Measuring Vulnerability Interdependence: To What Extent Do Chinese Investments in Africa Make China Vulnerable?

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MEASURING VULNERABILITY INTERDEPENDENCE: TO WHAT EXTENT DO
CHINESE INVESTMENTS IN AFRICA MAKE CHINA VULNERABLE?

by

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Cathy Wu (Member)
ABSTRACT

MEASURING VULNERABILITY INTERDEPENDENCE: TO WHAT EXTENT DO CHINESE INVESTMENTS IN AFRICA MAKE CHINA VULNERABLE?

Nurullah Ayyılmaż
Old Dominion University, 2018
Director: Dr. Jesse T. Richman

The pace of Chinese investments in Africa accelerated after the 2000s as one of many consequences of China’s “going out” policy. The importance of Sino-African investment relationship has been signified by conveying large-scale tri-annual collective dialogue forum, named Forum on China Africa Cooperation (FOCAC), first in 2000. It is generally assumed that Africa needs China, mostly due to being recipient of Chinese investments, but what about the opposite and what would that mean for China? This dissertation looks at the bilateral relationship between China and Africa from the perspective of creating vulnerability for the investor party. Accordingly, the research questions of this study are: How can we measure the extent to which the external investor is vulnerably interdependent? To what extent is China vulnerably interdependent in Africa? The dissertation answers the first research question by using vulnerability interdependence theory and putting forth an index to measure the level of investor country’s vulnerability. The index of vulnerability interdependence has five dimensions—asset specificity, switching costs, ratification and compliance costs, proportionality, and issue linkages—which are represented in 17 questions. In order to answer the second research question, Chinese investments in three of its top five Sub-Saharan African trading partners are analyzed as a case study by using the vulnerability interdependence index.
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Dedicated to my dad.
ACKNOWLEDGEMENTS

Writing a dissertation is a very long journey! I started mine in September 2016 with a quite different topic in my mind. As I made research on my topic, it changed its track toward the Sino-African relations. David Earnest was the most helpful as being the director of my study during this initial process. I am indebted to his expertise in theoretical framework, guidance on creating the main structure of the vulnerability interdependence index, and endeavor to my success.

My journey kept its way under the guidance of Jesse Richman. He became more than a supervisor for my dissertation. He was a mentor; he was a friend; he was the person who has always been available for my questions. He made me believe that my dissertation is the most important work of him among his many other works. He facilitated the difficult process of writing the dissertation by meeting me every week. I was fortunate to have him as my chair.

I appreciate the kindness of Cathy Wu, for taking part in my dissertation committee as our “China expert” in GPIS. Steve Yetiv also contributed to this dissertation with his helpful feedback in its earlier versions. We lost him too early, unfortunately. He passed away in March 2018. He did not only contribute to this dissertation but also stimulated my intellectual capacity with his classes in IR theory, Middle East politics, and geopolitics of energy.

Definitely, there is a pre-dissertation journey in a PhD student’s life, which broadens its intellectual and professional capacity. I am fortunate to take classes from Simon Serfaty, Regina Karp, Kurt Gaubatz, and Brandon Yoder, which enriched my perspective in the literature as well as training me as a professional in the field.

My friends in GPIS and at ODU were very supportive both in the period of classes and
during the time I wrote this dissertation. I thank all of my friends who shared their perspective, knowledge, culture, and time with me. Especially, Jamila Glover and Felicia Grey contributed to this study with their valuable comments and constructive criticisms in the early stages of this dissertation. They did more than contributing by encouraging me to keep writing even in the most difficult times of my dissertation journey.

Above all, the love and support of my immediate family made it possible to overcome such an arduous task. None of my accomplishments would be achievable without their spiritual support, love, and encouragement. I am indebted to my dad, mom, and brothers for supporting me not only in my dissertation journey but also throughout my life. Especially, I am grateful for the sacrifice of my wife, who had to share the first two years of our marriage with my dissertation in my after work hours and even in our holidays.
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CHAPTER I
INTRODUCTION

“... a useful beginning in the political analysis of international interdependence can be made by thinking of asymmetrical interdependencies as sources of power among actors.”

(Keohane and Nye, 2012, p.15)

China’s interest in the African continent has been on the rise since the beginning of the millennium. It is not surprising that world’s second largest and fastest growing economy shows an interest in the world’s fastest growing and one of the most promising continents. Chinese interest in Africa is caused by many factors. Africa’s unexploited mineral and fossil fuel resources, its position as a market for China, the strategic location of Africa, employment opportunities for Chinese labor and the 54 votes of African nations at the UN are the leading reasons of Chinese involvement in the region.

China has been criticized for exploiting African countries by taking away raw materials from those countries and selling consumer goods in return. China’s approach to its bilateral relationships is that a bilateral relationship should be mutually beneficial for both sides. Africa is no exception. China expects to get something from Africa in return for its investments. The benefits for the Chinese side have mostly been natural resources, access to African markets and employment opportunities for Chinese local people. In a sense, the bilateral relationships between China and the African nations are “benign but hardly altruistic”.

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3 Sanusi, “Africa Must Get Real about Chinese Ties.”
4 Sun, “China’s Increasing Interest in Africa.”
China has made substantial investments in the African countries and continues to do so.\textsuperscript{5} It is generally assumed that Africa needs China, mostly due to being recipient of the Chinese investments, but what about the opposite and what would that mean for China? This dissertation looks at the bilateral relationship between China and Africa from a different perspective. The relationship is examined from the perspective of creating vulnerability for the investor party. Accordingly, the research questions of this study are: \textit{How can we measure the extent to which the external investor is vulnerably interdependent? To what extent is China vulnerably interdependent in Sub-Saharan Africa?}

An important contribution of the dissertation is challenging the general acceptance about the investor-recipient relations. General acceptance would state that the Sino-African relations make the African countries vulnerable since China is giving away its money to them mostly by way of debts.\textsuperscript{6} This study, however, hypothesizes that China’s bilateral relationships make it vulnerable in its relations with the African countries, whose industries and infrastructure China sinks its money into. It further hypothesizes that what makes China more vulnerable is its investments in heavy industries, such as industries related to steel production or mineral production.\textsuperscript{7}

The study answers the research question by using vulnerability interdependence theory and putting forth an index to measure the level of investor country’s vulnerability. The index of vulnerability has five dimensions, which are represented in 17 questions. Most of the questions are directed to projects that an investor invests in a foreign country. Some questions require

\textsuperscript{5} Scissors, “China Global Investment Tracker.”
\textsuperscript{7} The research in the following chapters shows that this type of investments makes the investor party more vulnerable because they are not easy to be pulled out and moved in case of having a disruption in bilateral relations.
answers at the state level, and thus require data on interstate relationships, such as volume of
exports and imports. Hence, this study uses both country-level data and project-level data
regarding the Chinese investments.

The dissertation adopts a mixed method approach, in which both quantitative and
qualitative methods are used. The index of vulnerability interdependence forms the basis of the
quantitative part with case study chapters adding qualitative analysis of the research question.
The qualitative part of the dissertation comprises of four subsectors of investment projects and
three African countries.

China’s projected energy demand growth has been one of the leading reasons for its
expanding presence in Africa. Increases in China’s energy consumption are projected to be one
of the most important developments in the demand side of global energy market.8 While global
energy demand has currently been clustered mostly in developed countries, it is now expected to
have increase in developing countries in near future. More precisely, the focal point of energy
demand shifts from the United States and European countries to China, India, South Korea and
the Arabian Gulf. Africa has unexploited mineral and fossil fuel resources. This makes the region
one of leading places for China to be interested in. When analyzing a leading hypothesis of this
study –China is more vulnerable in its bilateral relationships with the African countries, whose
heavy industries China sinks its money into— Chinese investments in the energy sector in Africa
which are the result of China’s growing energy demand will be examined from the perspective of
creating vulnerability for China.

There are, of course, other benefits that China may get by expanding its place in Africa.
Besides mineral and fossil fuel resources, there are some strategic locations where developed

---

countries compete against each other. The geostrategic importance of various locations of the continent is one of other reasons why China is interested in the region. It built its first overseas base in Djibouti⁹, for example.¹⁰

Trade volume between China and Africa rose 22-fold in the one and a half decades since 2000, from $20 billion in 2000 to $220 billion in 2014.¹¹ African oil and minerals have almost made up half of this amount. China, in return, makes infrastructure investments in African countries such as roads, bridges, railways, and telecommunication infrastructure as well as industrial investments such as investments in metals and energy sectors.

Not only China but also many developed and developing countries are engaged strongly with Africa. The European countries—which have a history of colonization in Africa—and the U.S. are the leading ones. What causes the interest of the European countries and the U.S. in the region are mainly the aforementioned benefits; mineral and fossil fuel resources¹², strategic locations or military engagement¹³, and trade benefits¹⁴. Turkey, Brazil, India, and Japan are other leading countries in terms of their presence in the African continent.¹⁵ Among the countries that are interested in Africa, China has been more associated with the continent as a country that has a rising level of engagement by making many investments, providing loans, sending labor

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⁹ Although Djibouti is an important country for China to engage militarily, there are not much Chinese investments in this country. Chinese investments totaled $1.7 billion with only four transport projects until the beginning of 2018. See Scissors, “China Global Investment Tracker.”

¹⁰ Lendon and George, “China Sends Troops to Djibouti, Establishes First Overseas Military Base.”

¹¹ Patey and Chun, “Improving the Sino-African Relationship.”


¹⁵ No Reference

force and exchanging people for cultural expansion. Examining this rising level of engagement from the perspective of vulnerability interdependence theory provides a good understanding of the Sino-African relationship.

One of the most important contributions of this study to the literature will be the index of vulnerability interdependence, which aims at understanding the extent to which investor companies of a country makes it vulnerably interdependent in its relations with the host country of investments. Although discussed and used widely in the literature, Keohane and Nye’s vulnerability interdependence theory does not have a well-defined measurement method. The increasing number of bilateral and multilateral relationships in the world as the result of globalization makes it more useful and necessary to have a well-defined method for measuring vulnerability interdependence to make it easier to understand the level of vulnerability between interdependent actors.

The index of vulnerability that this study introduces considers vulnerability of a country in its bilateral relationship with another country as consisting of some country-level and investment project-level components. The components of the index are namely; costs of asset specificity, switching costs, ratification and compliance costs, proportionality, and issue linkages. The first three components require project-level analysis while the last two require country-level analysis.

Table 1: 17 Questions of the Vulnerability Interdependence Measurement Index

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<td>1. Are the assets or productivity mobile? (infinite immobile=3, immobile=2, mobile=1, infinite mobile=0)</td>
</tr>
<tr>
<td>2. Are transportation costs amenable to decentralized production? (infinite not amenable=3, not amenable=2, amenable=1, infinite amenable=0)</td>
</tr>
<tr>
<td>3. Is the value per unit of end-product’s weight high? (infinite high=0, high=1, low=2, infinite low=0)</td>
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There are 17 questions in total, representing these five components of the vulnerability index. The number of questions varies for each one of these components. Asset specificity is represented by 10 questions, while switching costs have three questions, ratification and compliance costs have two questions, proportionality has one question and issue linkages have one question. The number of questions does not necessarily reflect the weight of these five
components. Analytical Hierarchy Process is used for obtaining the weights for each of these 17 indicators, hence the weight of each of these five components.

These 17 questions will be applied to the 163 investment project cases in China’s top five African trading partners, namely South Africa, Angola, Nigeria, Ghana, and Kenya respectively. A vulnerability score for each one of these investment projects will be calculated. Then, the scores of sectors and subsectors in China’s five top trading countries will be extrapolated to get index scores for other African countries in which China had investments.

The content of this study is designed to start with presenting a background of China’s relations with Africa: Why is China in Africa? What activities has it in the region? Which policies have urged the Chinese companies to expand their existence in the continent? Why does Africa need China? What level of military relationship does China have in Africa? What does explain its military existence in the region the best? What are the popular myths regarding the Sino-African relations and what are the truths? The answers of these questions are discussed in the first chapter.

The second chapter will examine Keohane and Nye’s vulnerability interdependence theory and its explanation power for the case of China’s relations with Africa, based on its investments there. It will trace back the origins of Keohane and Nye’s vulnerability interdependence. In this respect, this chapter will discuss Hirschman’s work on the effect of foreign trade on exercising power and Wagner’s unexploited bargaining power concept. Another related concept, Vernon’s obsolescing bargaining model, will also be discussed in this chapter.

The second chapter will further suggest five concepts –which are borrowed mostly from the economics literature— considered to be good measures of vulnerability interdependence. The concepts of asset specificity, switching costs, proportionality, costs of ratification and
compliance, and issue linkages will be defined and discussed. This section that discusses these five concepts will be a base for creating questions to measure vulnerability interdependence in the next chapter.

A chapter on research design follows the theory chapter. In this third chapter, the methodology will be introduced. It will describe the index and the 17 questions which are considered to be good measures of vulnerability interdependence, present the choice criteria of the selected dataset among others, explain how reliability and validity of the index is assessed, justify case selections by explaining the rationale behind selecting four subsectors and three countries, and discuss methods used to obtain weighted index scores from normalized data for each one of indicators. This chapter will end with a section on making clear how to interpret index scores in a correct way.

Two case study chapters trail after the research design chapter. The first case study chapter will discuss four subsectors of Chinese investments in its five top African trading partners. Steel subsector of the metals sector, rail subsector of the transport sector, shipping subsector of the transport sector, and banking subsector of the finance sector are the subsectors that will be analyzed in detail. They will analyzed in terms of asset specificity and switching costs, since other three concepts—costs of ratification and compliance, proportionality and issue linkages—are not the measures at the project level. They are, rather, measures at the country level.

The second case study chapter will analyze three African countries. This chapter will serve a showcase for the index findings for these three countries. These countries are selected among China’s top five trading partners in Africa. Among these five countries, three of them are chosen according to the level of vulnerability that create for China. Nigeria, Angola, and Kenya
will be examined in four sections, namely country profile, their bilateral trade with China, Chinese investments in these countries, and an assessment of what findings in the first three sections may indicate in terms of creating vulnerability.

Last, the dissertation will be concluded with a conclusion chapter. This chapter will wrap up what the study developed as the measure of vulnerability interdependence, how it is used in the case of Chinese investments in Africa, and what the findings are.
CHAPTER II

BACKGROUND: CHINA IN AFRICA

This chapter aims at understanding the reasons why China might be interested in investing in the African continent as well as rapid increase in its foreign operations. It introduces and analyzes the Sino-African financial and military relationship, Africans’ perception of China and popular myths regarding this relationship. This sets the stage for and contextualizes the subsequent analysis. Chinese presence in the African continent has risen dramatically after the start of new millennium, after the first Forum on China-Africa Cooperation meeting was convened in Beijing in 2000.1 The relationship has been far more than mere interconnectedness. Both sides have become sensitively interdependent by having relationships in many fields that have reciprocal costly effects in case of one party or the other breaking the relationship.

Some important characteristics of the Sino-Africa relationship were apparent even before the dramatic rise of China’s engagement with the region started at the beginning of the 2000s. Some of these have lasted till today. For instance, comparing a presidential-level visit of China to African countries in 1996 and a Forum on China-Africa Cooperation (FOCAC) meeting in 2018 give some insight about these lasting characteristics. The then-Chinese President Jiang Zemin visited six African countries (Kenya, Egypt, Ethiopia, Mali, Namibia and Zimbabwe) in a 14-day visit in May 1996 and a declaration for the latest FOCAC summit was published on 5 September 2018. In both conventions, the parties agreed on some principles such as; treating each other as equals, respect the choices of African people to solve their own problems in their own ways, sticking to the principles of equality in economic cooperation and trade with each other, supporting China’s position on the Taiwan question, and not interfering each other’s

1 “Forum on China-Africa Cooperation (FOCAC).”
China’s financial activities in the African continent is the leading reason for its presence there. As the following pages delve into the details, China’s financial activities have increased with its “going global” strategy after the 1990s. A significant change in China’s outward foreign direct investment toward the African continent has occurred after 2000, when the first Forum on China-Africa Cooperation meetings was convened in Beijing. Infrastructure has been the leading sector among others. Like its investments in other regions, China has mostly invested in infrastructure projects in Africa.

China’s military presence in Africa has also started to increase in line with its financial activities. As one of Africa’s leading financial investors in the last two decades, its military presence aims at providing stability in the region since stability facilitates better financial activities. The operations that China has conducted in Africa have been operations other than war. It has contributed to the UN peacekeeping operations in Africa by participating under the UN auspices. Arms sales have been another important military relationship subject between China and Africa. Although the value of arms sold to Africa is not very high yet, it has a potential of growth.

Understanding China’s financial and military relations in Africa, how the Africans perceive Chinese existence in their continent, and some popular myths associated with China’s existence in Africa give the background concerning why China has involved in the African continent. Knowing the rationale behind China’s decision of taking a broader role in the African finance and military is important for understanding which party is more vulnerably interdependent in their bilateral relations. It helps to understand the relationship on the face of it;

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2 “President Jiang Zemin’s Visit to Six African Countries”; Ministry of Foreign Affairs of the People’s Republic of China, “Beijing Declaration.”
meaning that it gives a hint about overall Sino-African relations in terms of vulnerability interdependence. In this chapter, China’s increasing role in Africa is analyzed in two main areas; financial and military relations. Additionally, the sections on how the Africans perceive China and myths about the bilateral relationship are also examined as complementary parts of the overall Sino-African relations.

**China’s Financial Activities in Africa: Going Global**

“Going global” strategy is key to understand China’s financial activities in Africa. China started to incentivize outward investments after this strategy while it previously restricted money flows to foreign countries. This strategy was first developed in the first years of the 1990s, after a visit of the Chinese President to a couple of African countries and has matured till today. There have been four important steps throughout the lifespan of this strategy: (1) setting up international sales networks and engaging in low-value international trade, (2) hunting for oil and natural gas and initiating overseas infrastructure investment projects, (3) engaging with the world at a higher capacity by setting up factories abroad, employing local workers, and acquiring foreign companies, and (4) rising in foreign markets by diversifying investments and growing into the world-class innovators. In the current era of this “going global” strategy, China aims at shifting from a “world factory” position to a “world market” position. This means that China now needs countries or regions to take over its “world factory” role as well as being a “factory” for Chinese manufacturers. Africa is one of the perfect candidates for this position.

Africa has two leading roles in China’s “going global” strategy. First, it is a testing ground for Chinese companies’ outreach to overseas markets. They start their businesses abroad by investing in Africa. Second, it is a good candidate for taking over China’s role as “world
factory” with its low-cost labor. Hence, China’s “going global” strategy is significant for understanding China’s financial activities in Africa.

The “One Belt One Road” initiative is also important to understand China’s global financial presence. It aims at reincarnating the historical silk road by updating it. It includes many countries and regions but excludes the majority of the African continent. The reasons for Africa’s exclusion are discussed below in One Belt, One Road Initiative: Why Is Africa Excluded? section on page 19.

China’s outward foreign direct investment exceeded the inward foreign direct investment the first time in 2016. This means that China’s role has transformed from being a host country for other countries’ investments to an investor country. The change in its role is an indicator of shifting investments from China to other countries. Africa is a good candidate for new investments due to its cheap labor. Other countries that invest in China and China itself may lean towards the African countries.

The pace of China’s investments in Africa has accelerated in the recent years in terms of greenfield investments. China surpassed the U.S. and became the top greenfield investor in Africa in 2016 and 2017. This signifies China’s appetite to invest especially in Africa’s infrastructure, which is the top reason for greenfield investments.

Some Chinese companies tend to prefer locations that have abundant natural resources while some companies seek new markets. Who owns the enterprise that makes outward investment affects the location determination. State-owned companies tend to choose natural resource-abundant locations. They also tend to invest in risky environments. Private companies, on the other hand, are found to be more market seekers compared to state-owned ones.³

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³ Ramasamy, Yeung, and Laforet, “China’s Outward Foreign Direct Investment.”
This section will analyze the Chinese strategies that cause them to lean towards foreign markets, the rise in presence of Chinese companies in the global financial market, China’s “One Belt, One Road” initiative, and its outward foreign direct investments as well as Africa’s place in all of these strategies.

“Going Global” Strategy of China

As Shambaugh states in his book, “[t]o understand China’s ODI, one must begin with the origins of China’s “going out” (走出去) or “going global” (走向世界) policy”.4 In the first half of the 1990s, the Chinese government mandated the Chinese companies “go out” or “go global” and operate in foreign countries as well as continuing their domestic operations in China. The beginning of this strategy marked a dramatic change in China’s outward investment policy; it shifted from being “one of tightly restricting capital outflows to one of encouraging Chinese enterprises to invest abroad”.5

The earliest indication of this strategy was in 19926, when the then president of China Jiang Zemin mentioned it for the first time in a speech at the Fourteenth Party Congress in this year.7 From 1993 to 1996, President Jiang’s policies aimed at directing Chinese companies mostly to the developed world, rather than the developing countries. He encouraged the Chinese companies to make outward FDI the first time explicitly when he returned from a state visit to Africa in July 1996. President Jiang spoke going out strategy in various platforms after 1992. He started to emphasize this strategy particularly for state-owned enterprises (SOEs) in 1998. Africa,

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4 Shambaugh, China Goes Global, 138.
5 OECD, China: Encouraging Responsible Business Conduct, 67.
6 Although “going global” strategy’s first indication was in 1992, China’s outward FDIs started much earlier. China opened its doors in 1979, when marked the start of China’s outward FDI. See OECD, 81.
7 Shambaugh, China Goes Global, 138–39.
Central Asia, the Middle East, and Latin America were among the market destinations President Jiang suggested to Chinese SOEs. The going out strategy was brought to the table at a Politburo meeting by Jiang in January 2000.8

Following 2000, the suggestions of the head of state were formalized by the Chinese Premier Zhu Rongji. He referred this strategy in the annual report that he gave to the National People’s Congress. His speech is considered to be a landmark launching the going out strategy officially.9 After this speech, the State Council formulated rules and regulations for Chinese enterprises going out and making outward investments.

A group of state decrees were issued between 2000 and 2002 to regulate the activities of outward FDI. Another objective of these decrees has been encouraging and supporting Chinese enterprises to go global and invest abroad by facilitating the process, rather than restricting it.10 China’s regulatory framework (government policies, laws, and regulations) has been a determinant of its dramatically increasing outward foreign direct investments.11 This framework has two goals: to help Chinese companies become more competitive in the international arena and to use these companies’ help to realize China’s development efforts.12

A requirement of these decrees was that the Chinese government should review and approve all the proposed outward FDIs of the Chinese enterprises. The Ministry of Commerce has been the authoritative organ to review all overseas investments of Chinese enterprises. Another important requirement was that natural resource investments exceeding US$200 million and non-resource investments exceeding US$50 million must be approved by the State Council’s

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8 Shambaugh, 139.
9 Shambaugh, 139.
10 Shambaugh, 139; Sauvant and Chen, “China’s Regulatory Framework for Outward Foreign Direct Investment.”
11 Sauvant and Chen, “China’s Regulatory Framework for Outward Foreign Direct Investment.”
12 Sauvant and Chen.
National Development and Reform Commission.\textsuperscript{13}

China’s five-year plans emphasize the importance of going global. The 12\textsuperscript{th} Five-Year Plan, that covered the years between 2011 and 2015, “emphasized the acceleration of the “go global” strategy”.\textsuperscript{14} Regarding that plan, Chinese institutions –such as the Ministry of Commerce, the National Development and Reform Commission, the Export-Import Bank of China, the China Development Bank and China Export and Credit Insurance Corporation— provided administrative, financial and commercial support to companies that went global.\textsuperscript{15} The 13\textsuperscript{th} Five-Year Plan, which covered the years between 2016-2020, also stresses “going global” as well as “bringing in” investment, technology and talents. It states that opening up is “vital for China’s prosperity and development”.\textsuperscript{16} The last five-year plan assumes exporting Chinese equipment, technology, standards, and services, particularly in some selected industries (making them go global):

“We will encourage more of China’s equipment, technology, standards, and services to go global by engaging in international cooperation on production capacity and equipment manufacturing through overseas investment, project contracting, technology cooperation, equipment exporting, and other means, with a focus on industries such as steel, nonferrous metals, building materials, railways, electric power, chemical engineering, textiles, automobiles, communications, engineering machinery, aviation and aerospace, shipbuilding, and ocean engineering.”\textsuperscript{17}

The State Council of China distinguishes “going global” in four phases. In the first phase, the “Go Global” era 1.0, Chinese enterprises just started to engage with the world by setting up international sales network and engaging in low-value international trade. The first step of

\begin{footnotesize}
\begin{itemize}
\item[15] OECD, 16–17.
\item[17] China National Development and Reform Commission, 142.
\end{itemize}
\end{footnotesize}
“going global” era was in the beginning of the 2000s. The “Go Global” era 2.0 was mainly the Chinese state-owned companies’ search for some specific properties such as oil and natural gas, and overseas infrastructure investment projects. In “Go Global” era 3.0, China’s private enterprises started to engage with the world at a higher capacity. They started to invest overseas, set up factories abroad, employ workers of host countries, and acquire foreign companies. The “Go Global” era 4.0 entails the rise of China’s private enterprises in foreign markets. They will increase share in foreign markets by diversifying investments and growing into world-class innovators. According to the State Council, “China is witnessing two dramatic changes [in “Go Global” era 4.0]: from a capital importing country to a capital exporting country; from “world factory” to “world market””. The latest process, which continues in the second half of the 2010s, is a sign of China’s ongoing economic transformation and also a proactive part of China’s “going global” policy.

