link the west part of Angola to the interior and to neighboring countries in the West could add to the strengthening of Angola connectivity network. By enhancing input-output linkages of Luanda and the southern coastal provinces and, from there, to the highlands, the region's natural centrality in Angola and in subtropical southern Africa could finally emerge. As a final point, the wise spatial distribution of the oil revenues could also speed up the process of recovery of the Angolan periphery. As usual, additional research is needed to help providing further evidence to evaluate these issues more completely.

Acknowledgements. Eduardo A. Haddad (Grant 302861/2018-1) and Fernando S. Perobelli (Grant 304205/2016-8) acknowledge financial support from CNPq. This work was supported by the National Institute of Science and Technology for Climate Change Phase 2 under CNPq Grant 465501/2014-1, FAPESP Grant 2014/50848-9 and the National Coordination for High Level Education and Training (CAPES) Grant 16/2014.

References

- African Development Bank (2017). Angola: Country Strategy Paper 2017-2021. Available: https://www.afdb.org/en/documents/document/angola-country-strategy-paper-2017-2021-95462
- Altman, M. (2003). Staple Theory and Export-Led Growth: Constructing Differential Growth. Australian Economic History Review, 43(3), 230-255.
- Boame, A. K. (1998). Primary-Export-Led Growth: The Evidence of Ghana. Journal of Economic Development, 23(1), 175-194.
- Dentinho, T. P. (2017). Urban Concentration and Spatial Allocation of Rents from Natural Resources: A Zipf's Curve Approach. Region, 4(3), 77-86.
- Haddad, E. A., Cotarelli, N., Simonato, T. C., Vale, V. A., & Visentin, J. C. (2017). The Grand Tour: Keynes and Goodwin Go to Greece. TD Nereus N.05-2017. University of São Paulo.
- Haddad, E. A., Perobelli, F. S., & Araújo, I. F. (2019). Matriz de Insumo-Produto para Angola, 2012 (Nota Técnica). TD Nereus N.08-2019. University of São Paulo.
- Hirschman, A. O. (1958). The Strategy of Economic Development. New Haven, Conn.
- Hirschman, A. O. (1984). A Dissenter's Confession: "The Strategy of Economic Development" Revisited. In: Meier, G. M. & Seers, D. (Ed.). Pioneers in Development. Published for The World Bank and Oxford University Press. p. 85-111.
- Limão, N., & Venables, A. J. (2001). Infrastructure, Geographical Disadvantage, Transport Costs, and Trade. The World Bank Economic Review, 15(3), 451-479.
- Los, B., Timmer, M. P., & de Vries, G. J. (2016). Tracing Value-Added and Double Counting in Gross Exports: Comment. American Economic Review, 106(7), 1958-66.
- Manyuchi, A. E. (2016). Foreign Direct Investment and the Transfer of Technologies to Angola's Energy Sector. Africa Spectrum, 51(1), 55-83.
- Mouzinho, Â. (2016). Understanding the Angolan FDI Regulatory Landscape. SAIIA Occasional Paper N. 238.
- North, D. C. (1955). Location Theory and Regional Economic Growth. Journal of Political Economy, 63(3), 243-258.
- Ovadia, J. S. (2013). The Reinvention of Elite Accumulation in the Angolan Oil Sector: Emergent Capitalism in a Rentier Economy. Cadernos de Estudos Africanos, (25), 33-63.
- Perroux, F. (1950). Economic Space: Theory and Applications. The Quarterly Journal of Economics, 64(1), 89-104.
- Rocha, A., Paulo, F., Bonfim, L. & Santos, R. (2016). Estudos sobre a Diversificação da Economia Angolana. Centro de Estudos e Investigação Científica da Universidade Católica de Angola. Angola Catolic University Press.
- Schwab, K. (2018). The Global Competitiveness Report 2018. World Economic Forum. Switzerland. Available: http://www3.weforum.org/docs/GCR2018/05FullReport/
- Watkins, M. H. (1963). A Staple Theory of Economic Growth. Canadian Journal of Economics and Political Science, 29(2), 141-158.
- Williamson, J. G. (1965). Regional Inequality and The Process of National Development: A Description of the Patterns. Economic Development and Cultural Change, 13(4, Part 2), 1-84.

Appendix. Measurement of Regional Value Added in Interregional and International Trade Flows

The input-output model can be expressed by

$$\mathbf{x} = \mathbf{Ax} + \mathbf{f} \tag{1}$$

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} = \mathbf{Lf} \tag{2}$$

where **x** and **f** are the vectors of gross output and final demand; **A** is a matrix with the input coefficients (a_{ij}); **I** is the identity matrix; and **L** is the Leontief inverse.