The trend of going global has become strong in China. Even infant Chinese start-ups aim at going global although China’s large domestic market provides a good opportunity for rapid growth. Analysts say that this move of Chinese start-ups will change the perception of “Made in China”, which is associated with low quality and low cost in the world. In the current phase of “going global”, China furthers its position in foreign markets from merely an exporter of capital to exporter of both capital and innovation.

The government strategy of “going global” also included having Chinese companies in the premier league of international commerce in terms of reaching out to end-consumers. Although Chinese enterprises have increased the amount of China’s outward FDI rapidly in the

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18 “Chinese Enterprises Enter ‘Go Global’ Era 4.0.”
19 “Chinese Enterprises Enter ‘Go Global’ Era 4.0.”
20 Lee, “China’s Start-Ups Usher in New Phase of ‘Going Out’ Movement.”
21 “Chinese Enterprises Enter ‘Go Global’ Era 4.0.”
last decade, the strategy of having a growing share in the international consumer market is far away from being successful. Yet, it has a potential of succeeding in the future.  

Although “going global” mostly associates with financial activities, it also enhances other parts of China’s engagement in foreign countries. For example, a Chinese university opened a large-scale branch in Malaysia, which can be considered both as a financial activity since it is an investment and as a soft power component since it will attract many Malaysian and international students.

“Going Global” in Sino-African Relations

What does China’s “going global” policy mean for the Sino-African financial relations? The chief answer for this question would be that China sees Africa as a testing ground for its “going global” policy. Africa is seen as a test ground by Chinese multinational companies according to some experts on Sino-African relations. The Chinese companies that want to extend their operations to overseas start with African countries and use their operations in these countries as a testing ground for their first experience in a foreign country. Also, Chinese peacekeeping operations in the region – discussed widely in the next section --, and construction of infrastructure such as roads, railways, and ports are seen as a testing ground for Beijing’s going global policy.

The policy of “going global” has a different meaning for Chinese state-owned

23 Bevins and Phillips, “Going Global': China Exports Soft Power with First Large-Scale University in Malaysia.”
enterprises—abundant fossil fuel and valuable mineral resources. These existence reasons have
been widely discussed as China’s existence reasons in the continent. Oil resources in Angola,
Nigeria and Sudan, copper mines in Zambia and the Democratic Republic of Congo, and
uranium resources in Namibia, for example, attracted Chinese state-owned enterprises. They also
appeared to buy cobalt from Congo with multibillion dollar stake purchases in mines in this
country.26

This strategy also relates to finding an appropriate candidate to take over China’s role as
a “world factory” as it shifts from being “world factory” to “world market”. Africa is a good
candidate for both companies that invest in China and Chinese companies that look for places to
invest in. Especially Africa’s cheap labor attracts labor-intensive investments to the region.27

The Chinese policy of “going global” also means a marketplace in Africa. Ethiopia is a
good case for China’s interest in Africa’s marketplace. It is a resource-poor country with a 102
million population. It has been the sixth largest recipient of Chinese investment between 2004
and 2017, with an estimated total of $4 billion. What may attract China in this country is its
marketplace, strategic location and sustainable growth in the last 15 years. The amount that
China invested in this country is far more than oil-rich Sudan and mineral-rich Congo.28

One Belt, One Road Initiative: Why Is Africa Excluded?

The Silk Road Economic Belt and 21st-Century Maritime Silk Road project—or with its
short name “One Belt One Road (OBOR)” project—has been regarded as an important
projection of China’s evolving role in global financial activities. It was raised by the Chinese

26 Pilling.
27 Xiaotao, “China’s ‘Belt and Road’: Where Is Africa?”
President Xi Jinping in 2013 and is simply a reincarnation of two historical trade routes that connect China to the majority of old-world continents.\textsuperscript{29} In its updated form, the OBOR initiative includes “65 countries covering 55 percent of the world’s GNP, 70 percent of the global population and 75 percent of the proven energy reserves”.\textsuperscript{30}

China gives importance to its financial relations with Africa. Although China’s “One Belt One Road” initiative is a significant indicator of its global financial relations and Africa is an important trading partner, the African countries are not on the roadmap of China’s “One Belt One Road” Initiative. There might be two leading reasons for Africa’s exclusion from the OBOR initiative. First, there might be historical reasons. Only a small portion of Africa was part of the historical silk road. Second, there might be worries about its infrastructure. Although Africa has received a significant number of infrastructure investments from China and other countries, its infrastructure has not matured well enough to be a base for other large-scale investments. Especially Africa’s transportation infrastructure needs to be developed.\textsuperscript{31} Still, it should be noted that the OBOR initiative is not a fixed plan: “The Initiative is open for cooperation. It covers, but is not limited to, the area of the ancient Silk Road. It is open to all countries, and international and regional organizations for engagement, so that the results of the concerted efforts will benefit wider areas”.\textsuperscript{32} If interested, African countries can also take places in the OBOR initiative.

\textsuperscript{30} Demiryol, “What Is China’s ‘One Belt, One Road’ Initiative?”
\textsuperscript{31} Xiaotao, “China’s ‘Belt and Road’: Where Is Africa?”
Global Presence of Chinese Companies

Chinese companies started to occupy top places in the Fortune 500 companies list in recent years. While there was not any Chinese company in 2004 in the top five Fortune 500 companies in banking, logistics, automobile, telecom, engineering and construction, petroleum refining, mining and crude oil production, and metals sectors, they have shown up in 2015. The sectors and the number of Chinese companies in the top five of Fortune 500 companies were as follows: four companies in the banking sector; no company in the logistics sector, no company in the automobile sector, one company in the telecom sector, five companies in the engineering and construction sector, two companies in the petroleum refining sector, one company in the mining and crude oil production sectors and one company in the metals sector.

Table 2: Comparison of Chinese Companies in Top Five of Fortune 500 Companies in 2004 and 2015

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<tr>
<th>Banking</th>
<th>Logistics</th>
<th>Automobile</th>
<th>Telecom</th>
<th>Engineering Construction</th>
<th>Petroleum Refining</th>
<th>Mining, Crude Oil Production</th>
<th>Metals</th>
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<tbody>
<tr>
<td>Top Five Fortune 500 Companies in 2004</td>
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<td>Citigroup, Inc.</td>
<td>Valero Energy Corp</td>
<td>GM</td>
<td>Nippon Telegraph</td>
<td>Bouygues SA</td>
<td>BP plc</td>
<td>Anglo American plc</td>
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<td>2</td>
<td>Credit Suisse</td>
<td>Deutsche Bahn AG</td>
<td>Ford</td>
<td>Verizon</td>
<td>Vinci S.A.</td>
<td>Exxon Mobil Corp</td>
<td>BHP Billiton Ltd.</td>
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<td>3</td>
<td>HSBC</td>
<td>SNCF</td>
<td>Daimler Chrysler</td>
<td>Deutsche Telekom</td>
<td>Skanska AB</td>
<td>Royal Dutch/Shell</td>
<td>RAG AG</td>
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<tr>
<td>4</td>
<td>BNP Paribas</td>
<td>East Japan Railway</td>
<td>Toyota</td>
<td>Vodafone</td>
<td>Kajima Corporation</td>
<td>Total</td>
<td>JFE Holdings, Inc.</td>
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<tr>
<td>5</td>
<td>Fortis</td>
<td>Lufthansa</td>
<td>Volkswagen</td>
<td>France Telekom</td>
<td>Taisei Corporation</td>
<td>Chevron Texaco</td>
<td>Alcoa Inc.</td>
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</table>

(No Chinese company was present in the top five of any sector in 2004.)
The rise of Chinese multinational companies in some sectors is remarkable. In the sectors of banking, engineering and construction, they occupied almost all of the top five places. One Chinese company occupied the top place in petroleum refining and another occupied the third place in the same sector. Their existence and relative ranking in these sectors is also an indicator of their existence in the world as foreign investors.

The total number of Chinese companies in the Fortune 500 list also showed growth at an impressive pace. They increased more than six-fold, from 16 in 2004 to 98 in 2015. One-fifth of top 500 companies were Chinese companies in 2015. Their number accelerated especially after the global financial crisis in 2008-2009. Compared to U.S. companies that are often more than 100 years old, Chinese companies in the Fortune 500 list are very young. Most of them

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34 OECD, 22.
35 OECD, 22.
were founded after 1950 and some after 1980. Three of them are even less than 20 years old.\textsuperscript{36}

The internationalization rate of the Chinese companies, however, is far away from other countries (e.g. the U.S. and Japan). The number of countries that a company operates in is a good indicator for understanding the internationalization level of companies. On average, U.S. companies in Fortune Global 500 list operate in 28 countries including their home country, while the number is 26 for Japanese companies. Chinese companies operate abroad much less compared to the U.S. and Japan: the number of countries that Chinese companies operate in is only 10 on average; roughly one-third of U.S. companies’ average.\textsuperscript{37} This shows that Chinese companies are concentrated in a limited number of countries whereas U.S. and Japanese companies distribute their investments widely in the world.

The growth in the number of Chinese companies in the Fortune 500, obviously, is not a direct indicator of Chinese companies’ operations in Africa. It is, though, associated with China’s outward FDI values, which affects China’s role in Africa as an investor. The next section will show how Chinese outward FDI has increased in the last decade. The rise of top Chinese companies has a correlation with the increase in China’s outward FDI.

\textit{China’s Outward FDI}

China’s outward FDI value exceeded its inward FDI value the first time in 2016, which made China a net outward direct investor for the first time.\textsuperscript{38}

Figure 1 compares China to the largest outward financial direct investor of the world—the U.S.. In this chart, the U.S. FDI stocks are much higher compared to China’s FDI stocks. The

\textsuperscript{36} OECD, 22.
\textsuperscript{38} “FDI in Figures.”
FDI flows of China, however, almost catch the U.S. FDI flow value.

**Figure 1: Outward FDI Flows and Stocks of China and the U.S. Between 2000 and 2016**

![Outward FDI Flows and Stocks of the U.S. and China (2000-2016)](image)

**Source: Created by the Author with the Data from UNCTAD Stat Database**

Chinese outward FDI flows—and accordingly its outward FDI stocks—can be expected to grow further as it has plans for going global. Double-digit growth rates can be expected in Chinese outward FDI flows in the upcoming years as Chinese enterprises rapidly increase their global existence by making overseas investments and China supports them in the ways that a state can by easing processes, creating incentives, etc.\(^{40}\) The One Belt One Road initiative, the

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\(^{39}\) UNCTAD STAT, “FDI Flows and Stocks Data.”

\(^{40}\) Lee, “China’s Start-Ups Usher in New Phase of ‘Going Out’ Movement.”
Asian Infrastructure Investment Bank, the New Development Bank of BRICS, and the Forum on China-Africa Cooperation are indicators of China’s intent to extend its financial footprint all around the world.

China’s Outward FDI in Africa

Outward foreign direct investment data is an indicator of China’s financial footprint in Africa. As discussed above concerning Africa’s role in China’s “going global” policy, China’s outward FDI has been increasing recently.

Figure 2: Greenfield Outward FDI of China and the U.S. into Africa (2004-2017)

A greenfield investment shows what an investor party does in a host country from the

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ground up by constructing new operational facilities. The opposite of this type of investment is brown field investment, where an investor party uses or leases an existing production facility to operate a production activity. Greenfield investments require more expenses compared to brown field investments. It, therefore, indicates a longer term strategic approach of the investor toward the host party.

China’s investments in Africa has increased in the last decade. Comparing it to its rival investor in Africa – the U.S.—China’s interest in long-term investments has increased in the last half decade. Figure 2 compares greenfield outward FDIs of China and the U.S. China has a trend of rapid rise since 2013. While the average greenfield investments have valued around $10 billion for the U.S., China’s greenfield investments exceeded $25 billion in 2017. China surpassed the U.S. only in 2016 and 2017.

Figure 3: Infrastructure Financers of Africa (2015)

Source: Sun, Jayaram, and Kassiri, 2017, “Dance of the Lions and Dragons”, p.20

Infrastructure investments take a large part in greenfield investments. As Figure 3 illustrates, China invested in Africa’s infrastructure far more than other leading infrastructure

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investors in 2015. Its investment in infrastructure sector was $21 billion, seven-fold of the second country’s infrastructure investment. France, Japan, Germany, and India followed China as other top infrastructure investors.

Table 3: Chinese Investment Projects in Sub-Saharan African Countries by Sector and by Year*

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* Blank cell for subsectors indicates “Other” category, which is for investment projects that fit into the main sector but does not fit into any of subsectors.

Source: Compiled by the Author with the Data Drawn from CGIT Dataset

Chinese investments in Sub-Saharan African countries are shown in Table 3 by year and sector. This table clearly shows that China started its investments in Africa by investing in infrastructure-related sectors. The subsector that Chinese companies had the highest number of investments in is the autos subsector of the transport sector, which mostly includes highway building or highway rehabilitation investments. Similarly, the rail subsector of the transport sector has investments in many years. This sector is also easing transportation by investing in railway infrastructure. The total number of investments in shipping and aviation indicates that

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43 Scissors, “China Global Investment Tracker.”
transportation has been one of the most important sectors for China within its African investments.

Energy is another notable sector. In its hydro subsector, China has always had investments after 2007. The number of Chinese investments in this subsector is 54 from 2007 to 2017, which makes this subsector ranked second together with the construction subsector. This subsector mostly consists of hydropower projects, which aims at electrification of Sub-Saharan African countries. A portion of investments in this subsector are about building dams for supplying drinking water. The gas subsector is also mostly about electrification. It consists of many gas-fired power plants. It also includes natural gas pipelines.

Real estate’s construction subsector is another noteworthy subsector with the number of investments it had from 2006 to 2017. In total, Chinese companies invested in 56 investment projects in this subsector. In this subsector, two groups of investment are clustered; cement plant construction and house building. Almost half of investments consist of cement plant construction. Slightly more than half of them include building houses, mostly as large-scale social housing projects.

The utilities sector is also one of the most prominent sectors. It ranks as the fourth mostly invested subsector after investments in transportation and energy’s subsectors. This sector’s investments are mostly electrification (mostly transmission lines) and drinking water supply.44

Be it transportation sector, many subsectors of the energy sector, the construction subsector or utilities subsector, the sector with the highest number of investment projects are generally about expanding the infrastructure capacity of the African countries. The discussion

44 Information regarding the share and detailed content of investments is gathered from author’s detailed analysis of 163 Chinese investment projects in China’s top-five African trading partners—Angola, Ghana, Kenya, Nigeria, and South Africa—which make 33 percent of all investments in Sub-Saharan African countries in terms of the number of investments.
about the importance of the infrastructure sector continues in the following section, which includes a detailed analysis of what China might be aiming at with strengthening Africa’s infrastructure.

Why Does Africa Need China Financially?

It is also important to ask the question “Why do the African nations need China?” The main reason is the economic ties between China and Africa. Bilateral trade between China and Africa was already higher than $200 billion in 2015. It was much higher than Africa’s commerce with the U.S. or the European Union.⁴⁵

African nations have an opportunity by China’s rapprochement to their continent, which they may not get from somewhere else. Although China was mostly associated with investing in countries which have natural resources or valuable minerals in the period of its first investments, it has touched upon the lands of almost all African countries—whether they have natural resources or not. One of the most widely observable investment sectors has been infrastructure. China made infrastructure investments all around the region. These infrastructure investments include transportation infrastructure; such as roads, railways, and ports.

Infrastructure is critical for developing countries. If a country has strong infrastructure, it is then able to have sustainable development in many other areas as it provides a base for other investments. The role of infrastructure in Africa’s economic transformation is critical as well since the continent has a lot of developing countries. Infrastructure helps “facilitate human activity, in particular by lowering the cost of various economic activities and by improving their

⁴⁵ Lee, “China Comes to Djibouti.”
quality” in Africa. Industrialization and agricultural modernization will come with infrastructural development and industrial collaboration of African nations with investor countries.47

Most of African countries are unable to make their own infrastructure investments. “The annual investment that Africa needs to fill the infrastructure gap over the next few years is estimated to be over 100 billion US$$, which cannot be provided with the African countries’ own budgets.48 China can contribute the infrastructure development as an investor known with its infrastructure investments. Its main difference compared to traditional donors (e.g. Western countries) is that it makes large investments with “long pay-back terms that traditional donors are reluctant to provide”49. This is one of the leading reasons why Africa needs China financially.

Africa is at a critical juncture in terms of having opportunity with its demographics. If the African countries can use this dynamic effectively, they can accelerate their development pace in many areas, led by economic development. Its population is expected to grow from one billion to two billions by 2050. The rapid growth in population means a rapid increase in the number of young, working-age people. They are expected to predominate over the older and younger unproductive dependents.50

It depends on governments whether they match their dynamics with China’s interest in the region. If they can use Chinese investments in the right direction, they can have sustainable development.

So, the question –why does Africa need China?—has an obvious answer:

47 Yabin and Xiao, “China’s Infrastructure Development Strategy in Africa.”
49 Sun, “China’s Increasing Interest in Africa.”
50 French, China’s Second Continent, 7.
“[T]he continent’s “rediscovery” by China will mirror the lucky timing of China itself a generation ago, when it began its historic opening. Strong new demand and plentiful investment from this big and hungry new partner will fuel growth and dramatically expand opportunities.”51

As the least developed continent, it can use this unprecedented Chinese rapprochement in favor of providing sustainable development by converting its growth into development. By doing so, African countries can jump to the league of middle-income countries.

**China’s Increasing Military Presence in Africa**

China’s military activities in the African continent have risen in the last two decades. Parallel to its financial relations in the continent, China’s military involvement aimed at providing stability. In this respect, China had military operations other than war in the region. The peacekeeping operations under the UN auspices are the most visible Chinese military footprints in Africa. Arms trade has been another dimension of its existence in the continent. Although the value of arms sold to African countries are low, the number of African countries that buy Chinese arms consist of almost half of the total. It shows that the African countries possess a much larger potential for China’s arms sales in the future.

China started to play a role in global security, mostly under UN auspices, after having a policy of non-intervention for years. Its military footprints in Africa have been in the context of the UN operations. In order to better understand China’s military presence in Africa, this part will first examine China’s global military presence.

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51 French, 7.
China had the second largest military expenditure in 2016, leading Russia and trailing the U.S. Its military expenditures have risen 5.2-fold from 2000 to 2016. In the same interval, the U.S. --the largest military spender of the world- has an upwards trend until 2010 and then has a downwards trend. The increase in the U.S. military expenditure was 1.5-fold between 2000 and 2016. Russia --the third-biggest military spender- has also an upwards trend for all years from 2000 to 2016. Its military spending has risen 3.4-fold in the same interval. Although both China and Russia have larger increase rates, their military spending value is still far less than what the U.S. spends.

Figure 4: Military Expenditures of the U.S., China and Russia between 2000 and 2016

Source: Created by the Author with the Data Drawn from the SIPRI Database

What explains the rise in military expenditures of China is the growth in its GDP. Its

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52 Stockholm International Peace Research Institute, “SIPRI Military Expenditures Database.”
military spending as a percent of GDP has been around 2% from 2000 to 2016, while it is 4% on average for Russia\textsuperscript{54} and 3.8% on average for the U.S.\textsuperscript{55} “[H]igh-profile procurement programs, military reforms, and doctrinal and strategic shifts within the PLA” account for the increase in its military spending.\textsuperscript{56}

China’s rising military spending gives a profile about its engagement with the world militarily. As its military expenditure increases, it will join the league of superpowers like the U.S. and Russia in military cooperation matters. This will also affect its military-related role in African countries.

\textit{Military Modernization Efforts of China}

Since the late 1990s, China aims to modernize and upgrade its military capabilities. A landmark year for the Chinese military can be marked as 1997. As of this year, China’s military spending had a trend of having a double-digit annual growth. Also, in 1997, the Chinese government made a decision that the military would concentrate its core functions –deterrence, compellence, and war-fighting- rather than solely conducting some military-related business operations. The third important decision made that year was to reform state-owned enterprises. This attempt has actually been a starting point for restructuring and upgrading the Chinese defense industry. The fourth important point of military modernization was the People’s Liberation Army’s (PLA) adoption of a new strategic concept of fighting “limited local wars under high-technology conditions”.\textsuperscript{57}

\textsuperscript{54} Russia has an upwards trend, rising from 3.6\% in 2000 to 5.3\% in 2016 in military spending as percent of GDP.
\textsuperscript{55} The U.S. had an upwards trend from 2000 to 2010 and downwards trend later on. It was 2.9\% in 2000, peaked in 2010 with 4.7\% and then decreased to 3.3\% in 2017.
\textsuperscript{56} China Power Team, “What Does China Really Spend on Its Military?”
\textsuperscript{57} Bitzinger, “The China Reader.”
Military equipment acquisitions, R&D activities in defense industry, and training and professionalism of its personnel have been the major fields of modernization in the PLA.\textsuperscript{58} The modernization of the PLA has changed the balance of power in the Asia-Pacific region: “With the exception of the United States, China now has the region’s largest navy and air force, by far the largest ballistic missile arsenal, the largest standing army, and the most sophisticated space-based communication and reconnaissance system”\textsuperscript{59}.

There are several objectives of military modernization: China aims to (1) be a global power eventually by increasing its hard-power capabilities (although it currently does not bring its development of hard-power capabilities in the foreground to be perceived as a country rising peacefully), (2) have an ability of defending and promoting its regional interests such as its interests in the South China Sea, (3) have a pressure on Taiwan militarily in order to keep it away from declaring independence and eventually participating to the mainland (4) become a regional power by mitigating the U.S. military existence in the Asia-Pacific, and (5) increase its capacity for military operations other than war to be able to defend its growing interests in the world.\textsuperscript{60} Parenthesis

The first four objectives are all conflict-related objectives of its military modernization as they reflect somehow its use of hard-power capabilities. However, the latest objective is based on cooperation, which reflects its military’s soft-power dimension. In this respect, it relates to its existence in the African continent. China has participated many peacekeeping operations under the auspices of the UN in Africa in the last two decades.

\textsuperscript{58} Bitzinger.
\textsuperscript{60} Bitzinger, “The China Reader,” 312–13.
China Is the Second Largest Financial Contributor of the UN Peacekeeping Operations

China does not maintain a global military presence in the world and is not expected to maintain one in the near future. Though, it participates in UN peacekeeping operations in some third-world countries and plays an important role in its near abroad as a robust military actor in its region:

China’s global security presence to date is not evolving in the “traditional” great power manner of establishing alliances, acquiring bases and dispatching troops abroad, building global power projection capabilities, sailing its navy around the world, coercing others, or fighting in conflicts directly or via surrogates. Instead, the People’s Republic is expanding its capabilities, but thus far limiting deployments to China’s own sovereign territory, Asian maritime littoral, or under UN-mandated peacekeeping missions in third nations. … At the same time, the regional military posture is becoming more and more robust and will continue to impact the balance of power in Asia.⁶¹

In terms of its military presence in the world, China will, most likely, follow the same trend with the previous decade: it will have a steadily modernizing military with progressively evolving capabilities; it will participate in solving international crises by ways of diplomacy or by using low-cost security precautions; it will be in a dilemma of being reluctant to involve in global governance and expanding its global security footprints via expanding its military in the world.⁶²

China has been traditionally reluctant to intervene in other countries’ internal affairs. UN peacekeeping operations have been an important indicator of this. It previously rejected the idea of peacekeeping completely since the UN peacekeeping operations were manipulated by the great powers from the Beijing’s perspective. The fact that China had been the first target of a

⁶² Shambaugh, 218.
US-led enforcement target authorized by the United Nations in 1951 during the Korean War, initiated China’s opposition. This trend of rejection continued even after China joined the United Nations in 1971. It continued doing so by rejecting to vote in UN peacekeeping operations. Then, it started to warm itself gradually toward the idea of peacekeeping operations as of the 1980s.  

Finally, China publicly recognized its shifted view toward using military force in peace support operations in a UN Security Council meeting in 2004: “in conflict management, the roles of military action and that of the civilian elements are closely interrelated and predicated on one another. There can be no reconstruction without peace and no stability without reconstruction. Military success guarantees the presence of a civilian role, which is an essential and indispensable element in any post-conflict reconstruction.”

Although traditionally reluctant to participate in foreign military operations, China has become one of the major contributors to UN peacekeeping operations. It has been the largest contributor of troops among the permanent members of the UN Security Council and the second-largest financial contributor to UN peacekeeping operations among all members. It started to take a position “in favour of every newly established UN peacekeeping operation since the beginning of the new millennium” by voting for them in the UN and taking roles in these operations. Its contribution has risen to a level that is more than any other permanent members of UN Security Council on average.

There are various arguments for the increasing engagement of China in UN peacekeeping operations. Stähle argues that the change in China’s voting behavior is caused by its

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66 “Scale of Assessments for the Apportionment of the Expenses of United Nations Peacekeeping Operations.”
67 Stähle, “China’s Shifting Attitude Towards United Nations Peacekeeping Operations.”
68 Fung, “China’s Troop Contributions to U.N. Peacekeeping.”
reinterpretation of its previous understanding toward these operations and the change in the nature of UN peacekeeping operations “in such a way that full participation became more acceptable to Beijing.” 69 Fung argues that identity-related concerns are the main driver of Chinese involvement. 70 She states that China claims to be the only UN Security Council permanent member with dual identities; a great power and a Global South state. China’s opportunity of training and modernizing its military through peacekeeping operations,71 having a positive image in the international arena, and benefiting from the UN as a means of exerting global influence can be listed as other arguments for China’s participation on UN peacekeeping operations. 72

China’s contribution to the peacekeeping operations is evaluated positively in terms of personnel quality and integrity. Most Chinese troops that have taken places in the UN peacekeeping operations are deployed in African countries, including Liberia, the Democratic Republic of Congo, Cote d’Ivoire, South Sudan, Darfur region and Mali. 73 The number on deployment in Congo, Liberia, Mali, Sudan and South Sudan has been more than 2000 troops including around 750 in South Sudan as of 2017. 74

In sum, China’s contribution to UN peacekeeping operations benefits China, the UN, and the recipient countries. As African countries are the major beneficiary of China’s involvement in this field, it contributed a lot to the Sino-African relationship.

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70 Fung, “What Explains China’s Deployment to UN Peacekeeping Operations?”
71 Brazil is known to modernize its military by participating in UN peacekeeping operations. See “Policy, Not Altruism: How Global Ambitions Are Helping to Modernise the Army.”
73 “China’s Contribution to Peacekeeping ‘Extremely Important’, Says UN Peacekeeping Chief”; Shambaugh, China Goes Global, 238.
China Increases Its Weapon Sales

While China was the 11th largest arms exporter in 2007, it became the 5th largest arms exporter in 2016 (coming after the U.S., Russia, Germany, and France). It might be expected to surpass Germany and France in the near future, but it is difficult for it to sell more arms than the world’s two leading arms exporters in the short term.

Table 4: The Top 15 Arms Exporters with Their Ranks in 2007 and 2016

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Source: Created by the Author with the Data Drawn from the SIPRI Database

The values of both the U.S. and Russia are far more than what China had in 2016. Given that the two leading arms exporters created their own markets in a very long term in the Middle East, South and East Asia, Latin America, and some other developing countries, China might

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75 “The Top 50 Largest Arms Exporters, 1997-2016.”
have difficulty in entering these markets. On the other hand, its arms sales can be expected to increase in developing countries, where it has strong trade relationships.\textsuperscript{76}

Although having a volatile trend, the African countries are among the top arms buyers. The reason of China selling so much to developing countries in Africa and South Asia is the relative price of Chinese arms. These customers prefer China as its prices are relatively cheap.\textsuperscript{77}

\textbf{Table 5: China's Arms Exports by Countries}

(Values show SIPRI Trend Indicator Values)

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<th>Countries</th>
<th>Annual Average</th>
<th>Trend (2007-2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
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<tr>
<td>Bangladesh</td>
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<td>Algeria</td>
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<td>Venezuela</td>
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<td>Tanzania</td>
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<td>Ghana</td>
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<td>Cambodia</td>
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<td>Sri Lanka</td>
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<td>Zambia</td>
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</tbody>
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\textsuperscript{76} Shambaugh, \textit{China Goes Global}, 241–42.
\textsuperscript{77} Shambaugh, 242.
Countries Annual Average Trend (2007-2016)

<table>
<thead>
<tr>
<th>Country</th>
<th>Average</th>
<th>Trend</th>
</tr>
</thead>
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<tr>
<td>Syria</td>
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<td>Chad</td>
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<td>Kenya</td>
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<td>Bolivia</td>
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<td>Laos</td>
<td>4</td>
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<tr>
<td>Equatorial Guinea</td>
<td>3</td>
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<td>Mauritania</td>
<td>3</td>
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</tbody>
</table>

Source: Created by the Author with the Data Drawn from the SIPRI Database

China is known to sell its arms to countries where some other countries implement arms exporting bans under international embargo or sanction. Iran, Libya and Myanmar have been among its customers in the last decade. Although China does not comply with individual embargos or sanctions of various countries, it respects the UN decisions when the UN bans some countries from acquiring weapons. For example, once Iran was a major buyer of Chinese arms and beneficiary of Chinese military industry’s supports, but China neither supported its industry nor sold arms to Iran after the UN Security Council implemented a resolution on banning arms exports to Iran in 2010. That said, there have been some cases where there were signs that banned countries got support from some Chinese arms trading companies even though China had complied with the UN sanctions according to statements of government officials.

The number of countries that China had arms trade with was 58 between 2007 and 2016. The Sub-Saharan African countries were almost half of all buyers of Chinese arms although their

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78 “Importer/Exporter TIV Tables.”
79 Shambaugh, China Goes Global, 243.
80 In the summer 2011, representatives of the Qaddafi regime went to Beijing and negotiated a $200 million arms package with unnamed Chinese arms trading companies. China denied that there was the knowledge of the Chinese government in this arms trading case. See Shambaugh, 243.
value was lower compared to China’s arms sales to other regions. There were 25 Sub-Saharan African countries that China sold arms to between 2006 and 2017. The number of Sub-Saharan African countries consisted of 43% of the total whereas their average arms trading value consisted of 12% of China’s total arms sales. What these numbers indicate is that China has these countries as its customers. Even though the value of Chinese arms exports to these countries has been low, it has a potential of rising as these countries develop.

*Sino-African Security Cooperation Diplomacy*

Security cooperation started to take place in the Sino-African relations in the last half decade. Accordingly, it started to be discussed widely in the academic literature. In 2012, security cooperation between China and Africa has appeared for the first time in a programmatic document. At the 5th Ministerial Conference of the Forum on China-Africa Cooperation in July 2012, security cooperation took its place among five major cooperation areas. The others were investment and financing, assistance and people’s livelihood, African integration, and people-to-people exchanges.

Security cooperation took its place again in the Chinese Premier’s visit to four African countries in May 2014. It has been one of six major cooperation areas that was stated by the Chinese Premier in his speech, together with industrial cooperation, financial cooperation, poverty reduction, ecological and environmental protection, and cultural and people-to-people exchanges. The Chinese Premier stated that security and cooperation is an important pillar of African development: “Without a peaceful and stable environment, development will be out of

81 “Importer/Exporter TIV Tables.”
82 Alden et al., *China and Africa: Building Peace and Security Cooperation on the Continent.*
the question. China firmly supports Africa in its efforts to resolve African issues in African ways”.  

The Johannesburg Summit of the Forum on China-Africa Cooperation has also declared the importance of security cooperation in its convention in December 2015. The declaration of the summit states that China will support Africa to solve African problems in African ways. It also states that some other security-related measures will also be taken:

“China supports Africa in its efforts to solve African problems through African solutions; Implement the "Initiative on China-Africa Cooperative Partnership for Peace and Security", support the building of the collective security mechanism in Africa, and jointly manage non-traditional security issues and global challenges such as, but not limited to, food security, energy security, cyber security, climate change, biodiversity conservation, major communicable diseases and transnational crimes”.  

**Other Chinese Military Activities in Africa**

Apart from joining UN peacekeeping operations in Africa and stressing the importance of supporting Africa in solving its own security problems in its own ways, China also started to expand its own presence in the region. Its first overseas military base, for example, started its operations in Djibouti in July 2017. This has been a historical landmark for Chinese foreign policy as well because that military base has been the first that China had in a foreign country. Although China states that the base will be used for logistical purposes to support its peacekeeping operations, providing humanitarian aid in Africa and East Asia, some observers see it as a tool for China to expand its global outreach by using military ways.  

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84 Keqiang, “Bring About a Better Future for China-Africa Cooperation.”  
85 “Declaration of the Johannesburg Summit of the Forum on China-Africa Cooperation.”  
86 Connor, “China Sends Troops to Its ‘support Base’ in East Africa.”  
87 Connor.
Conclusion

China increases its military spending accordingly with the increase in its GDP. Despite this increase, China still neither has the capacity to become a military superpower in the world nor does it seem to desire to be in the near future. Contrary to what many expect from China as a rising great power, it does not tend to establish alliances, increase the number of its bases abroad, dispatch troops in other regions, have a navy all around the world, coerce others, or fight with others directly or by using proxies. It expands its military capabilities, but has not used it except its own territories, near abroad, or some UN peacekeeping operations in the third world countries.

Parallel to its defense industry, China increased its arms sales to other countries. There has been a rapid increase in China’s position as the arms exporter; its global rank has risen from 11 in 2007 to 5 in 2016. There were 25 African countries out of total 58 countries, where Chinese arms exports are reached in the last decade. The total value of African arms imports was low, however. Despite their current values, these countries hold a potential growth in their arms imports accordingly with their economic development in the future.

China is increasing its military presence in Africa. Its military presence is not perceived as a sign of being hegemon in the region, rather it protects its investments by providing peace and stability, what works perfectly for both the Chinese government and the African countries. Furthermore, peace and stability in Africa serves all countries that invest in Africa as well as contributing to global peace, security, and stability.

How Do the Africans Perceive China?

Some argue that China is associated with negative images in Africa, being accused of
focusing solely on resources\(^8\), making cheap-labor and low-quality investments\(^9\), not employing local people\(^9\), harming local industries\(^1\), smuggling ivory\(^2\), disobeying local rules and regulations\(^3\), and bribing\(^4\). Even the Nigerian Central Bank Governor criticized China publicly in an op-ed in the Financial Times, alleging that it sells consumer goods—which are supposed to be produced in local markets—in return of buying Nigerian crude oil. He added that Chinese infrastructure projects are built by Chinese labor using the equipment brought from home, which prevents local development and skills transfer to Africa.\(^5\)

China had a negative image in other regions of the world, as well. In order to change its perception in other countries, it has spent a significant amount of money and effort. The concept of “soft power” is widely discussed among Chinese academics and applied well by politicians. As the title of an Economist article successfully illustrates, “China is spending billions to make the world love it”\(^6\). The ways China uses to influence others are opening Confucius Institutes, making some elements of Chinese culture dominant in foreign cultures (for example, China aims at making Chinese New Year as popular as Christmas), convincing other countries that China’s rise will be peaceful, investing in its foreign-language media, encouraging private companies to acquire well-operating systems that may work for promoting good image (Alibaba—the biggest Chinese e-commerce company—bought a newspaper in Hong Kong that was critical of China,

\(^8\) Kuo, “Why Almost a Third of Overseas Chinese Investments Fail.”
\(^1\) Esposito and Tse, “China’s Growing Footprint in Africa Is Potentially Damaging.”
\(^3\) Kaiman, “China-Africa Relations Hurt by Bad Chinese Behaviour, Says Ambassador.”
\(^4\) Esposito and Tse, “China’s Growing Footprint in Africa Is Potentially Damaging.”
\(^5\) Kuo, “Why Almost a Third of Overseas Chinese Investments Fail.”
\(^6\) Sanusi, “Africa Must Get Real about Chinese Ties.”
\(^6\) The Economist, “China Is Spending Billions to Make the World Love It.”
for example. Also, the richest Chinese man aims at buying Hollywood film studios and production companies.), and advertising itself in some large places (it used, for example, billboards of the Time Square many times to advertise itself).97

Although its image is described as negative in some media outlets and op-eds, the African people perceive China to be one of the best countries. It ranked the second both as a development model for African countries and as greatest external influence in Round 6 surveys of Afrobarometer.98 The survey has been conducted in 2014 and 2015 by interviewing 54,000 people from 36 African countries99—that represents more than three fourth of the continent’s population—in the language that they prefer.

China has been ranked the second in terms of the most popular development model for national development of African nations. The respondents were asked “In your opinion, which of the following countries, if any, would be the best model for the future development of our country: United States? China? [Former colonial power]? India? South Africa? Another country?”100 China has been cited by 24 percent of the respondents. It came after the U.S., which is preferred to be the most popular development model by 30 percent of the respondents. The third choice was the former colonial power, which was preferred by 13 percent. South Africa has been ranked the fourth after the former colonial power, cited by 11 percent of the respondents.101 Compared to the U.S., China has been ranked the first (35 percent vs 24 percent) in Central African countries (Cameroon, Gabon, São Tomé and Príncipe), and was equal to the

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97 The Economist.
99 The countries are Algeria, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Côte d’Ivoire, Egypt, Gabon, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, São Tomé and Príncipe, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.
101 Afrobarometer, 3–7.
U.S. (24 percent) in North African countries (Algeria, Egypt, Morocco, Sudan, Tunisia). It was just one percent lower (23 percent vs 24 percent) in Southern African nations (Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe).

The greatest external influence is another important dimension that the Afrobarometer Round 6 survey measures. The same respondents from the same countries are asked “Which of the following do you think has the most influence in your country, or haven’t you heard enough to say? United States? China? [Former colonial power]? India? South Africa? International organisations like the United Nations or the World Bank?”  China has perceived to have the second greatest external influence. Different than the “best model for national development” question, former colonial powers ranked the first –before China—and the U.S. ranked the third—after China—. The percentages of former colonial powers, China and the U.S. are 28%, 23% and 22%, respectively. The fourth and fifth greatest external influences are perceived to come from South Africa and international organizations, both cited by 6% of the respondents. The countries that see former colonial powers as the greatest external influence are mostly French colonies. The top 14 countries that cite the former colonial powers are all former French colonies. Former British colonies mostly cite the U.S. or China as the greatest external influence.103

Some China-specific questions show perception of China’s performance alone in African countries. For example, the vast majority of respondents think that China’s economic activities had a lot influence in their countries. They are asked “How much influence do you think China’s economic activities in your country have on your economy, or haven’t you heard enough to

102 Afrobarometer, 8.
103 Afrobarometer, 7–12.
say?”. On average, 69% of respondents from 36 African countries found China’s economic activities to have a lot influence in their countries. However, the percentage decreases to 56% on average when it comes to the question “In your opinion, does China’s economic development assistance to your country do a good job or a bad job of meeting the country’s needs, or haven’t you heard enough to say?” On average, 56% of respondents think that China’s economic development assistance do somewhat/very good job, 19% think it does somewhat/very bad job and 8% think that it does neither good nor bad job.

A question is asked about factors that influence China’s image positively or negatively. This question is important to understand a detailed view of China’s perception in African countries. Factors that contribute to both China’s positive or negative image are mostly economic factors.

**Table 6: Factors Contributing Most to Positive and Negative Images of China**

<table>
<thead>
<tr>
<th>Factors for Positive Image</th>
<th>Factors for Negative Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. China’s investment in infrastructure</td>
<td>32% Quality of Chinese products</td>
</tr>
<tr>
<td>or other development</td>
<td></td>
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<tr>
<td>2. Cost of Chinese products</td>
<td>23% Taking jobs or business from locals</td>
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<td>3. China’s business investment</td>
<td>16% China’s extraction of resources from</td>
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<td></td>
<td>Africa</td>
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<td>4. China’s support for the country in</td>
<td>6% Land grabbing by Chinese individuals or</td>
</tr>
<tr>
<td>international affairs</td>
<td>businesses</td>
</tr>
<tr>
<td>5. Non-interference in the internal</td>
<td>5% Behavior of Chinese citizens in the</td>
</tr>
<tr>
<td>affairs of African countries</td>
<td>country</td>
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</tbody>
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104 Afrobarometer, 13.
105 Afrobarometer, 17.
106 Afrobarometer, 17.
<table>
<thead>
<tr>
<th>Factors for Positive Image</th>
<th>Factors for Negative Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Appreciation of the Chinese people, culture, and language</td>
<td>2% China’s willingness to cooperate with undemocratic rulers</td>
</tr>
</tbody>
</table>

Source: Afrobarometer Round 6 Surveys\textsuperscript{107}

All of the factors that contribute to a negative image of China in these 36 African countries are almost the same factors that were cited from news pieces in the beginning of this part. Although many news pieces talk about negative part of Chinese image in Africa, African people perceive China to be more beneficial rather than harming their countries.

In conclusion, contrary to hard criticisms in news pieces, China is not perceived to be a bad actor in the African continent. Africans perceive China to be the second-best national development model for their countries. A vast majority of them, 63%, consider China to be a somewhat or positive influence for their countries.

**Popular Myths in the Sino-African Relations**

The relationship between China and Africa is associated with many unrealistic claims. They are mostly caused by lack of transparency in this relationship. Neither China nor African countries provide enough information or data for the public to help better understand some aspects of the relationship.

Some myths circulate even within African people. Some are worries of people while some reflects partial truth. For example, the African people think that China sends its prisoners to work in Chinese projects in Africa. They especially think that they work in large infrastructure

\textsuperscript{107} Afrobarometer, 19–23.
projects. This section shows that this is how people assume these workers to be although the situation is not like how they assume.

This section clarifies four myths: China is in Africa only for natural resources, China does not employ local people, China is Africa’s largest investor/donor, and China sends prisoners to work in Chinese projects in Africa. It delves into the issue areas that these myths entail.

**Myth 1: China is in Africa Only for Natural Resources**

It is true that China seeks new resources for its growing energy demand. And it is true that China has an interest in Africa’s natural resources. But its natural resources hunt does not explain the whole story. There are other important reasons as well, that explain China’s existence in the region. Some other incentives that draw China into the region are the rising level of bilateral trade, investment opportunities of Africa and Africa’s place as a testing ground for China in its first experiences in going global policy.

The figure of share of China’s investments is an indication of the reality. Figure 5 shows the number of Chinese investment projects in Africa between 1998 and 2012. There were only 45 mining projects while the number of agricultural, manufacturing and service projects were much higher than mining projects.

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Figure 5: Number of Chinese Investment Projects in Africa by Sector (1998-2012)

Service sector has the highest number of investment projects. There have been 2,771 service sector investments in Africa by Chinese companies. The total of agricultural and manufacturing project numbers is 1,173, less than half of the number of investment projects in service sector.

Source: Created by the Author with the Data Drawn From Chen, Dollar and Tang, 2016, “Why is China Investing in Africa”, p.15

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The latest available data on Chinese investment and contracts is illustrated in Figure 6. It shows that the share of the energy sector’s investment value has not been high within its total investment value. The last five year’s data indicate that China’s interest in the energy sector was not very large except in 2013. It has always been less than one-third with one exception. The latest available annual data belongs to 2016. In this year, the percentage of the energy sector was around a quarter of total Chinese investment and contract values.

Both the number of investment projects by sector and investment values from 2005 to 2017 indicate that China’s existence in Africa cannot be explained solely by a resource hunt. Investing in service, agricultural and manufacturing sectors shows that Chinese companies have financial motivations to invest in Africa.

Source: The Economist, 2017, “China Goes to Africa”

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110 The Economist, “China Goes to Africa.”
This claim—that center around the view that China is in Africa for its natural resources—is also associated with Marxist discourses. Neo-colonialism is, for example, one of the leading Marxist discourses used for the relationship.\textsuperscript{111} China is sensitive about neocolonialism claims. Some Chinese media sources, that reflect the official opinion, try hard to refute it.\textsuperscript{112} Also, Chinese officials declared that “China will not take the path of Western colonists in Africa”.\textsuperscript{113}

The key question to determine whether a relationship is based on neocolonialist bases is whether former colonial powers or developed countries “block growth in developing countries and retain them as sources of cheap raw materials and cheap labour”.\textsuperscript{114} In this relationship, China does not block growth in African countries, does not use cheap labor for its own benefit but uses the continent’s raw materials to some extent. Chinese investments include many infrastructure investments, which indicates that China aims at having sustainable development in countries where it invests. Second, it has abundant cheap labor at home, which shows that it does not need cheap African labor. As the answer of this question’s third dimension; China does use Africa’s raw materials. A majority of African exports to China consists of raw natural resources. Hence, it can be concluded that China’s rapprochement toward African countries is not a new version of colonialism. It is, rather, a collaboration between the two parties.

\textit{Myth 2: China Does Not Employ Local People}

China is mostly blamed for bringing its own workforce from China rather than employing

\begin{itemize}
  \item \textsuperscript{112} Grammaticas, “Chinese Colonialism?”
  \item \textsuperscript{113} “China Will Not Take Path of ‘Western Colonists’ in Africa -Foreign Minister.”
  \item \textsuperscript{114} Halperin, “Neocolonialism.”
\end{itemize}
local Africans. Even some political leaders think that this myth is true. US President Barack Obama advised African leaders “to make sure that if, in fact, China is putting in roads and bridges, number one, that they’re hiring African workers”.116

This claim has an important point, indicating China does not care about the local development in countries, where it invests or incentivizes Chinese companies to invest. It has a partial truth. The claim is true for workers at the managerial level, but not accurate for the overall number of workers that work at Chinese investment projects. According to a report, which was conducted in eight African countries (Angola, Ethiopia, Côte d’Ivoire, Kenya, Nigeria, Tanzania, South Africa, and Zambia) that make up almost two-thirds of African GDP at more than 1,000 Chinese firms in Africa, Chinese companies prefer Chinese workers for managerial positions. African people, however, occupy far more places than Chinese employees when it comes to the overall number of workers in Chinese investments.117 The reason for employing locals is the lower cost of these employees. “Although China rose to global manufacturing prominence on a large, low-cost labor pool, its payroll costs have been rising and its labor is becoming less price competitive with Africa”118. Also, most recent contracts of Chinese investment projects in Africa include large quotas for local workers and training programs.119

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115 Esposito and Tse, “China’s Growing Footprint in Africa Is Potentially Damaging.”
116 Micklethwait and Carr, “The President on Dealing with China.”
117 Sun, Jayaram, and Kassiri, “Dance of the Lions and Dragons.”
118 Sun, Jayaram, and Kassiri, 40.
119 Hruby, “Five Popular Myths the China-Africa Summit Should Help Dispel.”
Figure 7: Percentages of African Workers in Chinese Investments in Africa

As Figure 7 indicates, 89 percent of employees in Chinese investments in Africa is local people. Private companies tend to employ more African people, while state-owned enterprises prefer less locals. By sector, manufacturing has the largest share of local employees. In the manufacturing sector, 95 out of 100 employees are African people. The construction, real estate and service sectors prefer slightly less local employees compared to the manufacturing sector. In these sectors, 85 out of 100 workers employed are locals. The trade sector has the smallest share of African people with 82 percent.


Figure 8: Percentages of African Workers in Chinese Investments in Africa at the Managerial Level

At managerial positions, Chinese companies tend to employ less locals. On average, 44 percent of managers are from African countries. Shares of managerial-level employees have the same trend with overall local employee percentages by investment ownership and by sector. Private companies prefer employing more local people at managerial positions compared to state-owned investor enterprises. While private investors prefer 47 local managers out of 100 managers, state-owned enterprises employ 35 local managers out of 100 managers.

China also employs local people for training them in some expertise areas. An example to this is a state-owned company, that operates in Kenya and is among the major construction contractors and heavy machinery providers of that country. This company made major investments in order to train Kenyan people. In this example, the skills-transfer program has


Source: Sun and Lin, “Creating a Market for Skills Transfer.”
both social and business concerns because the company wants to train people that use its
machineries in how to use them.

**Figure 9: Percentages of Training Programs Offered by Chinese Companies in Africa to Their Employees**

![Bar chart showing training programs offered by Chinese firms](image)

**Source:** Sun, Jayaram, and Kassiri, 2017, “Dance of the Lions and Dragons”, p.41

Overall numbers indicate that Chinese companies train local employees. In total, two-thirds (64 percent) of them train their employees. One-fifth (21 percent) of Chinese companies provide professional training and/or apprenticeship to their employees. Almost half (43 percent) of them provide only apprenticeship for training their employees. Slightly more than one-third (36 percent) of Chinese companies provide no training for their employees.

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124 Sun, Jayaram, and Kassiri, 41.
Myth 3: China is Africa’s Largest Investor/Donor

China’s financial position in the continent is often misunderstood. It is true that Africa’s largest trade partner is China. But it is not true to say that China is Africa’s largest investor or the largest donor.

**Figure 10: China's Financial Position in Africa**

![Diagram showing China's financial position in Africa compared to other countries.](image)

**Source:** Sun, Jayaram, and Kassiri, 2017, “Dance of the Lions and Dragons”, p.20

As Figure 10 presents, China is the largest trading partner of Africa, with a trade volume of $188 billion. It is more than three times India’s trade volume, the second trading partner of...
Africa. The gap between the remaining four countries in Africa’s top five trading partners list is not as wide as the gap between China and India. India ranks the second with $59 billion and followed by France, the United States, and Germany with $57 billion, $53 billion, and $46 billion, respectively.