Considering a national interregional input-output model with *n* different regions and the RoW as a column vector in the final demand, (1) and (2) can be represented as

$$\begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^n \end{bmatrix} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1n} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{n1} & \cdots & \mathbf{A}^{nn} \end{bmatrix} \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^n \end{bmatrix} + \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1n} & \mathbf{f}^{1row} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \mathbf{i} \tag{3}$$

$$\begin{aligned} \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^n \end{bmatrix} &= \left\{ \begin{bmatrix} \mathbf{I} & \cdots & \mathbf{0} \\ \vdots & \ddots & \vdots \\ \mathbf{0} & \cdots & \mathbf{I} \end{bmatrix} - \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1n} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{n1} & \cdots & \mathbf{A}^{nn} \end{bmatrix} \right\}^{-1} \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1n} & \mathbf{f}^{1row} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \mathbf{i} \\ &= \begin{bmatrix} \mathbf{L}^{11} & \cdots & \mathbf{L}^{1n} \\ \vdots & \ddots & \vdots \\ \mathbf{L}^{n1} & \cdots & \mathbf{L}^{nn} \end{bmatrix} \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1n} & \mathbf{f}^{1row} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \mathbf{i} \end{aligned} \tag{4}$$

where **i** is a column vector with all elements equal unity which sums all elements in each of the n+1 rows of the matrix **f**.

Following Los et al. (2016), the value added in region 1 (VA_1) can be expressed as

$$VA_1 = \mathbf{v}_1(\mathbf{I} - \mathbf{A})^{-1}\mathbf{fi} \tag{5}$$

where $\mathbf{v}_1$ is a row vector with ratios of value added to gross output in industries in region 1 as first elements ($\tilde{v}_1$) and zeros elsewhere ($\mathbf{V}_1 = [\ \tilde{v}_1 \ \ 0]$); and **i** is a column vector which all elements are unity.

In order to attribute the amount of domestic/regional value added in exports from region 1 to region n, we consider a hypothetical world where region 1 does not export anything to region n. In this case, the new VA or hypothetical VA can be represented by

$$VA_{1,n}^{*} = \mathbf{v}_1(\mathbf{I} - \mathbf{A}_{1,n}^{*})^{-1}\mathbf{f}_{1,n}^{*}\mathbf{i} \tag{6}$$

where $A^*_{1,n}$ and $\mathbf{f}^*_{1,n}$ are the hypothetical matrix of input coefficients and final demand, respectively, expressed as

$$\mathbf{A}^*_{1,n} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{0} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{n1} & \cdots & \mathbf{A}^{nn} \end{bmatrix} \tag{7}$$

$$\mathbf{f}^*_{1,n} = \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{0} & \mathbf{f}^{1row} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \tag{8}$$

In addition, in order to attribute the amount of domestic/regional value added in exports from region 1 to the RoW, we consider a hypothetical world where region 1 does not export to the RoW. In this case, the hypothetical VA can be represented as

$$VA^*_{1,row} = \mathbf{v}_1(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^*_{1,row}\mathbf{i} \tag{9}$$

where $\mathbf{A}$ is the original matrix with the input coefficients as in (5); and $\mathbf{f}^*_{1,row}$ is the hypothetical matrix of final demand, expressed as

$$\mathbf{f}^*_{1,row} = \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1n} & \mathbf{0} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \tag{10}$$

From (5) and (6), we can define the domestic value added in exports (DVA) from region 1 to region n as follows:

$$DVA_{1,n} = VA_1 - VA^*_{1,n} \tag{11}$$

and, from (5) and (9), we can define DVA in exports from region 1 to the RoW as

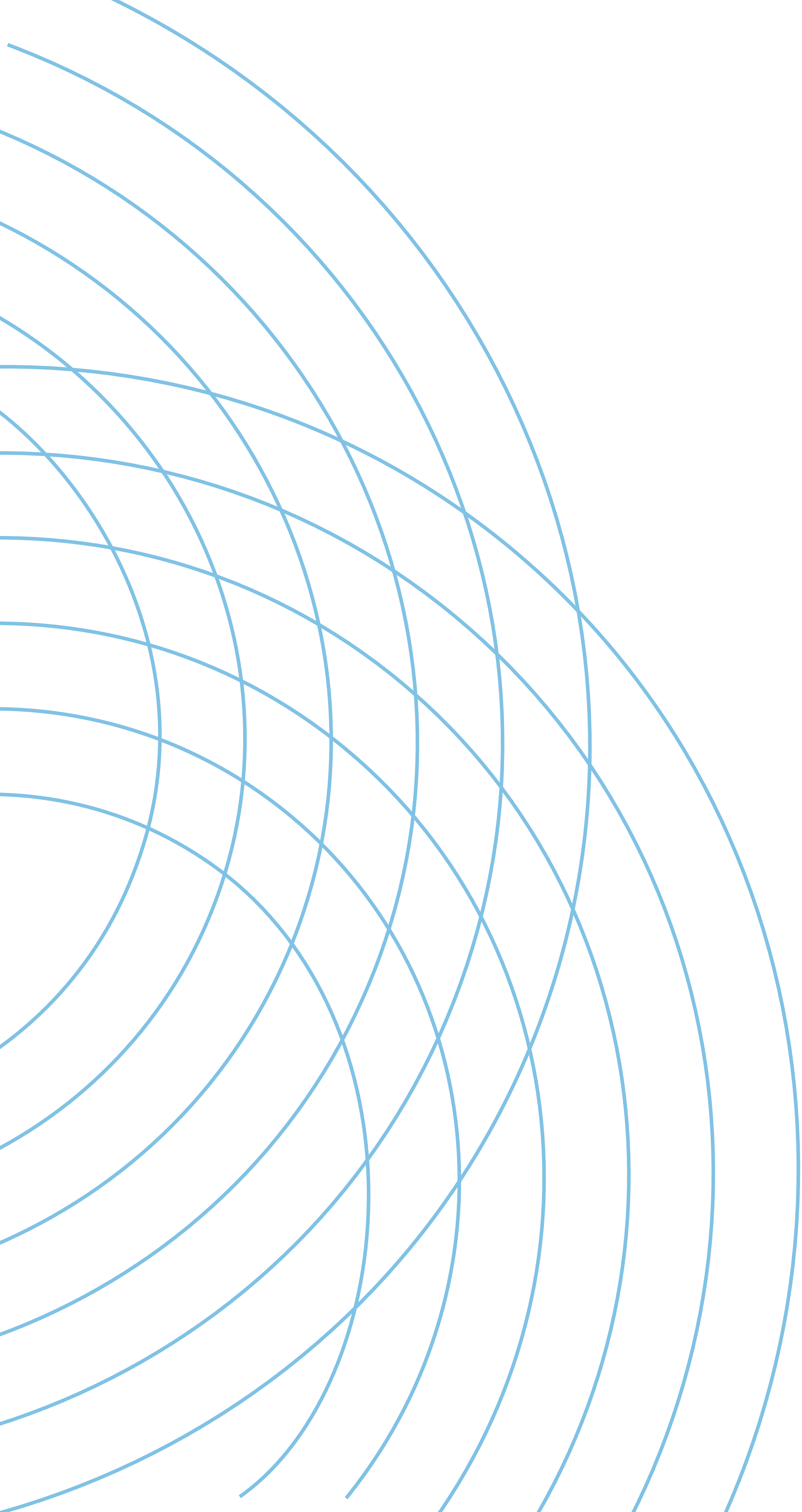
$$DVA_{1,row} = VA_1 - VA^*_{1,row} \tag{12}$$