In terms of investments in Africa, China does not have as much investment as how it is perceived. Among countries that sunk money in African investments, China ranks the fourth, coming after the United States, United Kingdom and France. South Africa is the fifth largest investor, comes after China. China’s investment amount is less than half of each of the U.S., U.K. and France. China sunk into African investments $32 billion, while the top three countries invested $79 billion, $71 billion, and $70 billion, respectively. Also, Chart 1 showed on page 25, China’s position as an outward foreign direct investor in the world by comparing it to the United States, the top investor in the world. Although China has a higher growth rate in outward FDI stocks, Chart 1 showed that its outward FDI value is much lower than the value of the United States.

However, China comes first if countries are listed in terms of FDI growth rate. Between 2010 and 2014, growth in China’s outward FDI toward Africa has been higher than any other country that invested into the region. China’s FDI growth rate was almost twice South Africa’s FDI growth rate, which comes second after China. The top two FDI investors in Africa—the U.S. and U.K.—had a growth rate of 10 percent and 11 percent, respectively, while China had 25 percent.

It is also not true to say that China is the largest donor of Africa. China’s aid is unconditional and it has non-interference policy toward the countries which it donates aid to. This differs China from other leading donor countries, like the U.S., U.K., France, and Germany.
The misunderstanding arises from this point. Providing unconditional aid does not make China the leading donor in Africa. It ranks third among top donors of Africa with $6 billion aid. The U.S. is the top donor with $10 billion, followed by United Arab Emirates with $7 billion aid. The United Kingdom and Germany rank as the fourth and fifth donors with $6 billion and $4 billion aid, trailing after China.

To sum up, China is neither the largest outward foreign direct investor nor the largest donor of Africa even though it has the largest volume of bilateral trade and highest growth rate of FDI.

**Myth 4: China Sends Prisoners to Work in Chinese Projects in Africa**

Before reemerging in the 2010s, this myth first appeared two decades ago, in 1991. Roberto Cohen, then a trustee of the International League for Human Rights wrote in the New York Times’ op-ed section that “[t]he Chinese not only export goods made by prison labor, but they export prison workers too”.126 She claimed that each year thousands of Chinese workers are sent to Africa and other third-world countries to work in construction and some other infrastructure investment projects. The Chinese embassy in Washington, D.C. refuted this claim in the same newspaper.127 The press counselor of the Chinese embassy said that her claims were based on hearsay and not true.

In the beginning of the 2010s, the same claims have appeared in various newspapers, reiterating the claims that Chinese companies employ prisoners in their overseas investments.

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126 Cohen, “China Has Used Prison Labor in Africa.”
127 Guoqing, “China Doesn’t Use Prison Labor in Africa.”
including African countries.\textsuperscript{128} Most of these stories originated from the same author in op-ed pieces in various newspapers. The author does not back his claims by concrete evidences, sources, or specifics. According to a friend of his, he is known to be an ultranationalist, living in New Delhi, India. His friend said: “He is a bit of an ultranationalist ... I read this story. I don't believe it. Brahma tends to fly off the deep end sometimes while he is China bashing...”, quoted in a blog post.\textsuperscript{129}

As for the case after allegations of employing Chinese convicts in 1991, Chinese officials publicly refuted these claims in 2010 too.\textsuperscript{130} They argued that the allegations of the author are “unfounded and totally untrue”.\textsuperscript{131}

Claims of employing Chinese convicts in Chinese investments in Africa might be arising from local people’s assumptions. Locals assume that “the highly disciplined Chinese workers in identical boiler suits they see toiling day and night must be doing so under duress”.\textsuperscript{132} Their living conditions look like they are living in a prison. They live in extremely basic conditions in compounds. The construction sites are also surrounded by fences, which is to secure the construction site, not to keep workers locked in a zone.\textsuperscript{133} Dr. Deborah Brautigam, a Sino-African relationship expert, thinks that China is highly unlikely to export prisoner workers to the African construction sites as a government policy. She adds that there might be some exceptional situations, in which a contractor might bring a small number of prison workers to Africa by bribing the local prison officials in China. According to her, “exporting large contingents of

\textsuperscript{128} Chellaney, “China’s Newest Export”; Chellaney, “China Now Exports Its Convicts”; Chellaney, “CHELLANEY: China’s Latest Export Innovation?”
\textsuperscript{129} Brautigam, “Is China Sending Prisoners to Work Overseas?”
\textsuperscript{130} 赵晨雁, “Commerce Ministry Denies China Exports Prison Labor”; Chellaney, “China’s Newest Export.”
\textsuperscript{131} Chellaney, “China’s Newest Export.”
\textsuperscript{132} “Trying to Pull Together.”
\textsuperscript{133} Brautigam, “Is China Sending Prisoners to Work Overseas?”
prison labor as official policy would be politically very risky. If it has happened, it is almost certainly uncommon and ad hoc.” ¹³⁴ Dr. Aubrey Hruby, another Sino-African relations expert, agree with Dr. Brautigam: “those early stories of the Chinese bringing prison labor to build different projects, I don’t think any of that is true these days. Almost all of the projects that I have seen firsthand and know about may have Chinese foremen on the job, but they certainly have local workers building things. So it’s not a case of all Chinese labor”. ¹³⁵

Conclusion

This chapter presented the background of China’s existence in the African continent. It analyzed the bilateral relationship in two aspects as financial and military relationships. China’s financial outreach to the African continent is directed by its “going global” strategy. The origins of this strategy go back to the beginning of the 1990s. It simply aims at incentivizing Chinese companies to operate in foreign countries. Africa has been one of regions that Chinese companies focus on. The region has mostly been a testing ground for companies that start operating in foreign countries.

The “One Belt, One Road” strategy has been an important strategy of China’s global financial outreach. It includes 65 countries that are responsible for 55 percent of the world’s GNP, 70 percent of the global population and 75 percent of the proven energy reserves. African countries, however, are not included in the first draft of the “One Belt, One Road” project. Infrastructure may be a leading reason for exclusion of the region; its infrastructure is not at a level that will ease financial relationship. Excluding one region does not necessarily mean that it

¹³⁴ Brautigam.
¹³⁵ The Cipher Brief, “Dispelling Myths About Chinese Investment in Africa.”
will be out of this strategy in its future versions. Africa may take its place in China’s “One Belt, One Road” strategy in the future.

The military relationship between China and Africa goes hand in hand with bilateral financial relationship. In a sense, China’s military existence backs its financial existence by aiming at providing stability in the continent. For instance, China does not take side with a conflicting party. It, rather, aims at alleviating conflicts. In this respect, China contributes in UN peacekeeping operations in Africa. Its contribution to these operations has risen recently.

Another important aspect of military relationships is China’s arms sales to African countries. Although the value of arms sold is not very high yet, the sales are expected to increase as Africa’s demand increases as a result of its economic expansion.

Many news pieces have hard criticisms for China’s involvement. The question of “how do the Africans perceive Chinese existence in Africa?” is widely discussed in Sino-African relations due to these hard criticisms. China is not perceived to be a bad actor by African people despite its negative coverage in the media. China is seen by the African people as the second-best national development model for their countries. Almost two-thirds of the Africans consider China to be a somewhat or positive influence for their countries.

Negative media coverage leads also to myths about the Sino-African relations. A section in this chapter lists four of the most popular myths in the bilateral relationship and refutes them by giving the truths. These myths include that China is in Africa only for natural resources, China does not employ local people in its investments in Africa, China is the largest investor and donor of Africa, and China sends prisoners to work in Chinese investment projects in African countries. The section about these myths refutes these four popular myths by analyzing truths regarding them: (1) Natural resources are not the only motivation of Chinese existence in Africa,
there are other reasons as well, (2) the overall share of local workers in Chinese investments in Africa is 89 percent, though it is lower at managerial positions with 44 percent, (3) although China is the largest trading partner and infrastructure financer of Africa, and the growth rate of its FDI in Africa was higher than other countries between 2010 and 2014, it was the fourth largest country in terms of FDI stocks and the third in terms of aid.

This chapter shows that the relationship between China and Africa is more than interconnectedness. There is asymmetrical interdependence between the two parties.\textsuperscript{136} Although natural resources are not the only reason for Chinese existence in Africa, the supply of resources is critical for China, which is getting thirstier for natural resources as its economy grows. Also, Africa is an important region for Chinese investments. There is a wide gap for investments in Africa until it comes to its saturation level. African countries’ need for investment drove many investor countries to the continent. Africa is seen by Chinese investors as a testing ground. Many Chinese investors start their overseas operations in Africa before outreach to other countries. Some Chinese investments are linked to its thirst for natural resources. These investments and some other investments like infrastructure investments link China to the continent as they are difficult to transfer, move or use for other purposes.

The next chapter will examine different perspectives that may help to understand the structure of the Sino-African relations. It also includes a preliminary index design for calculating vulnerability interdependence by analyzing five concepts that are considered to be useful for understanding a country’s vulnerability against another country.

\textsuperscript{136} Interconnectedness and asymmetrical interdependence is defined in the following chapter. Simply defined, interconnectedness is the relationship between any two parties whose interactions do not have costly effects for the parties. If there is costly effects, then this relationship is defined as interdependence. Asymmetrical interdependence indicates a bilateral relationship where one party is more interdependent to the second one.
CHAPTER III
THEORY OF VULNERABILITY INTERDEPENDENCE

Many international relations theories intrinsically argue that interstate politics have been the arena for exercising power of one state over other(s). Even though they argue about the same dependent variable, their independent variable varies. They agree that states exercise their power over others but argue different reasons as its causes. Among them, Keohane and Nye’s asymmetrical interdependence theory has been one of the most well-regarded theories in this arena. Their theory simply argues that asymmetrical interdependencies are sources of power among actors: “Power comes not simply out of the barrel of gun, but from asymmetries in vulnerability interdependence.”

The origins of Keohane and Nye’s theory can be traced back to Albert Hirschman’s work on the effect of foreign trade on exercising power. In his own words, the object of his study is “the politics of foreign trade, the possibility of using trade as a means of political pressure and leverage”. He argues that there is a relationship between foreign policy and economics. According to Hirschman, foreign trade has two main effects upon the power position of a country. The first one, he calls, the supply effect of foreign trade, which is mainly enhancing the potential military force of a country by using trade. The supply effect is not a direct effect of foreign trade on power. It may affect the power position of a country by providing more of plentiful goods or increasing the amount of goods wanted more by replacing them with the goods wanted less, for example. The second effect is the influence effect of foreign trade. Different than the first one, this is a direct effect of foreign trade on power. He uses an

1 Keohane and Nye, Power and Interdependence, xxxii.
2 Hirschman, National Power and the Structure of Foreign Trade.
3 Hirschman, V.
4 Hirschman, 14–18.
example with a few countries to illustrate this effect; country A that trades with countries B, C, D, etc. and country A has a much larger share in other countries’ foreign trade. In this case, countries B, C, D, etc. would grant country A some advantages –military, political, economic- in order to keep the same level of trade with country A. This effect has an assumption that countries B, C, D, etc. cannot get supplied goods from each other or any other third country and country A is free to sell its good to whatever country it desires.

Wagner makes a good point about the essence of Hirschman’s analysis by comparing it to the theory of international trade:

Hirschman’s analysis is based mainly on reversing the story illustrating the gains from trade in standard accounts of the theory of international trade. Instead of discussing the effects of two formerly autarkic countries’ opening up trade with each other, Hirschman asks the reader to consider countries already engaged in trade that are suddenly faced with the necessity of doing without it. Then the gains from trade in the standard account become the losses resulting from the interruption of trade. Since both gain from trade, both suffer losses; what Hirschman adds to the classical theory of international trade is the commonsense notion that if they do not value the gains from trade equally, then the one that values them more will be in a weak bargaining position.5

More simply, Hirschman’s point argues the interruption of trade matters more for one side due to asymmetrical dependence6 on this trade relationship. He adds that “[t]he greater the percentage of exports and imports involved in a dominant market, the more difficult it will be to provide substitute markets and source of supply”.7

Wagner argues that Hirschman’s argument is not successful in explaining exercising political influence of one actor over another. In other words, it is not good at explaining

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6 Although asymmetrical interdependence is associated with Hirschman’s study, his book’s first edition, published in 1945, does not have the concept with this name. In the second edition of the book, he starts to use it in his book’s newly added preface section, which was reproduced from a 1978 article of him.
7 Hirschman, National Power and the Structure of Foreign Trade, 29.
exploitation in bilateral trade. He applies modern bargaining theory as he thinks that the case of exercising economic power is about bargaining. In bilateral trade relations, if one side still has unexploited bargaining power\(^8\) after they bargained for the trade of something, then this country uses it to gain political leverage from the counter party. In his very simplified example, Wagner assumes that OPEC consists only of Arab states, the U.S. produces no domestic oil, and there is no other supplier for the U.S. other than OPEC members. In this illustration, the members of OPEC have the opportunity of using unexploited bargaining power in their oil trade with the U.S. in exchange for a political concession. This has been the case in the 1970s, when Arab OPEC members implemented sanctions by reducing oil supply to Western powers in order to reduce the level of their support towards Israel.

In Wagner’s argumentation, the “unexploited bargaining power” concept is important. According to him, modern bargaining theory, rather than the theory of asymmetrical interdependence, explains this relationship as it is based on using “unexploited” bargaining power in an interstate trade relationship.

Hirschman and Wagner think about the same basic trade relationship and how it enhances power of states. Hirschman considers every traded good equal and only focuses on the volume of foreign trade, not what the traded good is. An important distinction of Wagner is that his approach also covers the type of traded good. The traded good itself may put the supplier country in a more powerful position. Exporting potatoes and fossil fuels do not create the same power position for a supplier country. Fossil fuels—as they have the problem of fewness—puts the supplier in a better bargaining position, which it can use as a leverage against the counter trading

\(^8\) According to Wagner, unexploited bargaining power means that there might be some bargaining power of an actor left after bargaining for exchange of something (e.g. trade). If there is still some gap in this bargain that one side may use to exploit something more, it means that there is still “unexploited bargaining power” of an actor in this relationship.
party. Considering the year Hirschman’s book was first published, it is normal that his approach did not catch this point about the type of traded commodity. Goods that have problem of fewness did not have a large share in international trade in these years. Their power was widely understood after the 1970s when the Arab members of OPEC used their oil supplies as a tool to get political concessions from the Western countries. Wagner’s article was published in 1988, which is more than a decade after the OPEC oil crisis.

In the second edition of his book in 1980, Hirschman acknowledges that there are some changes in the international economics system. Foreign aid, for example, started to take a larger role. Hirschman’s approach does not catch this type of transaction that may create power for one country, with which this country can get some political concessions. Wagner’s approach, however, can also cover it since foreign aid may create bargaining power. If this bargaining power is unexploited, it can be used by donor country as a tool of power at some point.

Keohane and Nye matured the concept of asymmetrical interdependence in their book, *Power and Interdependence*, which is mostly associated with complex interdependence theory. Their definition of asymmetrical interdependence integrates the realist and liberal traditions of international relations theory. They consider “asymmetrical interdependencies as sources of power among actors”, which brings together the essence of realist thought and the essence of liberal thought: power and interdependence.

Keohane and Nye answer two major questions about how world politics evolved: (1) “What are the major features of world politics when interdependence, particularly, economic interdependence is extensive?” and (2) “How and why do international regimes change?” They

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9 Keohane and Nye, *Power and Interdependence*.
10 Keohane and Nye, 15.
11 Keohane and Nye, 5.
use the concept of asymmetrical interdependence in order to provide an explanation for these questions. As aforementioned, they consider asymmetrical interdependencies as sources of power among actors. This approach extends the extent of power concept beyond its classical borders, which was mostly considered to be solely military power when they put forward this approach in 1977. According to this definition, power includes economic power as well. They agree on that asymmetries in military power is still more significant than economic means in world politics: “Military power dominates economic power in the sense that economic means alone are likely to be ineffective against the serious use of military force”.12 However, they argue that the rising cost of military power usage makes it less effective compared to getting the desired outcomes by using economic means.13

In the context of Keohane and Nye’s thinking, asymmetrical interdependences are means of exercising power. Their study, however, mostly describes and discusses complex interdependence, which they argue to be the ideal status of international relations. To better understand what asymmetrical interdependence is, one should first understand the characteristics of complex interdependence because (1) they build their theory on the main assumptions of the realist school14 and the core of realist thinking is power and (2) complex interdependence describes how the international relations are in their arguments in general and asymmetrical interdependence is one of their arguments. Complex interdependence challenges three main assumptions of realism, which can be listed as: (1) states are the main actors in international

12 Keohane and Nye, 16.
13 Keohane and Nye, 17.
14 They take three main assumptions of realism and challenge them by replacing the actors and means in these assumptions. They think, for example, that power is at the core of international system but do not consider it solely as military power. Although they challenge realism, they think sometimes it is more useful to understand international events. According to them, realism and complex interdependence are two extremes, which international events fall within. See Keohane and Nye, 20.
relations, (2) there is a hierarchy in international relations, and (3) military power is an effective instrument of policy.

Three main characteristics of complex interdependence are:

1. Multiple channels connect societies, varying from formal state-to-state relations to informal ties among non-governmental elites. The actors in international relations can be states, transgovernmental actors, and transnational actors. This assumption simply challenges the first realist assumption, which consider states as the fundamental actors.

2. There is no hierarchy in international relations due to the presence of multiple issues in the agenda. Domestic politics are not distinct from foreign politics and therefore several government departments at different levels (not just foreign departments) might have relations in the international level. This assumption challenges the notion that there is hierarchy in international relations and that military power dominates the agenda.

3. Military force may not always be an effective instrument of politics. For example, economic and ecological welfare goals cannot be accomplished by using military force. Instead, states should cooperate to achieve this type of goal. Keohane and Nye do not fully reject the necessity of using military force. They use examples where complex interdependence is unable to explain the case. As indicated in the previous footnote, they see realism and complex interdependence as two extremes, which international events fall within. The necessity of using military force depends on where an international event fall within this scale.\footnote{Keohane and Nye, 20–21.}
Asymmetrical interdependence is the source of power in the theory of complex interdependence. Considering it within the main characteristics of complex interdependence, this power can arise among any actors including transgovernmental organizations, elites, transnational actors, and states. Second, it may arise due to the relations at different levels. These different levels may be intra-state or inter-states. For example, two ministries of economy may be source of power due to the complex interdependence among these two agencies. Last, the power arisen in an asymmetrical interdependent relationship may be used as an instrument in the international arena. This power is mostly considered as economic power. The use of this power may be exercised by using it as a bargaining tool: “Less dependent actors can often use the independent relationship as a source of power in bargaining over an issue and perhaps to affect other issues.”

Sensitivity interdependence and vulnerability interdependence are two dimensions of interdependence, Keohane and Nye distinguish to understand the role of power in interdependence. The following part will define and discuss these two dimensions and elaborate more on vulnerability interdependence, which this study focuses on. Then, some concepts, which aim to measure the level of vulnerability interdependence will be introduced. A literature review on these concepts will follow it.

**Sensitivity Interdependence and Vulnerability Interdependence**

In order to understand vulnerability interdependence, one should first understand sensitivity interdependence because vulnerability is one step further from sensitivity and sensitivity is further from interconnectedness. The level that a country is affected by a change of

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16 Keohane and Nye, 9.
a counter party is defined as sensitivity interdependence. It is a measure of effects of costly changes by a country toward another one: “how quickly do changes in one country bring costly changes in another, and how great are the costly effects?”17 It can be thought as a momentarily shock that a country has in case of disruption of a constantly continuing process.

Interdependence is more than interconnectedness. In their definition of interdependence, Keohane and Nye warn that it “is not the same thing as mere interconnectedness”18 and define interdependence “in terms of reciprocal costly effects”19 with declaring that “where interactions do not have significant costly effects, there is simply interconnectedness”20. Examples of interconnectedness can be the spread of internet in the 1990s and the first decade of the 2000s or the increase in the number of airports and airplanes. People, and therefore countries, are connected to each other more than before with the rise of globalism. There is no significant costly effect in these examples. Hence, they are merely interconnectedness.

Carbon dioxide emissions provide an example of interdependence. Any country may emit carbon dioxide to the atmosphere. Since one country’s emissions cause significant costly effects on other countries’ atmosphere –although the emitting country does not direct its carbon dioxide to a particular country- this is more than interconnectedness and an example of interdependence. This is an example of environmental sensitivity. A sensitivity against the diffusion of information, ideas, and images is social sensitivity. An Islamic country that aims to preserve the life that its people live is an example of this type of sensitivity. Military sensitivity is the awareness of countries against possible threats that may be directed to themselves. The development of intercontinental ballistic missiles, for example, made the United States more
sensitive militarily against threats from the Soviet Union in the Cold War. The United States was not as sensitive to Soviet military power previously due to the advantage of being surrounded by oceans in its Western and Eastern borders and having peaceful neighbors on its Northern and Southern borders. Trade and financial markets create economic sensitivity as almost every country that has economic relationships with foreign countries, and these links can lead to financial and economic consequences. It has increased with the rise of economic globalism.

The costly effects that an interdependent relationship has might be any costs that people care about, not merely economic costs. Other costs of a vulnerably interdependence may include “moral standards, aesthetic tastes, personal security, or ecological integrity”,\textsuperscript{21} which concern people and consequently politics.

\textit{Table 7: Comparison of Sensitivity Interdependence and Vulnerability Interdependence}

<table>
<thead>
<tr>
<th>Sensitivity Interdependence (SI)</th>
<th>Vulnerability Interdependence (VI)</th>
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<tbody>
<tr>
<td>Costs imposed by outside actors</td>
<td>Costs imposed by outside actors</td>
</tr>
<tr>
<td>Current cost without a policy change</td>
<td>Current cost after a policy change (if there are available policy options to encounter)</td>
</tr>
<tr>
<td>The level of SI only changes depending on automatic reactions (e.g. oil supply disruption -&gt; decrease in domestic production -&gt; decrease in foreign oil dependency)</td>
<td>The level of VI changes with implementing effective policy options (e.g. oil supply disruption -&gt; shifting towards the domestic energy resources as substitute for oil imports)</td>
</tr>
<tr>
<td>Focuses on how the rules are set</td>
<td>Focuses on which actors can set the rules</td>
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\textsuperscript{21} Keohane and Nye, 232.
## Sensitivity Interdependence (SI) vs. Vulnerability Interdependence (VI)

<table>
<thead>
<tr>
<th>Sensitivity Interdependence (SI)</th>
<th>Vulnerability Interdependence (VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“One step more than interconnectedness”*22 (interconnectedness + costly effects)</td>
<td>One step more than SI (interconnectedness + costly effects + adjusting by changing policy)</td>
</tr>
<tr>
<td>Shortly: Losses caused by disruption of a relationship</td>
<td>Shortly: Total costs of disrupting a relationship including costs of adjusting to new situation</td>
</tr>
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</table>

*Source: Compiled by the Author with the Information Drawn from Keohane and Nye 23*

According to Keohane and Nye’s definition, “sensitivity refers to the costly effects of cross-border flows on societies and governments, within an unchanged framework of basic policies”.24 The source of sensitivity can be real flows or perceptions of potential flows. For example, some financial crises are caused by responses of stock markets in one state to events moving in another stock market. This is an example of sensitivity to perceptions of potential flows within economic sensitivity. An example to economic sensitivity caused by real flows can be the decrease in global oil prices in the mid-2010s. Oil exporter countries were affected by this decrease, but their level of sensitivity to low oil prices determined the extent to which they were affected by it. Venezuela, Russia, and Saudi Arabia, for example, were affected more compared to Canada because they were more sensitive due to meeting a high percentage of their government revenue by oil exports.

Vulnerability is a step further from sensitivity. It was first put forth by Kenneth N. Waltz in his piece “The Myth of Interdependence” in Kindleberger’s25 book *The International*...

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22 Keohane and Nye, 232.
23 Keohane and Nye, *Power and Interdependence*.
24 Keohane and Nye, 232.
Corporation\textsuperscript{26}, later developed by Keohane and Nye in their study, \textit{Power and Interdependence}\textsuperscript{27}. Vulnerability interdependence is defined by Keohane and Nye as “relative availability and costliness of alternatives”\textsuperscript{28} in case of having a disruption in an interdependent relationship. In vulnerability interdependence, there has to be an actor or an agent that reacts to a set of flows. This actor or agent finds an alternative choice for itself within the constraints of interdependence.\textsuperscript{29}

The costs associated with vulnerability interdependence are more than sensitivity interdependence. Sensitivity interdependence has the immediate costs of disruption of a relationship. This is the loss of parties in a relationship. They lose the gains that they get with this relationship. Vulnerability interdependence includes more costs. It entails the costs associated with sensitivity interdependence. Furthermore, any additional cost that a party may need to pay in order to compensate the losses that it has with the disruption is part of vulnerability interdependence. The measure of vulnerability interdependence would be, as Keohane and Nye state, “the extent of these costs and the political willingness to bear them”.\textsuperscript{30}

In an example of a disruption in oil supply, sensitivity would be costs associated with immediate reaction of a country against the disruption whereas vulnerability would be costs after this country adjusts itself to the new framework of policies, meaning that finding alternative resources to meet its domestic oil demand. To make this example more concrete, suppose two countries importing the same amount of oil from foreign resources (the resources that they do not

\textsuperscript{26} Baldwin, “Interdependence and Power,” 475. argues that the first distinction between “sensitivity interdependence” and “vulnerability interdependence” was made by Kenneth Waltz although these concepts are commonly attributed to Keohane and Nye’s study “World Politics and the International Economic System”.
\textsuperscript{27} Keohane and Nye, \textit{Power and Interdependence}.
\textsuperscript{28} Keohane and Nye, 11.
\textsuperscript{29} Keohane and Nye, xxxiii. suggest that countries can decrease their vulnerability by having the ability to set rules of the game as well.
\textsuperscript{30} Keohane and Nye, 12.
have control of) but having different amount of domestic energy reserves (whether being oil or other substitute energy types). And suppose these countries have the same amount of oil imports disruption. Their level of sensitivity is the immediate shock that they have in this disruption. In such a case, both countries will have the same level of sensitivity as both importing the same amount of oil from foreign resources and having the same amount of disruption. However, their level of vulnerability to the oil supply shock would depend on their ability to adjust themselves to the oil supply disruption. In the case illustrated above, one country is more vulnerable due to not having enough domestic energy resources to substitute the amount of oil disrupted and the other one is less vulnerable as it can meet the disrupted oil supply from domestic energy reserves.

Raymond Vernon’s obsolescing bargaining model helps to clarify the path of an investor party towards becoming vulnerable after making investment in a country. Vernon’s model examines changing bargaining conditions in a relationship between a multinational enterprise – be it a private multinational enterprise or a government-owned multinational enterprise—and a host country’s government from the perspective of bargaining. The model argues that after an investor (a multinational enterprise, Vernon says) invests in a country, the host country’s relative bargaining power increases as the bargaining positions change over time. The original bargaining therefore obsolesces.

In Vernon’s obsolescing bargaining model, there are two main actors – multinational enterprises and host country governments—whose goals conflict. Despite conflicting interests,

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31 This example assumes that countries can make their energy reserves available to the market in a reasonable period of time. Normally, vulnerability would include any costs from disruption till recovering from effects of disruption.

32 Their vulnerability may also depend on some other factors such as cost-efficiency of domestic energy reserves’ production, the timeframe required to make them available to the domestic market, etc.

33 Vernon, Sovereignty at Bay.
the obsolescing bargain model argues that bargaining is a positive sum game in which both parties achieve some absolute gains. In the initial bargain, actors care about how close they come to achieving their first best goals (their absolute gains) rather than their relative gains, which depend upon their relative bargaining power. This means that they voluntarily cooperate as long as they achieve some absolute gains even if an actor’s relative gains are lower compared to the other actor.

Initial conditions favor the relative bargaining power of the investor party rather than the host country’s government in Vernon’s model. The reason is that “the MNE [multinational enterprise; the investor party] can invest in several locations (has other alternatives) and is therefore highly mobile or has capabilities and resources to extract raw materials that the host country does not have, the HC [host country] has to offer locational incentives to attract inward FDI”.34 However, relative bargaining power shifts to the host country over time and the invested assets starts to become held hostage in the hands of the host country’s government in iterated bargains. As the relative bargaining power shifts to host country, it may start to implement higher taxes or even expropriate the investment. Vernon applied this model to expropriation and nationalization of natural-resources companies invested in developing countries in the 1970s.35 This model’s mechanism tends to work more in non-democratic host countries since democracies, compared to autocracies, “provide firmer institutional barriers against policy arbitrariness”.36

34 Eden, Lenway, and Schuler, “From the Obsolescing Bargain to the Political Bargaining Model,” 255.
35 Eden, Lenway, and Schuler, 253.
36 Jakobsen, “Does Democracy Moderate the Obsolescing Bargain Mechanism?,” 98.
Measuring Vulnerability Interdependence

Although defined and used in various studies, vulnerability interdependence does not have a well-defined measurement method. Keohane and Nye suggest a way to measure it but do not operationalize it in a way that would help to chart the level of vulnerability interdependence in an interstate relationship. They suggest that “vulnerability interdependence can be measured only by the costliness of making effective adjustments to a changed environment over a period of time”.37

The literature has only one study that operationalizes vulnerability interdependence to measure it. Blanchard and Ripsman38 suggests a method in their study “Measuring Economic Interdependence”, in which they examine the level of vulnerability interdependence of Germany and Britain on critical minerals before the outbreak of the World War I. They suggest a four-step test: (1) determining the vital goods for national defense and economic well-being, (2) consulting to the international trade data to understand the extent to which a particular state secures these goods through trade and investment, (3) assessing the level of disruption in the supply of these goods in case of the outbreak of a war, and (4) evaluating whether the supply disruption can be satisfied from alternative suppliers, domestic production, substitutes, national conservation programs or stockpiles.

This study will offer a five-step method to measure vulnerability interdependence. The method will be elaborated in the next section, which entails the research design of this study. In this section, the literature about these concepts will be reviewed. The steps are meant to comprehend any vulnerably interdependence at the interstate level and are different than what

38 Blanchard and Ripsman, “Measuring Economic Interdependence.”
Blanchard and Ripsman\textsuperscript{39} offered. Five components of the vulnerability interdependence index are (1) costs of asset specificity, (2) switching costs, (3) proportionality, (4) costs of ratification and compliance, and (5) issue linkage.

1. Asset Specificity

Asset specificity is a term originated from the economics literature and put forward in an organized way by Williamson in his transaction cost economics theory. In Williamson’s own words, asset specificity refers to “the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value”.\textsuperscript{40} There are, of course, other definitions of this term.\textsuperscript{41}

Specific assets increase the investor party’s vulnerability by making its relative bargaining power weaker. The government of the host country, on the other hand, has more relative bargaining power if the investor invests specific assets. As the obsolescing bargaining model indicates, an opportunistic host country government take advantage of the investor after the investment made and it is difficult for the investor to move its invested assets. In this regard, specific assets make the investor vulnerable as the initial bargaining obsolesces and host country might aim at bargaining again as its relative bargaining power goes up.

Williamson distinguishes four types of asset specificity: (1) site specificity\textsuperscript{42}, which refers to the close proximity of production stages of an asset (2) physical asset specificity that refers to the assets that are produced for a particular buyer and cannot be sold to another one, (3) human

\textsuperscript{39} Blanchard and Ripsman.
\textsuperscript{40} Williamson, “The Logic of Economic Organization,” 70.
\textsuperscript{41} For the compilation of other 24 definitions of the “asset specificity” term, see De Vita, Tekaya, and Wang, “The Many Faces of Asset Specificity,” 331.
\textsuperscript{42} This study calls site specificity as “location asset specificity” in the index of vulnerability interdependence.
asset specificity that is the skills of individuals that are gained for the purposes of a specific area of interest, and (4) dedicated asset specificity\textsuperscript{43}, which is a general asset but produced for a specific buyer by increasing the production capacity.

Physical asset specificity and dedicated assets contradict with each other. Whereas a specific asset is produced for a particular buyer in physical asset specificity, dedicated assets entail products that are suitable for selling to other buyers but no other buyer can buy it due to being produced in excessive amount. Williamson uses dies to exemplify physical asset specificity.\textsuperscript{44} In automobile sector, production of dies requires a substantial investment and cannot be sold to other automobile companies since it is a customer-specific production. A product that is produced by a company in defense industry to sell to a particular country’s defense ministry can be an example of dedicated asset specificity. It can be sold to other countries but cannot be sold easily due to being produced for the needs of a particular country.

Location factors are key to understand site specificity. The questions about mobility of assets, cost-efficiency of transportation for decentralized production, the transportation value of the produced good, and the necessity of close proximity of production stages can be used to understand how vulnerable a country is in an interdependent relationship from the perspective of site specificity.

Physical asset specificity is about the costs associated with investment in productive equipment. Whether the productive equipment is specialized (single-purpose) and whether fixed production costs are high compared to total production costs can be used to understand the extent to which countries are vulnerable. A good example can be a nuclear energy generation facility

\textsuperscript{43} This study calls dedicated asset specificity as “plant asset specificity” in the index of vulnerability interdependence.

\textsuperscript{44} Williamson, \textit{The Mechanisms of Governance}, 105.
that was constructed by a state in another one. When a country makes such a large-scale investment in another country, the investor country cannot liquidate its investment or move it to another country.

Human asset specificity can be measured by looking at whether the production requires a high-skilled workforce and whether the workforce is mobile. Some investments require expertise that may be provided by the investor party. The investor may bring its high-skilled workforce for the investment project. In most cases, the workforce –whether it is high-skilled or low-skilled workforce- is mobile.

Last, dedicated asset specificity can be measured by understanding whether the physical plant is dedicated for the productive purpose. If the investor cannot liquidate an asset of its investment or cannot move it, then it makes the investor more vulnerable.

2. Switching costs

Switching cost\(^{45}\) is a term borrowed from the economics literature like asset specificity. A good definition is put forth by Burnham et al who define switching costs as “onetime costs that customers associate with the process of switching from one provider to another”.\(^{46}\) To put it in a broader context for the international relations literature, switching costs can be defined as the costs associated with shifting to a different counterparty. The costs can be more than solely economic costs. Fornell lists some other costs associated with switching costs as “search costs, transaction costs, learning costs, loyal customer discounts, customer habit, emotional cost, cognitive effort, coupled with financial, social, and psychological risks on the part of the

\(^{45}\) Some part of the literature prefers using “switching barrier” instead of “switching cost”. This study prefers using “switching cost”.

buyer”. Though, many of them are specific to business-to-customer or business-to-business relations. The aim is to understand switching cost in these types of relations and cannot therefore be attributed to the relations at the interstate level.

Switching costs have a close relationship with asset specificity. They go hand in hand although they are distinct indicators of vulnerability in an interdependent relationship. If an investment is asset specific, then switching costs become high except for human asset specificity. For instance, a location asset specific investment –either due to its mobility or transportation cost or necessity to co-locate with other productive activities- would create high switching costs for the investor if either one of the parties wants to break the investment relationship. Similarly, a plant asset specific investment creates high switching cost because it is dedicated to a productive purpose and cannot be repurposed. An investor cannot easily switch to a different counterparty. Human asset specificity, however, may not create high switching costs if the workforce is mobile. The reason of this is that the investor can move its workforce to another location that belongs to a different counterparty in case it has mobile workforce.

Switching costs are related to obsolescing bargaining model of Raymond Vernon. As in the case for specific assets, higher switching costs make the host country’s government more powerful in terms of relative bargaining power while decreasing the investor’s relative bargaining power, increasing vulnerability for the investor. In this respect, switching costs can be used by host country’s government as a bargaining tool in iterated bargains as described in Vernon’s obsolescing bargain model. Higher switching costs decrease investor’s mobility after it sinks an investment with high switching costs into a country.

In a vulnerably interdependent relationship at the country level, switching costs can either

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48 For detailed explanation of Vernon’s obsolescing bargaining model, see page 18
be associated with switching to alternative suppliers or switching to alternative products. The type of transaction is important to examine the cost of switching to alternative buyers or alternative products. If a product or service is abundant and can be supplied by other countries, then it does not create vulnerability in an interdependent relationship. For instance, agricultural goods are widely available in the world. If a country faces disruption in the supply of agricultural goods, it can either prefer switching to substitute agricultural goods or switching to alternative suppliers. By contrast, energy products have the problem of fewness. A country would not have much choice in case of having a disruption in an important amount of energy products supply. If domestic alternatives to substitute imported energy products are not enough to satisfy domestic demand, then this country would be highly vulnerable in terms of either switching to another supplier or losing its supplier.

Oil’s problem of fewness creates oligopoly in its market. A relationship that is based on oil trade can be illustrated by using the interdependent relationship between China and Angola, the second-largest supplier of China’s imported oil. China meets a substantial amount of its domestic oil demand from Angola. In case of having a disruption in this trade relationship, China’s options might be switching to other suppliers or meeting its energy demand from other substitute products. These substitute products may be supplied from domestic energy resources (e.g. using more domestic coal reserves instead of importing oil from Angola) or from foreign energy resources (e.g. importing Russian natural gas instead of Angolan oil)\(^49\). However, substitute products can help China to meet its energy demand to only some extent. The country

\(^{49}\) Using coal has its own problems. It rises concerns related to climate change as it emits more greenhouse gases than oil or natural gas, which causes international pressure on China as it has almost one-fifth of the world population. Importing more natural gas is limited to the capacity that it can import from neighboring countries (e.g. Russia) and increases its dependency on these countries since importing natural gas via pipelines requires long-term contracts.
cannot fully satisfy the demand by these substitute products. It has to switch to other suppliers to meet the remaining energy demand after increasing the share of substitute oil products. However, switching to other suppliers in oil supply is not easy due to the problem of fewness. There are a limited number of oil exporters and almost all of them currently has customers for their products. China may not be able to provide the flow of oil for the same price if it switches to other oil suppliers or loses Angola as the oil supplier.

3. Proportionality

In any interconnectedness, there is a level of trade between countries. International trade is directly related with the size of trading countries. If we think about one low-populated country and one high-populated country, the share of the former’s total exports might comprise a small percentage in the latter one’s imports while it may have a very high percentage for the low-populated countries’ exports. For example, the total export value of Angola to China was $27.7 billion in 2014. This absolute value had different relative values for each country. Among the total imports of China, Angola’s share was only 1.8% while China had 51% within the total exports of Angola in 2014.50 To make a decision about how vulnerable the investor country in a bilateral trade relations, one should look at the type of commodity that they are trading. For example, if trade between China and Angola comprises from the agricultural products, then these numbers mean that Angola has more vulnerability in this bilateral trade compared to China.

The volume of energy assets’ trade indicates a different meaning than other common products (e.g. agricultural products). They have the same proportionality problem but may

indicate an opposite meaning. Their absolute values might have different relative values, depending on the total economic size of countries. If we use the example of the same countries, Angola exported almost $26.6 billion worth of crude petroleum to China in 2014; it was half of Angola’s total crude petroleum exports while it only took 13% of China’s total crude oil imports in 2014.  

Proportionality ignites both supplier and buyer to think about switching costs. Although switching cost is mostly associated with buyers in the economics literature, it also has value for the supplier side. If a trade relationship is broken by a party, both parties will need to switch to other trading partners. A buyer will need to find a supplier and a supplier will need to find a buyer. In the case illustrated above, China will need to think about what it will cost for it to find 13% of its total crude oil imports from other sources except Angola. Angola will need to consider the costs of selling half of its total crude oil exports to other countries except China. The cost seems to be higher for China due the problem of fewness for the commodity they trade. It has a limited amount of supply while the global demand for oil is increasing steadily.

4. Costs of Ratification and Compliance

Costs of compliance and ratification are related to signing international treaties. Costs of ratification are the costs that are required to ratify a treaty. It is basically the answer of “What is it going to cost politically to get an agreement ratified?” for policy makers. Costs of compliance are the costs that come after starting to implement a ratified treaty. These costs make governments signal their intentions in a particular direction by making commitments that are

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hard to break after a treaty is signed.52

Investments are not done by countries. Though, they are regarded to be strategized by the investor companies’ country. They do it by using any means to direct companies’ attention to a particular country or to a particular region. China, for example, holds Forum on China and Africa Cooperation (FOCAC) together with the African countries every three years. In these summits, China commits giving financial support either by grants, interest-free loans, concessional loans or credit lines.53 By doing so, it incentivizes companies to invest there. This concept – compliance and ratification costs—is about what it may cost for China to ratify these financial plans in its legislative bodies and whether it can comply with the agreements in these summits.

Compliance and ratification costs are conceptually distinct but related at the same time. High compliance costs lead to high ratification costs. It might be difficult to comply with the requirements of a treaty. In this case, the approval body of a state will know this high compliance cost and make its ratification decision according to the compliance cost. For example, the U.S. did not ratify the Kyoto Protocol due to its high cost of compliance for the country.54

Costs of ratification are not always, but generally, political costs from the point of view of this study as vulnerability interdependence is measured from the perspective of states—not companies, NGOs or individuals. The governments may need to make some political concessions to get the support from the majority of government body that will ratify the treaty.

Costs of compliance are generally, but not necessarily, economic and political costs that occur after the requirements of a treaty is implemented. For example, the costs of an

52 Costs of ratification and compliance have a relationship with credibility. When ratification and compliance costs are high, it means that credibility is also high. For credibility, see Fearon, “Domestic Political Audiences and the Escalation of International Disputes”; Simmons, “International Law and State Behavior”; Martin, “The President and International Commitments.”
53 Coulton, “China Commits to African Development.”
54 von Stein, “The International Law and Politics of Climate Change.”
environmental treaty that requires some commitments from a state include some costly changes. Complying with the requirements of the Kyoto Protocol would be expensive for the U.S. The required U.S. commitments in the Protocol were very costly for the American people and the American industry. The cost of complying with this treaty has been the main reason why the U.S. did not ratify the Kyoto Protocol.

There are, obviously, some other costs related both to ratification and to compliance procedures albeit aforementioned costs are major costs. Societal and reputational costs are two other leading costs. Though, all other costs are mostly related with political costs. A change in society’s situation or a country’s reputation directly affects the status of the country in domestic or international politics.

In the context of vulnerability interdependence, costs of ratification and compliance are indicators of a country’s fragility to a change in its relationship with others. Higher costs of ratification and compliance mean more vulnerability for a country in an interdependent relationship. Suppose that China wants to change the route of its oil products supply from Angola to another counterparty. China needs to find a new oil products supplier and Angola needs to find a new market for its oil products. They both need to sign contracts with other counterparties. Whichever party has higher costs of ratification and compliance to their new treaties, that party is more vulnerable to the changes in their bilateral relationship from the perspective of ratification and compliance costs.

5. Issue Linkage

Issue linkage can be defined as “attempts to gain additional bargaining leverage by
making one's own behavior on a given issue contingent on others' actions toward other issue.”\textsuperscript{55} When parties link two or more issues in international relations, they make some concessions to each other in return of getting concessions in another agreement.\textsuperscript{56}

Game theoretic terms, mostly prisoner’s dilemma game, are used in the literature of issue linkage to explain how issue linkages help to create cooperation.\textsuperscript{57} In canonical prisoner’s dilemma game, the Nash equilibrium (the strategy set that no player has any incentive to deviate from) is defect-defect although the Pareto optimal outcome (best mutual outcome) is cooperate-cooperate. In a one-shot prisoner’s dilemma game, every rational player plays according to their best individual outcome. However, if all players know that their counterparty player will also defect, then they can link this game to another game that is played among the same players. By doing so, one of players can make some concessions in the first game to get concessions from the counterparty in subsequent games. They can link one issue to other issue(s).

In the Sino-African relationship, both parties have some issues to link to some other issues in their bilateral relations. For example, African states may use their votes in international organizations to support the Chinese view in return of getting some concessions from China. Looking at issue linkages from China’s perspective; China may use some trade incentives toward the African states to get more energy products from them in return.

The hypothesis for issue linkage can be stated as that a state that can create issue linkages will be less vulnerable in an interdependent relationship because it raises the cost of defection for its counterparty. The other party may lose concessions it gets by cooperating in

\textsuperscript{55} Axelrod and Keohane, “Achieving Cooperation under Anarchy,” 239.
\textsuperscript{56} See McGinnis, “Issue Linkage and the Evolution of International Cooperation.” for a broader discussion of issue linkage and cooperation.
case of defecting. The country that can create issue linkages will be the one with more additional bargaining leverage. In the case of the Sino-African relationship, the African countries are regarded to have additional bargaining leverage in return for getting concessions from China.

**Conclusion**

In a globalizing world, relations in the international arena are increasingly based on low politics (economics, social affairs) rather than high politics (security, survival). Therefore, international relations theories that explain international events from the perspective of economics and social affairs are gaining respect as more explanatory theories. Despite their success in explaining international events, they are, in fact, more complex than theories that argue high politics provide a better image of international relations due to being not as parsimonious.

The role of economics rather than military is more dominant in peaceful circumstances. Many relationships between wealthy and poor countries are based on their dependency on each other. The reason why a poor country is dependent on a wealthier one is obvious: They need rich ones’ money. The reasons why a wealthy country may be dependent on poor countries are various. They may need their minerals, need to sell their goods to their markets, have some investments that cannot be moved to somewhere else, etc. Realist theories, for example, cannot explain these circumstances, which occur in peaceful times, as they are not necessarily a part of the security or survival of a state.

As one of the theories that argue analyzing low politics is better to explain and understand international relations, vulnerability interdependence theory provides a good understanding of political analysis of international events. Keohane and Nye consider
vulnerability interdependence as one dimension of asymmetrical interdependence, which they define as the source of power among actors in international relations. Although the theory is put forth and well defined by Keohane and Nye, neither theirs nor any other study presents a way to measure the level of vulnerability interdependence in an asymmetrical interdependent relationship.

This study contributes to the literature by suggesting a way of measuring vulnerability interdependence by creating an index. This chapter introduced the concepts and presented a review of relevant literature in these fields. Asset specificity, switching costs, proportionality, costs of ratification and compliance and issue linkages are what this study offers as the concepts to be used in the index. These concepts are borrowed mostly from the economics literature to be used in the field of international relations. They are compiled together in a way to represent bilateral state relations in terms of vulnerably interdependent relationships and to create a measurement method for vulnerability interdependence.

“What is badly defined is likely to be badly measured”. This chapter, hence, examined the relevant literature very carefully and picked the related concepts that can be representative of vulnerability interdependence the best. The reasons for selecting the five concepts as subgroups of vulnerability interdependence are discussed in the parts where these concepts are explained.

The next chapter will present the research design of the study. It will concretize the index by putting forth some questions. These questions are kept very clear to get an objective value that shows the level of vulnerability interdependence. The questions of the vulnerability interdependence index are aimed to be directed to foreign direct investment projects of a country

58 Keohane and Nye, *Power and Interdependence*.
59 Keohane and Nye.
60 European Commission, “Step 1: Theoretical Framework | COIN.”
to understand how much their investment projects make that country vulnerably interdependent in its bilateral relationship with the host country.
CHAPTER IV

RESEARCH DESIGN

This chapter presents the methodology of this study. It both aims to lay out the method
that is used in the study and to provide any scholar enough information to replicate the study.
What a methodology part should entail is explained by Box-Steffensmeier, Brady and Collier
clearly. After giving the lyrics of a song of the Beatles that includes “revolution” and “we all
want to change the world”, they explain methodology as in the following:

“Methodology provides techniques for clarifying the theoretical meaning of
concepts such as revolution and for developing definitions of revolutions. It
offers descriptive indicators for comparing the scope of revolutionary
change, and sample surveys for gauging the support for revolutions. And it
offers an array of methods for making causal inferences that provide
insights into the causes and consequences of revolutions. All these tasks are
important and strongly interconnected. While causal inference is
fundamental in political science, making good inferences depends entirely
on adequate conceptualization and measurement of the phenomena under
study…”

Some part of the methodology is given in the previous chapter, such as clarifying the
theoretical meaning of concepts that are used in this study along with their relevant literature.
This chapter will (1) describe the index and its questions that are used to measure the level of
vulnerability interdependence, give the rationale behind these concepts and questions of the
index about how good they are as measures of vulnerability, (2) present the data choice that is
believed to refer vulnerability the best and the source of data, (3) explain the ways adopted to
assess validity and reliability of the index, and (4) justify case selections by explaining which
subsectors and country cases are selected and why they were considered to be important for
understanding the findings of the vulnerability interdependence index.

1 Box-Steffensmeier, Brady, and Collier, The Oxford Handbook of Political Methodology.
2 Box-Steffensmeier, Brady, and Collier, 3–4.
The Index of Vulnerability Interdependence

One of two most significant contributions of this study to the literature is the index of vulnerability interdependence that aims at measuring the level of vulnerability of an investor country. This part introduces the index in detail. The index consists of five broad concepts, which have been presented in more detail in the previous chapter. The index aims to provide the level of vulnerability interdependence of any two interdependent states by measuring costs of asset specificity, switching costs, proportionality, costs of ratification and compliance, and issue linkages.

17 Questions of the Vulnerability Interdependence Index

The proposed index operationalizing vulnerability interdependence has 17 questions. These questions cover asset specificity, switching costs, costs of ratification and compliance, proportionality, and issue linkages. Most of the questions are coded as binary variables; giving either 0 or 1 according to what a project gives answer to a particular question of the index. Most of the remaining questions are coded as 0, 1, 2, and 3. Questions 16 and 17 have answers of -1 and 1; meaning either decreasing or increasing the vulnerability level of the investor country. Higher values always indicate higher level of vulnerability for the investor country.