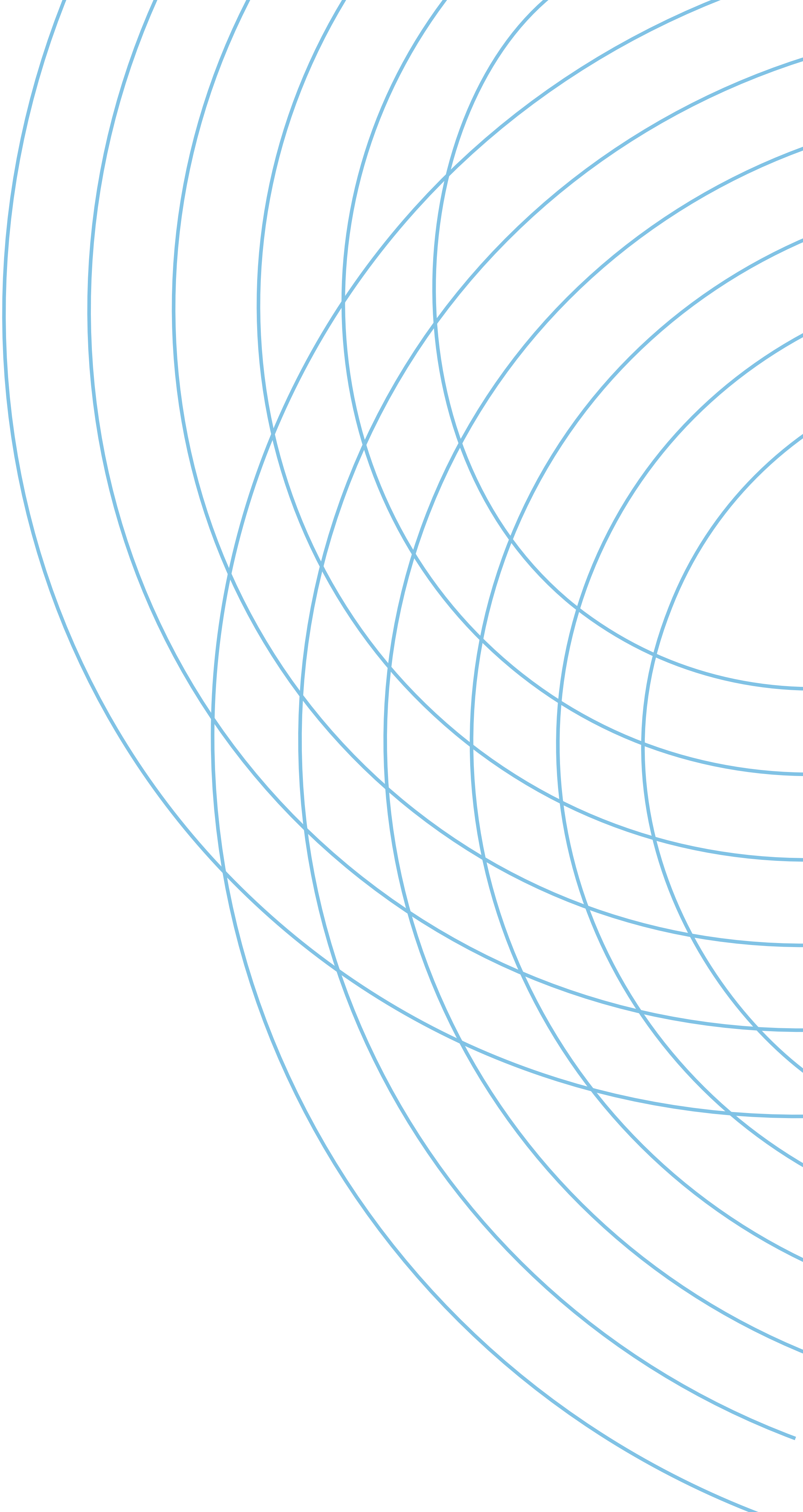
Similarly, we can attribute the amount of domestic value added in exports from region 1 to all regions (2, 3, …, n), and from each region to the n-regions (1, 2, …, n), excluding itself. We can also attribute the DVA from each region to the RoW. In this sense, in an interregional system with n regions and the RoW exogenous, we have n DVA in exports for each region, as illustrated in Table A.1.

For completeness, in order to compute the value added embedded in Angolan foreign imports, by province, we have used the WIOD inter-country input-output tables to estimate an aggregate “world” model. We have assumed that foreign imports into the Angolan economy were produced based on this aggregate world technology.

Table A.1. Domestic/regional value added in trade flows (DVA)

Hypothetical no export	to					
from	R_1	R_2	…	R_{n-1}	R_n	RoW
R_1		$DVA_{1,2}$	…	$DVA_{1,n-1}$	$DVA_{1,n}$	$DVA_{1,row}$
R_2	$DVA_{2,1}$		…	$DVA_{2,n-1}$	$DVA_{2,n}$	$DVA_{2,row}$
⋮	⋮	⋮		⋮	⋮	⋮
R_{n-1}	$DVA_{n-1,1}$	$DVA_{n-1,2}$	…		$DVA_{n-1,n}$	$DVA_{n-1,row}$
R_n	$DVA_{n,1}$	$DVA_{n,2}$	…	$DVA_{n,n-1}$		$DVA_{n,row}$
RoW	$DVA_{row,1}$	$DVA_{row,2}$	…	$DVA_{row,n-1}$	$DVA_{row,n}$	





Policy Center for the New South

Suncity Complex, Building C, Av. Addolb,
Albortokal Street, Hay Riad, Rabat,
Morocco.

Email : contact@policycenter.ma
Phone : +212 5 37 54 04 04
Fax : +212 5 37 71 31 54
Website : www.policycenter.ma