The majority of the vulnerability interdependence index’s questions are directed to productive activity, not to output product. The reason of this is that the index aims to understand whether an investment increases the level of vulnerability of the investing party. The end-product of an investment project does not have a significant effect on investor’s vulnerability since it is what the investment project produces. For example, a nuclear energy investment generates electricity as the output product. The questions are, however, directed to the nuclear energy
facility, not electricity generation service. A couple of questions, though, are directed to the output product. The rationale behind asking questions to output products is that they are indicators of what productive activities might entail. A question in the category of location asset specificity (question 3), for example, is directed to end-product of an investment since the end-product is indicative of whether productive activity is location asset specific.

Investments that relate to buying a percentage of a company’s stakes are considered to be investments in this company’s working area. For example, if a Chinese company bought 25% of an Angolan oil production company, then this investment should be regarded to be in the oil production sector. The questions of the vulnerability interdependence index should, therefore, be answered accordingly.

Some questions cover the relationship at the state level, rather than the investment level. For example, proportionality measures the trade relationship in the interstate level since international trade is considered to be the best way to explain proportionality. Likewise, question 15, which measures the costs of ratification and compliance, is answered by looking at bilateral investment treaties or free trade agreements at the state level.

Table 8: 17 Questions of the Vulnerability Interdependence Measurement Index

<table>
<thead>
<tr>
<th>Asset Specificity</th>
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<tbody>
<tr>
<td><strong>Location Asset Specificity</strong></td>
</tr>
<tr>
<td>1. Are the assets or productivity mobile? (infinite immobile=3, immobile=2, mobile=1, infinite mobile=0)</td>
</tr>
<tr>
<td>2. Are transportation costs amenable to decentralized production? (infinite not amenable=3, not amenable=2, amenable=1, infinite amenable=0)</td>
</tr>
<tr>
<td>3. Is the value per unit of end-product’s weight high? (infinite high=0, high=1, low=2, infinite low=3)</td>
</tr>
<tr>
<td>4. Is it the production of a natural (extracted) resource? (yes=1, no=0)</td>
</tr>
<tr>
<td>5. Are the assets generally co-located with other productive activities within a host country? (yes=1, no=0)</td>
</tr>
</tbody>
</table>

**Physical Asset Specificity**
6. Does production require investment in specialized (single-purpose) equipment? (yes=1, no=0)
7. Are fixed production costs (as percent of total costs) high or low? (infinite high=3, high=2, low=1, infinite low=0)

**Human Asset Specificity**
8. Does production require a specialized, high-skilled workforce? (yes=1, no=0)
9. Is the workforce mobile? (no=1, yes=0)

**Plant Asset Specificity**
10. Is physical plant dedicated to the productive purpose? Or can it be repurposed? (dedicated=1, repurposed=0)

**Switching Costs**

**Relational**
11. Are there a small number of available market participants with whom to partner? (Oligopsony or oligopoly) (yes=1, no=0)

**Opportunity**
12. Is the produced good storable? (no=1, yes=0) (It is always 0 if it is a public good)

**Financial**
13. Are assets characterized by high sunk costs? (infinite high=3, high=2, low=1, infinite low=0)

**Ratification and Compliance Costs**
14. Does information asymmetry favor investing party or hosting party? (0 if it favors investor, 1 if it favors host)
15. Is there an existing regime to monitor compliance among contracting parties? (no=1, yes=0)

**Proportionality**
16. Are exports proportional among the two countries? (-1 if it favors the investing country, 0 if it is proportional, 1 if it favors the host country)

**Issue Linkages**
17. What is the dyadic affinity score for the two countries? (least similar interests=-1, most similar interests=1)

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1. Questions Related to Asset Specificity

Asset specificity is considered to be the most important component of the vulnerability interdependence index. If an investor country has sunk into a recipient country with high asset
specific investment, then this investment increases the investor country’s level of vulnerability. Although asset specificity is mostly associated with physical asset specificity in this concept’s literature, other types of it are also considered in this index. Location, human and plant asset specificity are other types that are included in the index. Almost two-third of 17 questions indicate this term where five of them correspond to location asset specificity corresponding to the number of different aspects related to them.

**Question 1.** Are the assets or productivity mobile? (infinite immobile=3, immobile=2, mobile=1, infinite mobile=0)

This question aims to understand how easy it is to relocate an investment. Some investment projects are difficult to relocate compared to others. Most heavy industry investment projects are in this category. The mobility of a nuclear energy investment, for example, is not feasible for relocation. On the other hand, many service industry projects are mobile. For example, banking and most transportation assets are mobile naturally.

Answers for this question are given in four categories with the codes ranging from 3 to 0, representing levels of mobility from infinite immobile to infinite mobile. Public good investments generally fall into the category of infinite immobile and service investments are generally regarded as infinite mobile. Private good investments are coded either as 1 or 2, according to their mobility.

An airline investment is a private good investment, for example. In terms of mobility, it is a mobile asset. There are, definitely, some parts of an airline investment that are not mobile, such as airplane hangars. But the majority of an investment’s components will be taken into account when determining its mobility. The answer should be ‘1’ for an airline investment. Another example of mobile assets might be service within a constant infrastructure and with specialized
equipment. University investments include both the university building itself and some specialized equipment and services that operate the university. Some parts of the university investment like professional labor, the expertise, and libraries can be moved whereas it might be difficult to relocate some specialized equipment. Since the majority of a university investment consists of mobile assets, its answer should be ‘0’ in terms of mobility dimension of location asset specificity, which this question measures.

Infrastructures investments, by definition, are not mobile. Many of them are public goods, which are coded as infinite immobile. For example, utilities are public goods. In utilities sector, many drinking water investment projects include water treatment plants, storage dams, and distribution pipelines. All components of a drinking water investment are not feasible to relocate and use at another location. They would fall into the category of infinite immobile.

Many types of power plants (thermal power plants, coal power plants, oil power plants) are examples of private good investments that are not easy to relocate. The answer for this type of investments should be ‘2’ for this type of investments.

**Question 2.** Are transportation costs amenable to decentralized production? (infinite not amenable=3, not amenable=2, amenable=1, infinite amenable=0)

This question of location asset specificity is about offshoring and outsourcing. It aims to understand whether transportation costs are feasible to produce some components of a product in different places and bring them together via transporting to a single assembling place. The different places of production should be in different countries since the index measures vulnerability interdependence at the international level. The idea of this question is that to the degree transportation costs are low, the production can be de-centralized by producing some

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3 Some power plant types, though, are feasible for relocation. Natural gas power plants are regarded as having mobile productive tools. See “UOP Russell Modular Gas Processing Plants - Full-Length Animation.”
components in different countries. These questions provide a way of thinking about this question: “Is the asset merely a side of assembly?” or “Is it the place where the entire product is produced at a single site?”.

Four categories are used in coding this question, ranging from infinite not amenable to infinite amenable. Infinite not amenable category generally includes public goods; not amenable and amenable categories are generally for private goods; and infinite amenable category generally includes services.

An automobile company, for example, can machine and form all of automobile parts at the same place that they are assembled as the complete vehicle. Or, conversely, components could be made all over the world and shipped to a final assembly place. Since transportation costs are amenable to decentralized production in this sector, the second way is the most preferred way of production among automobile companies. An example from service sector would be education. The end product of a school investment is the learning activity. It is feasible to outsource some parts of education service via distance learning or hiring a part-time professor from another location. For this reason, education investments would fall into the “infinite amenable” category in terms of being feasible for decentralized production.

Transportation costs are crucial to understand whether a productive activity is feasible for decentralized production. If fuel is expensive and so transportation costs are very high, then it is very hard to locate parts of productive assets elsewhere. An example to this can be steel production. The productive activity of steel requires a lot of coal. Coal is heavy and expensive to transport. Hence, the final production in this example relies a lot on co-location of productive activities, which are steel and coal production. Steel production would fall into the “not amenable” category.
Investment projects of public goods are different than factory-like investments that produce a product as its output. For example, the vast majority of infrastructure investments do not produce a tangible product. They, rather, produce public service in place where they are built. Investments in road, railway or port projects fall into this category. For this type of infrastructure investments, transportation costs are not amenable to decentralized production since all steps of production has to be done at the site of investment. These investments would fall into the “infinite not amenable” category.

Transportation costs’ feasibility for decentralized production should be regarded at the international level. If some parts of the production can be provided from outside of the host country, then it is regarded as amenable for decentralized production. Components of a drinking water supply investment, for example, is generally built at different locations since water is easy to distribute by pipelines. Similarly, electricity distribution investments have decentralized production as electricity is transported via transmission lines. However, they are generally located within a host country. Hence, their decentralized production does not fit to the aim of this question. The answer should be ‘infinite not amenable’ for a drinking water supply investment or electricity distribution investments.

High-technology network systems are mostly feasible for decentralized production. This type of investments requires a significant level of know-how. Telecommunications investments are good examples to this. Their components are feasible for producing at different locations and their transportation costs are amenable for decentralized production.

Transportation costs’ amenability for decentralized production affects vulnerability of investing party by increasing the cost of defection if it wants to disrupt an investment. The reason of this is that the investing party cannot move some parts of productive activities if
transportation costs of some goods that are required in the chain of production do not make it feasible to move.

**Question 3:** Is the value per unit of product’s weight high? (infinite high=0, high=1, low=2, infinite low=3)

This question examines the relationship between the value of product and the cost of shipping as it shows how easy it is to offshore the production. In other words, its aim is to understand whether some components of a production is worth offshoring from the perspective of transportation’s feasibility. If an element is very expensive and light-weight, it is more likely to be offshored. But if an element is low-value and heavy-weight, the production might be co-located with the final production.

The answer of this question is given in four categories: infinite high, high, low, infinite low, which are given values from 0 to 3. The category of infinite low value per unit of weight mostly captures public goods. Public goods, by their nature, are generally very heavy and hard to relocate. Therefore, if an investment project is a public good that produces product or service, the answer should be ‘3’ (infinite low). Then, the second and the third categories capture private goods. If an output product is a private good and has low value per weight, then the answer should be ‘2’ (low). If an output product is a private good with a high value per unit of weight, then the answer should be ‘1’ (high). The last category is generally for service investments. Service investments are extremely light, which makes their value per unit of weight very high. Service investments are coded as ‘0’ (infinite high).

The weight of a product sets the price of transporting it; heavier products are more expensive to ship. In order to offset the cost of shipping, the value per unit weight of product has to be high. An example of this can be computer chips. Their value is high enough to make it
worth shipping by air. Computer chips fall into the category of high value per unit of weight goods and the answer for this good is ‘1’ (high). Oil itself, either in crude form or refined form, should be considered as a precious product, whose value per unit of weight is high. The answer for oil as the produced good is the same with the answer for computer chips.

The value per unit of weight of a product is regarded as an indicator of location asset specificity and so of vulnerability because it shows how feasible it is to end an investment at a location and move it to somewhere else.

**Question 4:** Is it the production of natural (extracted) resource? (yes=1, no=0)

This question aims to get whether the productive activity relates to production of minerals. Minerals, by definition, are generally produced at the site they are found. It is not feasible to produce oil at a location away from the oil field, for example. The same works for gold: one cannot produce gold at a location away from the gold field. This kind of natural (extracted) resource products are highly location specific assets.

Some productive activities might involve extracted natural resources but do not produce them as the end product. A coal-fired power plant, for example, generate electricity as the end product and requires using a lot of coal. Although coal is the main primary product of a coal-fired power plant investment’s productive activity, it is not regarded as the production of extracted natural resource. A coal-fired power plant is different than a coal mining investment. Also, a pipeline investment does not include extracted natural resource production although it is for transporting this commodity.

There are other types of natural resources that are called renewable natural resources and mostly not extracted from the ground such as wind energy or solar energy. Investments in these sectors are regarded as being production of non-extracted natural resources as they do not create
vulnerability in terms of this dimension of location asset specificity. This question aims at understanding whether the production relates natural resources whose production is only feasible at the site where they are found/located.

Extracted natural resources are indicators of vulnerability interdependence as it makes the investor country dependent on the hosting country, meaning that it makes the investing party more vulnerable due to the type of product that the productive activity entails.

**Question 5**: Are assets generally co-located with other productive activities within a host country? (yes=1, no=0)

Some products require multiple steps of production, meaning that more than one productive activity is needed to produce. This question is meant to cover the entire value chain of production. It asks whether there are steps in the product-chain that are generally co-located. It also aims to get at the idea of whether there are complementary products or services that need to be co-located. All production steps until the end-user gets the final product are counted as production steps that are considered when answering this question.

Co-location of productive activities can be considered both in goods and service sectors. Oil is a good example in the goods sector that has more than one productive activity and requires some of its productive activities to be co-located. It is extracted from the ground but for it to be used in various areas like transportation, it has to be refined and transported to the final consumption destination. If the site of distribution is also counted as a step of production, then it has three main productive activities; extraction, refinement, and transportation to the point of consumption. The way the markets are organized today is that refinement is done near the point of consumption. After the refinement process, it is transported a few miles to the service stations where end-users buy gas as the end-product. Hence, assets are regarded to be not co-located with
other productive activities for oil production investments.

External economies of scale, which simply means clustering a group of companies that are in the same industry near to each other, trigger co-location of productive activities. The Silicon Valley, for example, has a lot of co-located production of different steps in the value chain. In external economies of scale, companies of the same industry come together mostly to increase the productivity of their asset. The productivity of assets goes up when it is co-located with other assets. They can benefit from being co-located with each other in various ways. Decreasing the cost of transportation, increasing communication, benefiting from the pool of skilled labor, having a pool of research and development, and creating knowledge spillovers are some benefits of co-location of productive activities in external economies of scale.

Some investments might be feasible for decentralized production (see the explanation of question 2) while their assets might generally be co-located with other productive activities. Drinking water distribution or electricity distribution investments are examples of being feasible for decentralized production but being co-located with other productive activities.4

This dimension of vulnerability should be thought about at the international level. An investment can only make the investor party less vulnerable if some of the productive activities are located out of the host country. For example, a telecommunications network investment must be located at different locations in different countries for it to consider making the investor party less vulnerable. If it is located in different locations but within a host country, then it creates more vulnerability for the investor. (The answer should be ‘no’ for this type of cases.)

This question aims at understanding productive activities that have production steps

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4 As noted in question 2’s explanation part, drinking water distribution or electricity distribution investments might be feasible for decentralized production. They are, however, considered as not suitable for decentralized production in this index since this index aims at understanding whether some components of production can be done in a third country.
located at different locations. Productive activities that are generally done at only one production site are considered to be co-located with other productive activities. All public good investments, for example, would fall into this category. Similarly, a house construction project would fall into this category since all production is done at the production site.

Co-location of productive activities helps us to understand the level of vulnerability by showing whether the investing party has losses by moving its investment from the host country. If co-location of productive activities provides benefits for the investor, its vulnerability would increase due to having strong motivation to stay in the host country.

**Question 6**: Does production require investment in specialized (single-purposed) equipment? (yes=1, no=0)

There are some production tools that can be used for multi-purposes. A screwdriver, for example, can be used to repair a car, to fix home, or to assemble furniture. It is a multi-purpose tool that can be used for a lot of different productive enterprises. On the other hand, there are some tools that are unique to a productive enterprise. For example, dies in automotive sector are a pretty specialized product. They cannot be repurposed for other productive activities. Another example would be a railway investment. One cannot use railway for other productive purposes except providing transportation service on it. The question, in other words, is how easy it is to take a physical capital and convert it for use of other productive enterprises.

Extraction of petroleum products, for example, requires investment in specialized equipment. A pump jack can only be used in oil wells. Similarly, electricity distribution investments (which include construction of substations, transmission lines and power distribution facilities), drinking water supply investments (which includes construction of storage dams, water treatment plant and water distribution pipelines), coal-fired or gas-fired power plants, and
a fossil fuel pipeline investment require investment in specialized equipment since many equipment are not feasible to use for other purposes in these investments.

In contrary, many types of agricultural investments, for example, do not require investment in single-purposed equipment. Most infrastructure investments also require non-specific tools, which can be used for other purposes too.

As discussed in the physical asset specificity part of the literature review chapter, this is the crucial question to get the idea of whether there is an asset specific physical production enterprise. If an asset is physical asset specific, then it does not increase the vulnerability level of the investor country.

**Question 7:** Are fixed production costs (as percent of total costs) high or low? (infinite high=3, high=2, low=1, infinite low=0)

Production costs consist of fixed costs and variable costs. Fixed production costs do not change no matter how much or how little the production is, whereas variable production costs increase or decrease with the number of product produced. Aircraft manufacturing, for example, has very high fixed production cost. An aircraft manufacturer company has to do a lot of research and development to make an airplane, which constitutes a high proportion of fixed production costs.

Labor intensive industries tend to have low fixed production costs and high variable production costs. Textiles, for example, have some specialized machineries that are expensive but there is very little research and development. In a textile production, there is also a lot of labor involved. Hence, it has high variable costs. Similarly, a hospital investment is a labor-intensive investment. It requires employing well-educated medical workers which is a significant cost for operating a hospital. Its fixed production costs are low as a percent of total production
costs. On the other hand, pharmaceuticals and software have very high fixed costs and low variable costs. For example, research and development of Microsoft Word software has a very high cost for the Microsoft company. But once the company starts putting this software on a CD, then the costs become very low. The cost of a CD and writing the software setup files on this CD is less than one US dollar. Likewise, almost all cost of pharmaceuticals consists of research and development. There are a lot of very expensive fixed production costs such as biochemistry, human subject research, and critical trials. Once a pharmaceutical company invests in these fixed costs, though, the amount it pays to produce each individual dose or each individual bottle becomes very low.

Research and development takes an important share in the total cost of a product. It is the starting point of a product cycle. With regard to including research and development in fixed production costs, one should look at whether these research and development activities are done as a part of a particular investment. For example, China’s oil extraction technology is part of its investment that it has done for itself, not for the country that it is investing in. Therefore, these research and development activities do not count as the fixed production cost in an oil extraction investment in another country. However, if China developed some technology that is specific to the country that it is investing in and this technology only works in this country, then these research and development activities may count as the part of fixed production cost for this investment.

The coding has four categories for this question, ranging from 3 to 0, indicating from infinite high to infinite low share of fixed production costs. Public good investments are generally in the category of infinite high fixed production costs. They have some variable production costs such as maintenance costs. The majority of costs in this type of investments,
however, are fixed production costs, which are one-time investment costs that investors have to spend. Therefore, the answer of this question will be ‘3’ (infinite high) for the vast majority of public good investments. Services tend to have very low fixed production costs. They generally fall into the category of infinite low fixed production costs, which is coded as ‘0’ (infinite low).

Similar to investment projects of public goods, some projects have very high share of fixed production costs although they are not public goods. A house construction project is an example. Almost all costs of a house construction project are fixed production costs. Therefore, it is coded as ‘3’ (infinite high).

High fixed production costs lead to high asset specificity as it means that an investor has to make an important amount of investment before it starts earning. A foreign investor has to take a lot of risks and put a lot of money into a project before it can see return on its investment. It means that a significant amount of its money is locked up. It cannot be got out quickly. This makes the investor vulnerable.

**Question 8:** Does production require a specialized, high-skilled workforce? (yes=1, no=0)

This question aims to understand whether an investment has high human asset specificity. If it requires a specialized, high-skilled workforce for production, then it is highly human asset specific. Running a nuclear power plant requires a high-skilled workforce whereas running a mine requires a low-skilled workforce (miners do not need to be well-educated workers). The university example –also discussed while explaining location asset specificity in the first question- has a high-skilled workforce requirement. An important part of a university investment requires recruiting faculty members at the university, which are specialized and high-skilled workforce.

Investments related to high-technology activities are regarded mostly as requiring a high-
skilled, specialized workforce because even if their use does not require a high-skilled workforce, their regular maintenance and technical assistance need a high-skilled workforce.

Investments in utilities sector, agriculture-related sectors, highway construction sector, aviation sector, and fossil fuel pipeline investments are examples of not requiring a specialized, high-skilled workforce. Examples of sectors that require a high-skilled workforce are education, renewable energy generation, and power plants (coal-fired, gas-fired).

Specialized, high-skilled workforce is an indicator of the investing party’s vulnerability as it indicates one dimension of how easy it is to move an investment that requires high-skilled workforce to a third country. Investments that require a high-skilled workforce are more difficult to be moved to a third country.

**Question 9:** Is the workforce mobile? (no=1, yes=0)

This question aims to address both moving a workforce from one country to another one and finding a substitute workforce in another country when moving an investment there. Although it is meant to address these two dimensions, it is mostly used to refer the latter one – finding substitute workforce elsewhere.

Productive activities that require only a low-skilled workforce is always mobile. There are available substitute workforce elsewhere for this type of labor at any country. There is substitute workforce elsewhere in reaping corn, for example, as it is very low-tech activity and requires low-skilled workforce. In most cases, there will be workforce to be used for this job.

Some productive activities that require high-skilled workforce may entail non-mobile workforce. If the required workforce is in quantum physics, for instance, then there will be far fewer number of people that can be recruited. Therefore, it may be hard to find substitute worker for a project that needs to recruit a quantum physicist.
A specification of non-mobile workforce is the requisite of having some specific machinery for the productive activity. In investments that require engineering knowledge, there may be some production tools that are dedicated to the productive purposes and are produced by a limited number of producers in a sector characterized by oligopoly. If an investment requires using this kind of machinery in the productive activity, then they are dependent on workforce that only the producer of that tools might have. Only the producer of this machinery may provide the workforce that is required for its maintenance and renovation. This workforce can neither be substituted by another party nor can be moved to another location since the investor uses this workforce from a third party. Many investments in the security sector are examples to this, in which the investor countries may wish the required workforce only provided by themselves in order to hide engineering details of their invested machinery’s technology.

The vast majority of foreign direct investments has mobile workforce while there are some examples of investments that have non-mobile workforce. Examples of non-mobile workforce include petroleum investments (locating oil field, drilling, refinement), natural gas processing plant investments, telecommunications network investments, nuclear energy investment, high-tech defense sector investments. Examples of mobile workforce include education investments, transportation investments, power plant investments (coal, gas, hydropower), alumina refinery investments, cobalt production investments, steel production investments, and platinum production investments.

Mobility of workforce is an indicator of vulnerability of the investor by showing how easy it is to move its workforce to another location or to find substitute workforce in another location if it wants to break a trade or investment relationship and move its investment to somewhere else from that country.
If the investing party does not have an obstacle to move its investment due to not finding workforce in a country where it wants to move its investment to, then it will not be vulnerable in terms of workforce mobility.

**Question 10:** Is physical plant dedicated to the productive purpose? Or can it be repurposed? (dedicated=1, repurposed=0)

This question aims to understand whether the investing party becomes vulnerable due to the physical plant that is used for the investment it has done in a country. The question sounds similar to question 6 but they address different dimensions of an investment. Question 6 is about the specialized equipment and machinery, whereas this question is about actual facilities; the building itself, the grounds, the foundation, etc. Using a building for multipurpose fall into this question’s scope whereas using a machine for multipurpose fall into the scope of question 6.

Many physical plants can be repurposed. For example, if an investor builds a hospital, the building of the hospital can be repurposed and be used as a school. So the answer will be it can be repurposed for question 10. However, a hospital has some special equipment that cannot be used for other purposes. Therefore, the answer of this hospital example for question 6 will be that it requires investment in specialized (single-purposed) equipment.

Examples of dedicated physical plant include airports. An airport is only useful when it is used for the purposes for which it is built. It can, definitely, be used for other purposes as well but it is not as useful as other investment types to be used for other purposes. For example, a hangar can be used to store something but it is not a form that one can maximize its use. Other examples of dedicated facilities include coal-fired power plants, gas-fired power plants, and hydropower plants.

Dedicated physical plants increase the vulnerability level of the investor since they
cannot be used for other purposes. It is not profitable for the investor to stop the productivity of the investment and use it for other purposes if the physical plant is dedicated for a productive purpose.

2. Questions Related to Switching Costs

The next three questions address the three dimensions of switching costs; relational switching costs, opportunity costs, and financial switching costs. The rationale behind these questions is that the investing party will be vulnerable as its vulnerability caused by these three dimensions of switching costs increases.

**Question 11:** Are there a small number of available market participants with whom to partner? (Is it oligopsony or oligopoly?) (yes=1, no=0)

This question is about the relational switching cost dimension of vulnerability interdependence. It addresses the problem of fewness. If there is very few number of participants in a market, then an investor is much more vulnerable as it is less likely to switch. This dimension of vulnerability is considered at the international level since the index aims at understanding vulnerability in bilateral relationships.

Oil and valuable mineral markets are good examples to this dimension. Historically, oil purchasers have signed exclusive supplier agreements with oil producers, with which they guarantee to buy a particular amount of oil in return of getting concession from the supplier that it will not sell its oil to someone else. Similarly, the diamond market is locked up as the diamond industry is essentially a monopoly. There are very market participants who are willing to sell diamond to a particular customer.

Market participants could be from both the supplier side and the buyer side. It could be a
supplier, who supplies a component of the investor’s final product or some part that is used in the production process or it could be buyer of an investor’s product.

A hypothetical example helps better understand this question. Suppose that China has an agreement with Ghana on a bauxite mining project and there are no other bauxite miners in the world for China. In this case, there are two probabilities: Ghana is the only place that the world gets the bauxite from or all other bauxite mines are fully contracted by other miners or buyers. In this case, the lack of available alternative suppliers makes it very costly to switch for China.

A reverse hypothetical case can also be envisioned. Suppose that China is by far the largest buyer of cement. In this case, it will have the pricing power as it will have monopsony or oligopsony power. Because of its market power, China will be able to play off different suppliers. The switching cost would be very low in this reverse case of relational switching cost dimension.

Examples of oligopsony markets can be listed as telecommunications network service, aviation services, oil and natural gas production, and alumina refinery.

In sum, this question aims to capture the relationship between buyers and sellers and whether or not there are available alternative buyers or sellers in the international market.

**Question 12:** Is the produced good storable? (no=1, yes=0)

This question is about opportunity cost. Opportunity cost can simply be defined as the cost that an investor misses by investing in one place and not investing in another one. In other words, it is the difference of benefits between investor’s choice and other available choices. It is the cost of foregone investment.

This question aims to get the idea whether an investor can store some extra production in case it wants to switch to another host country or the host country wants to cut their bilateral
relationship. It assumes that the investor benefits from the end product by using the product for itself. For example, suppose that an investor produces computer chips in the country it has invested in and wants to move its investment to another host country since it foresaw its possible gains from moving to another host country more than locating its investment in its current host country. This investor needs to store some amount of computer chips in its warehouse to meet its demand in the interim period of between its current supplier and future supplier. In order to minimize the disruption in case of the counterparty ending their investment relationship, it has to store some extra amount of supplied goods. However, if the supplied product is not storable, then the vulnerability of the investor (buyer) goes up. Storage is only possible if the product is not perishable.

This question is about internationally traded commodities. For example, infrastructure investments produce an end-product but its storability is not important when answering this question. Drinking water is a good example for infrastructure investments. It can be stored but its storage is not for the investor party. Its storage can only be useful for the host party. For this reason, if an end-product of an investment is not internationally traded, then it is regarded as not storable even if it can be stored.

Investments regarding electricity generation involve a storable product, which is electricity. However, electricity’s storability is not the same with what this question aims at understanding about the project. Its storage in transmission lines does not last for a long time. An important amount of electricity is lost in its transmission period. If it would be feasible to store electricity in batteries, then it would fit for this question’s aim.

A good example of storability for a strategic commodity is the Strategic Petroleum Reserve requirement of the International Energy Agency. The agency requires its members to
store some amount of oil reserve, which is called the Strategic Petroleum Reserve. This petroleum reserve decreases the vulnerability level of the OECD member countries in case of having an oil supply disruption.

Storability has a reverse relationship with the level of investor’s vulnerability. When storability goes up, the investor’s vulnerability goes down.

**Question 13:** Are assets characterized by high sunk costs? (infinite high=3, high=2, low=1, infinite low=0)

This question addresses the costs that an investor sinks into an investment before it starts realizing profits. Those costs cannot be pulled back in case the investor wants to move its investment. In other words, it aims at addressing the ability to liquidate the investment assets.

This question is similar to question 7 (Are fixed production costs as percent of total costs high or low?). While question 7 aims to address the physical asset specificity dimension of the vulnerability interdependence, this question addresses its financial dimension. Question 7 addresses fixed production costs that an investment requires before starting a unit of production and this question addresses the costs that cannot be pulled back even an investor wants to cancel its investment. A fixed production cost does not necessarily mean that it is a sunk cost. For example, some high technological machines might be the fixed production cost of a production since it is needed to start one unit of production. However, if these machines can be moved to somewhere else, they are not considered among sunk costs. Investments that require high-technology are generally not associated with high sunk costs since the assets can generally be moved to somewhere else by the investor party. A hospital investment, for example, would fall into this category.

Public goods and services are at two extreme ends in terms of sunk costs. Public goods
tend to have very high sunk costs while services tend to have very low sunk costs. For this reason, four coding categories are used for answering this question, ranging from 3 to 0, indicating from infinite high to infinite low sunk costs. Public goods are generally coded as 3 and services are generally coded as 0. Construction investments are associated with high sunk costs, for example.

An investment that is associated with high sunk costs makes the investing party more vulnerable in terms of financial switching cost. It will be more costly for an investor to switch in case of having an investment asset characterized by high sunk costs.

3. Questions Related to Ratification and Compliance Costs

The next two questions address compliance costs. They indicate whether the investing party can trust what the hosting party says and what regime will provide solution in case of problems of distrust among parties. Although ratification cost is significant for measuring vulnerability at the interstate level, there is no question to measure it since ratification cost is hard to operationalize. Albeit, it should be included to a qualitative analysis of vulnerability interdependence.

**Question 14:** Does information asymmetry favor investing party or hosting party? (0 if it favors investor, 1 if it favors host)

“Unlike asymmetrical interdependence in trade, where power goes to those who can afford to hold back or break trade ties, information power flows to those who can edit and credibly validate information to sort out what is both correct and important.”

This question is about the compliance costs dimension of vulnerability. One party may

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know better about productive activity, pre-existing conditions of production site/facility or resources required for production (e.g. natural resources, financial resources, human resources) than the other party in investment projects. Suppose that an investor wants to start a mining investment. It is important to know who knows better about mine reserves under the ground. For example, Ghana can communicate with a Chinese mining company saying that it has iron reserves that will be enough to meet the Chinese demand for the next 20 years. In such a case, the buyer has to have the ability to verify seller’s claims. Typically, there are very high compliance costs in cases having high asymmetries of information between the contracting parties because there has to be some mechanisms/rules for verification of information provided by the seller.

This question is about verifying the truthfulness of counter-party’s claims: Is the investment recipient party capable of providing the good or service that the investor party is contracting for? The hosting party may claim that it has a lot of oil reserves. In this case, the investing party may want to verify the host’s claim by investing some amount of money before making the investment itself. A reverse example also might be possible: An investor may know better than recipient. For example, China may get information from US oil companies about Angola’s oil reserves before making an oil field investment in Angola. It is possible that US oil companies know better than Angolan national oil company since they have a long history of investing in Angolan oil fields.

Information asymmetry matters also in investments where two parties have fixed-price deals. Two parties may have a fixed-price deal for upgrading a railway, for example. In this case, it is highly likely that the hosting party knows better about the pre-existing infrastructure and therefore what it will cost to upgrade it to agreed status. In such an example, the information
asymmetry favors the hosting party.

This question is important to capture the idea of ratification and compliance costs theoretically. But it is difficult to operationalize it practically due to difficulty of finding the details of investment project deals. The best way to get the idea of information asymmetry would be to direct a basic question. The question of “who the seller is?” will be determinant when deciding about which party has information advantage. The seller tends to have information advantage. For example, if an African country is selling its natural resources to a Chinese company, then it will be regarded that information asymmetry favors the hosting party. If an investor is making a greenfield investment, then it will be regarded that the investor party has the information advantage. If an investor is reconstructing/renovating a previously built investment and it is known that there is a fixed price for the deal, for example, the hosting party will be regarded to have information advantage.

The more the investor party has information the less it becomes vulnerable in terms of compliance costs of an investment agreement.

**Question 15:** Is there an existing regime to monitor compliance among contracting parties?

(no=1, yes=0)

This question addresses compliance costs dimension of vulnerability interdependence. There might be a regime or an institution or some set of rules to monitor compliance among contracting parties. Having at least one of them helps contracting parties overcome problems of distrust. There are not really commercial courts in the international system. It is very hard for parties to find a resolution for their commercial problems.

Similar to the previous question, this question is important theoretically but hard to operationalize due to difficulty of finding the details of investment project deals. For this reason,
bilateral investment treaties (BIT) and free trade agreements (FTA) are used to answer this question. They include mechanisms for settling disputes and monitoring compliance among contracting parties.\textsuperscript{6} World Bank’s International Centre for Settlement of Investment Disputes (ICSID)\textsuperscript{7} is used for BITs for any bilateral investment relationships and the Chinese Ministry of Commerce’s (MOFCOM) website\textsuperscript{8} is used to monitor FTAs between China and the other contracting party. If there is a BIT or FTA between China and the host country for any investment project, then it is regarded that there is an existing regime to monitor compliance among contracting parties.

If there is an existing regime to monitor compliance among contracting parties, then compliance costs go down. In this case, vulnerability of the investing party will be less since it knows that there is a regime to overcome problems of distrust, which may lead to disruption of the bilateral relationship.

4. Question Related to Proportionality

Proportionality is measured by using one question. The question measures proportionality at the country level by comparing export percentages of the investor country and the investment recipient country in their bilateral trade.

**Question 16:** Are exports proportional among the two countries? (-1 if it favors the investing country, 0 if it is proportional, 1 if it favors the host country)

This question looks whether the trade relationship between two countries is proportional

\textsuperscript{6} Crochet, “Dispute Settlement Mechanisms in Free Trade Agreements”; Pohl, Mashigo, and Nohen, “Dispute Settlement Provisions in International Investment Agreements.”

\textsuperscript{7} World Bank International Centre for Settlement of Investment Disputes, “Database of Bilateral Investment Treaties.”

\textsuperscript{8} Chinese Ministry of Commerce, “China FTA Network.”
or favors one party. Proportionality is measured at the interstate level. It is calculated for each year and is given to any project in a year. For example, if the relationship between China and Angola favors China in 2014, all Chinese projects in Angola will have -1 as the proportionality value.

Export shares are used as the indicator of proportionality. In the codification of export shares, -1 is given if the percentage of investor country’s exports to the investment recipient country within its total exports is higher than the percentage of investment recipient country’s exports to the investing country within its total exports and 1 is given if proportions favor the investment recipient country. The index measures vulnerability interdependence from the perspective of investor country. For this reason, -1 is given as the proportionality value to decrease investor country’s vulnerability value if it favors the investor country.

The reason why continuous variable is not preferred over the dichotomous variable is that the trade data of the African countries may not be reliable. Specifically, the trade data is expected to reflect imprecise amounts of trade volumes. Hence, continuous variable of the trade data is converted to a dichotomous variable.

The more the investor country’s exports to the investment recipient country within its total exports compared to the investment recipient country’s exports to the investor country within its total exports, the less the investor country becomes vulnerable. Suppose that country A and country B have bilateral trade relationship among each other in a particular year. If country A’s exports to country B within country A’s total exports is higher than country B’s exports to country A within country B’s total exports, then this trade relationship favors country A. The rational is that country B will suffer more if the trade relationship is severed by a party.

It is discussed in the proportionality part of the literature review chapter that type of
traded commodity should also be considered to get a true picture of proportionality. For purposes of not making the vulnerability interdependence index highly complex, the type of commodity is disregarded in the index. Only total trade values are used in the index to get a proportionality value.

5. Question Related to Issue Linkages

**Question 17:** What is the dyadic affinity score for the two countries? (least similar interests=-1, most similar interests=1)

    Question 17 examines whether the selected two countries link different issues by making concessions in order to get some additional bargaining leverage in return. A good way to understand whether two countries link different issues is to look at their voting similarity at the UN as it is a good indicator of their responses to issues in international arena. In an investor-recipient relationship, the investor is likely to expect getting support from the recipient for the issues at the international arena in return for getting the host country’s support.

    Issue linkages is measured by using one parameter that belongs to a dataset on voting similarity in the UN General Assembly. The dyadic affinity score data\(^9\) is used to represent the level of issues that two countries link. The dataset has a data ranging from -1 to 1, indicating the least similar interests and the most similar interests of any two countries in a given year.

    The countries that have more similar interests are expected to link more issues. As mentioned when explaining issue linkages in the previous chapter, “the hypothesis for issue linkage can be stated as that a state that can create issue linkages will be less vulnerable in an interdependent relationship because it raises the cost of defection for its counterparty. The other

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\(^9\) Voeten, Strezhnev, and Bailey, “United Nations General Assembly Voting Data V18.”
party may lose concessions it gets by cooperating in case of defecting.” In this case, if the host country has issues to link in order to gain additional bargaining leverage, it will have lower level of vulnerability, which means higher level of vulnerability for the investor party. For this reason, 1 is given for the most similar interests, indicating investor’s high level of vulnerability.

In general, issues that are linked work in favor of the country that has more bargaining leverage. The coder should be careful about selecting the country with more bargaining leverage. If the host country has more additional leverage in bargain, then investor would be more vulnerable. If the investor country has more additional bargaining leverage, then it would work in favor of the investor country and will increase host country’s vulnerability. In the Sino-African relations, the African countries have always more bargaining leverage, which makes China more vulnerable in terms of issue linkages.

**Data Selection**

The index of vulnerability interdependence requires data at the project level. In order to understand whether an investment makes the investing country vulnerable, one should direct the questions listed above to each one of individual projects that an investing country makes in a host country.

Most of the data that are used in this study are created by the author by using descriptive information of Chinese foreign direct investments. More specifically, questions 1 to 15 require data in Chinese investments that includes project details (investment sector and subsector, productive activity of investment, whether it is a greenfield investment or repairing/restoring an existing investments, the end-product obtained from this investment etc.). Question 16 creates a new proportionality data by using export volumes of investor and host countries. Question 17
uses dyadic affinity score as it is provided in its original source.

Dataset Selection for the Chinese FDI Data

International capital flows consist of both official and private flows. Official Development Assistance (ODA) and Other Official Flows (OOF) are two major official sources of international capital flows. Private flows within international capital flows consist of Foreign Direct Investment (FDI), private sector loans to developing countries, and export credits. These flow types are used to see a country’s capital flows into another country. By definition, FDI “takes place when a corporation in one country establishes a business operation in another country, through setting up a new wholly owned affiliate, or acquiring a local company, or forming a joint venture in the host economy.”

ODA and OOF, which are official sources of international capital flows, are put forth by the OECD more than 40 years ago. According to the OECD definition, ODA is “government aid designed to promote the economic development and welfare of developing countries.” Government aid includes “‘soft’ loans (where the grant element is at least 25% of the total) and the provision of technical assistance.” The third major capital flow, OOF, is defined as “official sector transactions that do not meet official development assistance (ODA) criteria.” OOF includes “export credits extended directly to an aid recipient by an official agency or institution (official direct export credits); the net acquisition by governments and central monetary institutions of securities issued by multilateral development banks at market terms; subsidies

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10 Moran, “Foreign Direct Investment.”
12 “Official Development Assistance (ODA) - Net ODA - OECD Data.”
13 “Official Development Assistance (ODA) - Net ODA - OECD Data.”
14 “Other Official Flows (OOF).”
Among official and private international capital flow types, FDI is considered to provide answers for questions of vulnerability interdependence index because it consists of the kinds of investment projects to which the index needs to direct its questions. The aggregate data in the country level or regional level cannot answer those questions as they cannot capture specifications of investments due to not providing enough details about projects. For this reason, this study will use FDI data at the project level, rather than at the country level.

There are many datasets that provide FDI data. They include (1) United Nations Conference on Trade and Development’s (UNCTAD) dataset, (2) UNCTAD’s country profile pages, (3) Investment Map dataset of the International Trade Centre and (4) OECD Statistics dataset. All of these datasets have some limitations. UNCTAD’s dataset provides inflow, outflow, instock and outstock FDI data, but all are provided as country-level bilateral statistics. UNCTAD’s country profile pages list detailed FDI data for some countries. However, the data reports are not updated (dates of data are between 2011 and 2013) and China and the African countries –except South Africa- are not in the list of countries whose data are available. Investment Map of the International Trade Centre provides data for each country’s inward FDI by sectors. It also provides how much a country invested in a host country’s particular sector. The problem about this dataset is that its data for many African countries is not detailed; many of those countries have aggregate country-level data. The reason why OECD statistics dataset is not helpful for this study is that it only provides data for OECD countries. One side of bilateral FDI relationship has to be an OECD member country. Neither China nor African countries are

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15 “Other Official Flows (OOF).”
members of the OECD.

Although China treats most of its financial data like a state secret, it lists registered FDIs. The Chinese government is one of the good data sources for Chinese FDI. Chinese Ministry of Commerce (MOFCOM) provides data in two ways: It publishes statistical bulletins\textsuperscript{16} and lists registered FDI projects of Chinese companies\textsuperscript{17} from a database. Both datasets have some limitations. The statistical bulletins are not updated regularly and have very limited data. As of September 2017, the latest available FDI statistical bulletin was published on November 25, 2016. All bulletins of 2016 do not present outward FDI data. They just provide the data for top ten inward FDI investor countries with the amounts they invested in China. Compared to MOFCOM’s statistical bulletins, its Investment Project Information Database provide better data. This database’s website provides data both for inward FDI projects and outward FDI projects. The data is updated regularly by adding new projects and dataset have detailed information about each project at the project level. For each outward FDI project, the dataset presents project name, date, project type, industry, location of outward FDI investment, project validity period, total amount of project capitals, total amount of investment to be attracted, expected annual sales revenue, expected employment figure, and some description about the project content, investor condition, and environment protection. The problem with this dataset is that its English version presents less project data compared to its Mandarin version for outward FDI projects. Even its Mandarin version does not comprehend as much data as some other datasets, which is the reason why this study did not prefer using MOFCOM’s Investment Project

\textsuperscript{16} MOFCOM’s Statistical Bulletins can be reached from http://english.mofcom.gov.cn/article/statistic/foreigninvestment/ (Last accessed on September 3, 2017).

\textsuperscript{17} Investment Project Information Database of the Chinese Ministry of Commerce provides this data. The Mandarin language version of database can be reached from http://project.fdi.gov.cn/ and the English version can be reached from http://project.fdi.gov.cn/1800000091_10000108_8.html (Last accessed on September 4, 2017)
AidData project has a good source of dataset about China’s outgoing capital flows. Its Global Chinese Foreign Assistance is more detailed, more comprehensive and more up-to-date compared to other datasets listed above. It includes all types of Chinese international capital flows. Though, this dataset has only official financial flows that aim development in the recipient country. It, therefore, consists of official development assistance (ODA) or other official flows (OOF).

The China Global Investment Tracker dataset of the American Enterprise Institute (AEI) is the most comprehensive dataset among all others. It captures foreign direct investments (FDIs), which is a type of international private financial flows. The dataset lists investments with an investment amount that is higher than $100 million. Omitting the investment data with values lower than $100 million is useful for the purposes of using it in a vulnerability interdependence index. It is a useful threshold for the index because projects with investment amounts lower than this amount are not significant in creating vulnerability for the investor country.

China Global Investment Tracker Dataset of the AEI

The most helpful aspect of this dataset for the vulnerability interdependence index is that its unit of analysis is the project. Having projects as the unit of analysis helps to get a clear view of vulnerability interdependence since most of the 17 questions of vulnerability interdependence are directed to investment projects. Datasets that provide aggregate data (either aggregate data for any two country in a given time period or aggregate data for any sector in a bilateral

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18 AidData, “Frequently Asked Questions.”
19 Scissors, “China Global Investment Tracker.”
relationship in a given time period) are not appropriate for the purposes of using them to get answers for vulnerability interdependence index’s questions.

The China Global Investment Tracker dataset tracks various information for each investment project record:

- Project date: It is given as month and year.

- Chinese entity: It is the Chinese company which makes the investment. It can be either a private or state-owned Chinese company. The dataset only includes names of conglomerates although the investment is done by one of their subsidiary companies.

- Quantity: The USD amount of the Chinese FDI. The dataset has a threshold of $100 million. It omits investments whose value is lower than this amount. The value of investments are rounded to $10 million. For example, an investment project with a value of $243 million is listed as $240 million.

- Share size: This row has data only if the project is invested by more than one company. If more than one company is included in the investment, then this row shows the share size of the Chinese company.

- Transaction party: This information is valid for Chinese company buying pre-existing investments. It does not have any data for greenfield investments as there is no transaction party in a greenfield investment.

Sector, subsector, country, region, and whether the investment is a part of China’s One Belt One Road (OBOR) initiative are other information that this dataset provides.

The publicly available data of this dataset is very helpful. However, more information about investment projects is required to be able to answer questions on the vulnerability interdependence index. A detailed description of each investment project is essential to grasp
specifications of investments. The dataset provides sector and subsector information but they are not enough to answer questions of the index. For example, an investment in real estate sector and construction subsector might be a house construction or a cement plant construction. Specifications of a house construction investment and a cement plant construction investment is very different in terms of creating vulnerability for the investor party. Hence, more information is collected from various sources about each investment project listed in this dataset. Search in search engines in English and Mandarin languages provided detailed information about the projects. Company websites (either conglomerate’s website or subsidiary companies’ websites) were leading sources for gathering further information about the project. Newspapers and some other news spots are also used to gather detailed project information.\textsuperscript{20} During the searching period, we came across with some additional projects that are not listed in the China Global Investment Tracker dataset. These investment projects are also added with their detailed information.

\textit{Datasets for Other Data}

Data for questions 1 to 15 are answered by the coder according to each project’s specifications. The base for project information is CGIT dataset, which is described in previous pages in more detail. Only questions 16 and 17 use different datasets.

Question 16 is indicative of export and import proportionality between host country and investor country. It is simply obtained by calculating the share of the first country’s exports to the second country within the first country’s total export volume. Two percentage values are

\textsuperscript{20} Dr. Derek Scissors, the creator of the China Global Investment Tracker dataset, from the American Enterprise Institute kindly helped to get detailed information for 15 investment projects by providing their data sources.
calculated; one for host country and one for investor country. If investor country’s percentage of export share is greater than host country’s percentage of export share, then this indicates that the investor has proportionality advantage, which makes it less vulnerable. If host country has proportionality advantage, then this makes investor country more vulnerable. Export data for calculating proportionality value is obtained from World Bank’s WITS (World Integrated Trade Solution) dataset.21 This dataset has some missing values. Those values are filled by the data obtained from the Correlates of War Project’s Trade v4.0 dataset.22 There has been some missing data even after including data from COW’s Trade v4.0 dataset. How these missing data are handled is described in the next page in the section titled “How Are Missing Values Handled?”.

Question 17 uses a dataset, reflective of issue linkages between any two countries. Voting preferences in the United Nations General Assembly is an indicator of how two countries link different issues. Hence, the dyadic affinity score in United Nations General Assembly Voting Data is used to represent issue linkages.23 Within this dataset, dyadic affinity score using 2 category (yes or no) vote data (titled as “s2un” in the dataset) is used. This indicator ranges from -1 (least similar interests) to 1 (most similar interests). It is included in the vulnerability interdependence as it is.

*How Are Missing Values Handled?*

There were some missing values in proportionality and dyadic affinity score data. An index requires having all data for a given row. If there is a missing data point for any of the 17

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22 Barbieri, Keshk, and Pollins, “Trading Data”; Barbieri, Keshk, and Pollins, “Correlates of War Project Trade Data Set Codebook, Version 4.0.”
questions, there will not be an index score for this data point’s row since the index would be lower as much as the value of that missing value. In other words, the index score will not be able to be calculated without having all data points since the score will not be comparable with others. For this reason, missing data should be extrapolated. The regression imputation method, which is a data extrapolation method, is used to predict the missing data points. In this method, missing data points are substituted according to regression that is obtained from the available data.

Extrapolated data are as follows:

- Angola proportionality data for 2016 and 2017,
- Angola dyadic affinity score for 2015, 2016, and 2017,
- Ghana proportionality data for 2015 and 2017,
- Ghana dyadic affinity score for 2015, 2016, and 2017,
- Kenya proportionality data for 2014, 2015, 2016, and 2017,
- Kenya dyadic affinity score for 2015, 2016, and 2017,
- Nigeria proportionality data for 2015, 2016, and 2017,
- Nigeria dyadic affinity score for 2015, 2016, and 2017,

**Reliability and Validation of the Vulnerability Interdependence Index**

Reliability and validation are important checkmarks for constructing an index. One should make sure that an index should be both reliable and valid measure of intended concept. These two concepts are sometimes confused since they are mostly used together. Hence, this part will first define and exemplify what these concepts are. Second, the methods that are used for providing reliability and validity of vulnerability interdependence index will be discussed.
Reliability

Reliability “concerns the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials”. In other words, it is implementation of procedures consistently across cases and getting the same results. Validity is making sure that the measure is indeed measuring the intended concept with no systematic or random measurement error. It is possible to have a reliable and not valid measure. A miscalibrated ruler is example of this. Suppose that a ruler is intended to be had as 1 meter but miscalibrated by 3 centimeters, meaning that it is 97 centimeters. Every time a person uses that ruler, he/she will get the same measurement because he/she uses the same instrument and it gives him/her the same result. However, the result is not valid as the person measures with the same miscalibrated ruler every time. On the other hand, it is reliable as the person gets the same results after applying the same procedures for measuring the intended instrument. An instrument can be reliable but not valid. However, the inverse cannot be argued. Every valid instrument has to be reliable.

This study uses the retest method for reliability. The retest method is considered to be appropriate to check reliability of the index because the questions of the index that this study proposes are not subjective and the results of most questions are binary variables. All questions are directed to a particular project, meaning that answers come from projects, not from a person’s feelings, views, etc. This means that answers of the questions are objective. Second point about the answers is that they do not consist of continuous variables or percentages, etc. They give categorical values, either only 0 and 1 or four categories as 0, 1, 2, and 3. In the retest method, “the same test is given to the same people after a period of time. The reliability of the

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test (instrument) can be estimated by examining the consistency of the responses between the
two tests”.\textsuperscript{25} In other words, it only provides temporal reliability. This method is considered to be
enough as the answers are objective and simple yes/no answers. In order to implement this
method, nine projects, reflecting the variety of different investment types, were chosen. Answers
to these projects were coded by the author in May 2018 and July 2018. The previous coding was
found to be consistent with the second coding. This means that the index is a reliable measure as
it gives the same results when the same procedures are implemented repeatedly at different
times.\textsuperscript{26}

\textit{Validation}

“[V]alidity concerns the crucial relationship between concept and indicator”.\textsuperscript{27} An
indicator has to correctly represent an abstract concept to be able to call it as a valid measure. For
example, if a researcher wants to measure intelligence, then an IQ test will be a valid indicator. If
the researcher uses income as intelligence’s indicator, it would not be valid. The concept
(intelligence) should be measured by using a valid indicator (IQ test). There are various methods
of controlling for validity of a test/indicator. These different methods take different approaches
in assessing the ability of a test/indicator to measure what it aims to measure.

Criterion-related validity, content validity and construct validity are three widely used
validity methods. Criterion-related validity, as Carmines and Zeller\textsuperscript{28} quote from Nunnally, “is at
issue when the purpose is to use an instrument to estimate some important form of behavior that

\textsuperscript{25} Key, “Reliability and Validity.”
\textsuperscript{26} Key.
\textsuperscript{27} Carmines and Zeller, \textit{Reliability and Validity Assessment}, 12.
\textsuperscript{28} 17.
is external to the measuring instrument itself, the latter being referred to as criterion.” 29 For example, the success of a group of non-native speakers of English in the TOEFL exam can be validated by their success in English conversations. In this case, higher correlation between TOEFL exam (measuring instrument) and criterion (ability of conversing in English) would indicate higher validity of the measuring instrument. The second method, “content validity depends on the extent to which an empirical measurement reflects a specific domain of content”.30 It is simply sampling a broad content by selecting correct samples. A test should be a sample of the content that it purports to measure. In this method, content experts establish validity of the test. There is no method or procedure to determine the extent to which the assessment is content valid.

Construct validity is the most appropriate method for assessing validity of the vulnerability interdependence index that is suggested in this study.31 Because validity is determined upon theoretical expectations in this method: “if the performance of the measure is consistent with theoretically derived expectations, then it is concluded that the measure is construct valid”.32

This study will prefer the construct validity method for assessing the extent to which it is valid. Two case study chapters will be used for this purpose. The first case study chapter will discuss the findings of vulnerability interdependence index for four subsectors while the second case study chapter will have a discussion of three African countries in terms of what investments create higher or lower vulnerability score in these countries. If what the index finds is consistent

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29 Nunnally, Psychometric Theory, 87.
31 Construct validation has a broad applicability in the social sciences in general. The main reason of this is that social sciences represent abstract theoretical concepts. For a broader discussion of why construct validity is more useful in social sciences compared to criterion-related validity and content validity, see Carmines and Zeller, 26–27.
32 Carmines and Zeller, 27.
with the narrative that is told in case study chapters, then the index will be concluded as a valid measure of vulnerability interdependence.

**Index Construction Method: Additive Aggregation**

There are different methods for constructing an index. The additive method and reduction method are the two leading methods for composite indices like the vulnerability interdependence index. This study prefers additive method as the answers are appropriate (higher values indicates higher vulnerability for the investor) for using it. The data reduction method is not appropriate because the index uses subcategories of vulnerability interdependence. Each indicator of the index measures different aspects of vulnerability and are not expected to correlate. Since the chief aim of the reduction method is to interpret how a group of variables are related by looking at their correlation, the reduction method is considered to be inappropriate for vulnerability interdependence index.

A widely-used method of index construction, principal component analysis (PCA), is not appropriate for the index because the way the index is designed and the data available violate the most important assumption of PCA. “Principal components analysis, and more specifically factor analysis, groups together individual indicators which are collinear to form a composite indicator that captures as much as possible of the information common to individual indicators”33. The most important assumption of PCA is that the data should be suitable for data reduction (“There needs to be a linear relationship between all variables”)34. The data we have violates this assumption because it is not expected to correlate as it measures different aspects of

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34 Laerd Statistics, “Principal Components Analysis (PCA) Using SPSS Statistics.”
vulnerability. Even if some variables might correlate, their correlation is not meaningful since each of the five concepts and each questions of these concepts are distinct measures.

Additive Aggregation Index

The additive aggregation method is preferred for constructing the vulnerability interdependence index because the index has sub-categories of vulnerability interdependence, namely asset specificity, switching costs, ratification and compliance costs, proportionality and issue linkages. These concepts represent different aspects of vulnerability interdependence. Correlations among their indicators would not be meaningful in terms of data reduction method. Additive aggregation method will be useful after the data is normalized. The index is constructed in a way to be more suitable for an additive aggregation method because all questions of the index is designed to have higher value for higher level of vulnerability.

Data Normalization Method: Minmax

After the additive aggregation method is selected as the most suitable method for index construction, how data should be normalized is one of next important decisions to make. There are various methods for data normalization. Different normalization and weighing methods may create different outcomes for the index. Robustness tests will be carried out to understand whether changes in data cause sensitivity for the index score in different normalization and weighing methods.

The most suitable normalization methods are considered to be standardization by using Z-scores, decimal scaling and minmax normalization. Z-score normalization is based on calculating the difference between a selected sample data and the mean of sample population
divided by the standard deviation of sample population.

\[ Z \text{ score} = \frac{X - \mu}{\sigma} \]

The outcome of the above equation gives us the distance between our selected sample and the mean in the unit of standard deviation. For example, if our Z score is 1.3, it means that the selected data is 1.3 standard deviations above the mean. Z score helps us to understand the relativity of our sample data compared to others. In other words, it helps to understand how unusual our selected data is compared to the whole population. It does so by using a selected data point within the selected sample population, getting mean and standard deviation. Z score standardization assumes that the data is normally distributed. Z score table indicates how well or bad is our selected sample compared to others by providing the information of how many percentile the selected data is in.\(^{35}\)

One of other major drawbacks of using Z score normalization is that it would weigh the same value differently in different indicators. For example, 0 will not be converted to the same value for all indicators of an index. Instead, it will be converted to values that indicate how rare its existence is because Z score assumes a normal distribution. If it is very rare in an indicator’s data, it will have very high or very low value since it will be away from the mean in this case.

What we expect to get from data normalization is to scale all of our data in the same interval so that we can combine one question of vulnerability interdependence index with the others by aggregating them. Decimal scaling and minmax normalization are two useful techniques to have all data in the same interval. Decimal scaling helps us to convert our dataset to range from -1 to 1 and minmax helps us to convert our dataset to range from 0 to 1.

Decimal scaling is calculated by dividing our sample value by 10 to the power the

\(^{35}\) Laerd Statistics, “Standard Score - Understanding z-Scores and How to Use Them in Calculations.”
number of digits of the maximum value.\textsuperscript{36}

\[ v' = \frac{v}{10^j} \]

(where \( j \) is the number of integers of the maximum absolute value)

In decimal scaling, the converted dataset’s interval is \([-1,1]\) where minus values indicate negative values in the original dataset. In other words, if a data is lower than 0 in the original dataset, it will be lower than 0 in the new dataset as well.

Minmax normalization is similar to decimal scaling normalization but minmax ranges from 0 to 1. Its calculation uses the minimum and maximum values of the sample. It simply divides the difference between the selected sample and the minimum value by the difference between the maximum and the minimum value.\textsuperscript{37}

\[ \text{minmax value} = \frac{X - \text{min}}{\text{max} - \text{min}} \]

An advantage of using minmax normalization is that it will always give 0 for the lowest value of an indicator and 1 for the highest value of an indicator so that the converted data will always range from 0 to 1.

\textsuperscript{36} Aguiar and Johnson, “Data Transformation."
\textsuperscript{37} Aguiar and Johnson; OECD, European Union, and Joint Research Centre-European Commission, \textit{Handbook on Constructing Composite Indicators}. 
Table 9: Comparison of Three Normalization Methods (Z-score, decimal scaling, minmax)

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z score normalization</td>
<td>- It converts the dataset to range in the same interval</td>
<td>- Its range is wider than other normalization methods because its value is standard deviation value.</td>
</tr>
<tr>
<td></td>
<td>- It helps to compare a selected data against others to understand how unusual the selected data is.</td>
<td>- It has much higher/lower values for rare values which makes it not feasible for comparison in an additive index. (For example, 0 will not be converted to the same value for all indicators because Z score is calculated based on how many standard deviations the selected data is away from the sample.)</td>
</tr>
<tr>
<td>Decimal scaling normalization</td>
<td>- It converts the dataset to range in the same interval</td>
<td>- It is not comparable against other indicators because the converted value is just the decimal form of the original value. In this case, the converted value will generally not have values of -1 and 1.</td>
</tr>
<tr>
<td></td>
<td>- Its range is narrow enough to use it in an additive index with other indicators.</td>
<td></td>
</tr>
<tr>
<td>Minmax normalization</td>
<td>- It converts the dataset to range in the same interval</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Its range is narrow enough to use it in an additive index with other indicators.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- It is comparable against other indicators because the minimum and the maximum values in the original indicator are converted 0 and 1.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Compiled by the Author with the Information Drawn From Various Sources

This study will use minmax normalization because it is the most useful technique for an

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additive index that has equal weights for all indicators of a composite index. It satisfies what an additive index requires: it converts the dataset to range in the same interval and it is comparable against other indicator because all normalized data range from 0 to 1.

Weighing the Indicators of the Vulnerability Interdependence Index

The question of how much each of the 17 indicators of vulnerability interdependence index will weigh for the total index score is another significant step of constructing an additive index. The analytical hierarchy process (AHP) will be used to determine the weights of each indicator. AHP helps in decision-making process to weigh each indicator within its subcategories to get a percentage score for each indicator. It makes pairwise comparisons between each indicator of a subcategory. For example, asset specificity has four subcategories. One of its subcategories, location asset specificity, has five indicators. A 5x5 pairwise comparison is used for location asset specificity. Similarly, the same method is applied for other three categories of asset specificity. Then, a 4x4 pairwise comparison is done for asset specificity itself for its indicators (location asset specificity, physical asset specificity, human asset specificity, plant asset specificity). The importance degree of each indicator is determined based on the expertise of the author and weighing scores are calculated accordingly. Details of calculation for pairwise comparisons are presented in Weighing of Index Indicators by Using Analytic Hierarchy Process section. The results of the weights are presented in Table 10.

“Data Discretization - Preparing Datasets for Analysis”; OECD, European Union, and Joint Research Centre-European Commission, Handbook on Constructing Composite Indicators.
Table 10: Weighing of Vulnerability Interdependence Index's Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Weighing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Specificity</strong></td>
<td></td>
</tr>
<tr>
<td><em>Location Asset Specificity</em></td>
<td></td>
</tr>
<tr>
<td>1. Are the assets or productivity mobile?</td>
<td>0.028</td>
</tr>
<tr>
<td>(infinite immobile=3, immobile=2, mobile=1, infinite mobile=0)</td>
<td></td>
</tr>
<tr>
<td>2. Are transportation costs amenable to</td>
<td>0.016</td>
</tr>
<tr>
<td>decentralized production?</td>
<td></td>
</tr>
<tr>
<td>(infinite not amenable=3, not amenable=2, amenable=1, infinite amenable=0)</td>
<td></td>
</tr>
<tr>
<td>3. Is the value per unit of end-product’s</td>
<td>0.009</td>
</tr>
<tr>
<td>weight high? (infinite high=0, high=1,</td>
<td></td>
</tr>
<tr>
<td>low=2, infinite low=3)</td>
<td></td>
</tr>
<tr>
<td>4. Is it the production of a natural (extracted) resource? (yes=1, no=0)</td>
<td>0.013</td>
</tr>
<tr>
<td>5. Are the assets generally co-located with</td>
<td>0.019</td>
</tr>
<tr>
<td>other productive activities within a host</td>
<td></td>
</tr>
<tr>
<td>country? (yes=1, no=0)</td>
<td></td>
</tr>
<tr>
<td><strong>Physical Asset Specificity</strong></td>
<td></td>
</tr>
<tr>
<td>6. Does production require investment in</td>
<td>0.040</td>
</tr>
<tr>
<td>specialized (single-purpose) equipment?</td>
<td></td>
</tr>
<tr>
<td>(yes=1, no=0)</td>
<td></td>
</tr>
<tr>
<td>7. Are fixed production costs (as percent of</td>
<td>0.026</td>
</tr>
<tr>
<td>total costs) high or low?</td>
<td></td>
</tr>
<tr>
<td>(infinite high=3, high=2, low=1, infinite low=0)</td>
<td></td>
</tr>
<tr>
<td><strong>Human Asset Specificity</strong></td>
<td></td>
</tr>
<tr>
<td>8. Does production require a specialized,</td>
<td>0.048</td>
</tr>
<tr>
<td>high-skilled workforce? (yes=1, no=0)</td>
<td></td>
</tr>
<tr>
<td>9. Is the workforce mobile? (no=1, yes=0)</td>
<td>0.018</td>
</tr>
<tr>
<td><strong>Plant Asset Specificity</strong></td>
<td></td>
</tr>
<tr>
<td>10. Is physical plant dedicated to the</td>
<td>0.047</td>
</tr>
<tr>
<td>productive purpose? Or can it be</td>
<td></td>
</tr>
<tr>
<td>repurposed? (dedicated=1, repurposed=0)</td>
<td></td>
</tr>
<tr>
<td><strong>Switching Costs</strong></td>
<td></td>
</tr>
<tr>
<td><em>Relational</em></td>
<td></td>
</tr>
<tr>
<td>11. Are there a small number of available</td>
<td>0.066</td>
</tr>
<tr>
<td>market participants with whom to partner?</td>
<td></td>
</tr>
<tr>
<td>(Oligopsony or oligopoly) (yes=1, no=0)</td>
<td></td>
</tr>
<tr>
<td><em>Opportunity</em></td>
<td></td>
</tr>
<tr>
<td>12. Is the produced good storable? (no=1,</td>
<td>0.079</td>
</tr>
<tr>
<td>yes=0) (It is always 0 if it is a public</td>
<td></td>
</tr>
<tr>
<td>good)</td>
<td></td>
</tr>
<tr>
<td><em>Financial</em></td>
<td></td>
</tr>
<tr>
<td>13. Are assets characterized by high sunk</td>
<td>0.119</td>
</tr>
<tr>
<td>costs? (infinite high=3, high=2, low=1,</td>
<td></td>
</tr>
<tr>
<td>infinite low=0)</td>
<td></td>
</tr>
<tr>
<td><strong>Ratification and Compliance Costs</strong></td>
<td></td>
</tr>
<tr>
<td>14. Does information asymmetry favor investing</td>
<td>0.044</td>
</tr>
<tr>
<td>party or hosting party? (0 if it favors</td>
<td></td>
</tr>
<tr>
<td>investor, 1 if it favors host)</td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Weighing</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>15. Is there an existing regime to monitor compliance among contracting parties? (no=1, yes=0)</td>
<td>0.044</td>
</tr>
<tr>
<td><strong>Proportionality</strong></td>
<td></td>
</tr>
<tr>
<td>16. Are exports proportional among the two countries? (-1 if it favors the investing country, 0 if it is proportional, 1 if it favors the host country)</td>
<td>0.206</td>
</tr>
<tr>
<td><strong>Issue Linkages</strong></td>
<td></td>
</tr>
<tr>
<td>17. What is the dyadic affinity score for the two countries? (least similar interests=-1, most similar interests=1)</td>
<td>0.176</td>
</tr>
</tbody>
</table>

**Justification of Case Selection**

This study has two case study chapters in the following pages. One is the case study of four subsectors of investment projects and the other one is the case study of the three African countries.

There are 25 subsectors in which China had investments in its five top trading African partner countries from 2005 till 2017. Four of them are selected for a detailed analysis in the following chapter. The selection criteria for the subsectors have been their diversity in terms of creating vulnerability for the investor party.

Service sector investments and public goods-related sector investments are at the two extreme ends of vulnerability. Hence, one service sector and one public goods-related sector are selected for further analysis. As the service sector, banking subsector of the finance sector is preferred in the following chapter. The banking subsector is also one of the subsectors that have the lowest vulnerability score. As for the public goods-related sector, this study examines shipping subsector. Investment projects in this subsector are in fact not public goods but has the characteristics of public goods.

Steel subsector of the metals sector is another subsector that is selected to analyze as the
case study. It is one of the top-rated subsectors in the vulnerability interdependence index. It is also a representative of heavy industry subsectors, which are hypothesized to be one of the high-scored subsectors in the index. The last subsector that is selected for further analysis is rail subsector of the transport sector. The reason of selecting this subsector is that it is both one of the top-rated subsectors in the vulnerability interdependence index and has the highest amount of investments among all 25 subsectors.

China’s trade relations has been the criteria for selecting country cases. Three of the top five Sub-Saharan African trading partners –that are ordered according to the total of import and export volumes of China in 2016—are selected according to the total value of their import and export volumes. Among the five heaviest trading partners of China, three countries with the highest levels of vulnerability are selected.

Table 11: China's Top 20 Trading Partners in Sub-Saharan Africa in 2016

<table>
<thead>
<tr>
<th>Partner Name</th>
<th>China’s Exports (US$ Thousand)</th>
<th>China’s Imports (US$ Thousand)</th>
<th>Export + Import (US$ Thousand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 South Africa</td>
<td>12,849,507.64</td>
<td>22,228,893.55</td>
<td>35,078,401.19</td>
</tr>
<tr>
<td>2 Angola</td>
<td>1,680,398.62</td>
<td>13,966,117.08</td>
<td>15,646,515.70</td>
</tr>
<tr>
<td>3 Nigeria</td>
<td>9,713,912.55</td>
<td>907,008.03</td>
<td>10,620,920.58</td>
</tr>
<tr>
<td>4 Ghana</td>
<td>4,666,604.09</td>
<td>1,309,649.87</td>
<td>5,976,253.96</td>
</tr>
<tr>
<td>5 Kenya</td>
<td>5,587,646.82</td>
<td>97,135.49</td>
<td>5,684,782.31</td>
</tr>
<tr>
<td>6 Tanzania</td>
<td>3,566,861.31</td>
<td>315,826.81</td>
<td>3,882,688.12</td>
</tr>
<tr>
<td>7 Congo, Dem. Rep.</td>
<td>992,466.99</td>
<td>2,084,962.10</td>
<td>3,077,429.09</td>
</tr>
<tr>
<td>8 Zambia</td>
<td>489,913.91</td>
<td>2,183,500.68</td>
<td>2,673,414.59</td>
</tr>
<tr>
<td>9 Sudan</td>
<td>2,129,730.00</td>
<td>504,705.99</td>
<td>2,634,435.99</td>
</tr>
<tr>
<td>10 Senegal</td>
<td>2,194,360.63</td>
<td>161,589.46</td>
<td>2,355,950.09</td>
</tr>
<tr>
<td>11 Benin</td>
<td>2,039,435.62</td>
<td>55,392.33</td>
<td>2,094,827.95</td>
</tr>
<tr>
<td>12 Togo</td>
<td>1,919,246.64</td>
<td>105,331.52</td>
<td>2,024,578.16</td>
</tr>
<tr>
<td>Partner Name</td>
<td>China’s Exports (US$ Thousand)</td>
<td>China’s Imports (US$ Thousand)</td>
<td>Export + Import (US$ Thousand)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>13 Cameroon</td>
<td>1,557,030.06</td>
<td>402,230.11</td>
<td>1,959,260.17</td>
</tr>
<tr>
<td>14 Gabon</td>
<td>377,186.73</td>
<td>1,439,078.97</td>
<td>1,816,265.70</td>
</tr>
<tr>
<td>15 Mozambique</td>
<td>1,308,557.80</td>
<td>479,356.87</td>
<td>1,787,914.67</td>
</tr>
<tr>
<td>16 Guinea</td>
<td>1,144,424.26</td>
<td>630,056.94</td>
<td>1,774,481.20</td>
</tr>
<tr>
<td>17 Liberia</td>
<td>1,592,580.57</td>
<td>48,171.16</td>
<td>1,640,751.73</td>
</tr>
<tr>
<td>18 Mauritania</td>
<td>869,707.18</td>
<td>747,559.05</td>
<td>1,617,266.23</td>
</tr>
<tr>
<td>19 South Sudan</td>
<td>46,253.29</td>
<td>1,459,751.41</td>
<td>1,506,004.70</td>
</tr>
<tr>
<td>20 Zimbabwe</td>
<td>387,485.50</td>
<td>726,879.97</td>
<td>1,114,365.47</td>
</tr>
</tbody>
</table>

Source: Created by the Author With the Data Drawn from the World Integrated Trade Solution Database of the World Bank

This study will examine the characteristics of Chinese investments in the three African countries: What sectors does China tend to invest in these countries? What goods and services do their bilateral trade consist of? What characteristics of these countries may be factors that affect China’s decision to make investment there?

**Interpretation of Index Scores**

The following two chapters will have a discussion of subsectors and country cases in terms of their vulnerability scores. Understanding what the vulnerability interdependence index calculates is important to apprehend the following chapters. The index calculates a vulnerability score for each investment project, ranging from 0 to 1. Then, average of these index scores are used for getting an index score for each subsector. It is simply obtained by calculating arithmetic average of vulnerability scores of all investment projects in a particular subsector.

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Country-level amount-weighted index score calculates the extent to which an investor country becomes vulnerable in a host country. It gets the share of each investment’s amount within this particular country’s total investment amount. Then, each of these shares are multiplied by the index score of each investment project’s vulnerability score. These results are summed to get vulnerability score for each country.

Cross-country amount-weighted index score is used for comparing the extent to which an investor country became vulnerable in various countries. This index score has further steps from the country-level amount-weighted index score. It is simply multiplication of a country’s vulnerability score (country-level amount-weighted index score) by the total investment amount that this country received. It uses the total investment amount to differentiate countries from each other according to the amount they receive from the investor. For example, a country that receives $0.1 billion investment does not create the same vulnerability for the investor with a country that receives $10 billion investment.

All of these four index scores calculate the vulnerability for the investor. They do not find the degree to which the host country is vulnerable against the investor country. Though, the specific case that this study examines—the Sino-African relations—is one-sided, meaning that only China has investments in the African countries. There is not a significant number of investments that the African countries had in China. For such cases, the reverse of the index score can be used for understanding the host country’s vulnerability. It can simply be calculated by subtracting the index score for the first three index scores from 1. For instance, if the vulnerability score for a Chinese investment project in Angola is calculated as 0.711, it can be interpreted that this investment project create 0.711 point vulnerability for China and 0.289 (1 - 0.711) point vulnerability for Angola. Such an interpretation of index scores lays out the view
that an investor party is very likely to be more vulnerable since it is giving away something that it may not get back in case of a disruption in its bilateral relationship with a host country.

Also, the index calculates these four index scores mostly according to foreign direct investments that a country made in other countries. Proportionality of their bilateral trade and issue linkages that they may create in their relationship are also considered for calculating the vulnerability score.

**Conclusion**

This chapter developed an index for measuring vulnerability interdependence by building it on the five concepts—asset specificity, switching costs, proportionality, costs of ratification and compliance, and issue linkages—that are put forth in the previous chapter. These five concepts are accepted as components of a country’s vulnerability.

This chapter developed the index by suggesting 17 questions, most of which are at the investment-project level; asked to investment projects that companies of a country are made in another country. Two of these questions are at the country level which use country data for its answer.

A detailed explanation of the 17 questions of the vulnerability interdependence index were presented by having a discussion of how they may create vulnerability for the investor, which sectors are prone to create more or less vulnerability for the investor, and some other important points that a coder should care about in the process of codification of investment projects.

The chapter continued with a discussion of selecting appropriate data of Chinese foreign direct investments in Africa. It discussed a couple of datasets and why they are not considered to
be appropriate for the purposes of vulnerability interdependence index before suggesting to use China Global Investment Tracker dataset. Also, datasets for data other than investment projects were introduced. In these datasets, some data points were missing for some years. The section “How Are Missing Values Handled?” had a discussion of how these data points were filled. Missing data were extrapolated by using the available data. Then, discussion of reliability and validity followed. For reliability, the index applied retest method because the questions of the index do not have subjective judgements and there is not a wide range of answers. As the validity method, this study preferred construct validity, which will analyze the findings of the index in the two case study chapters in the following chapters.

Techniques for bringing the 17 questions together and normalizing the data to range in the same interval were also discussed. Additive aggregation method was preferred for creating an index method. The chief reasons of choosing this method is that all questions have different measures of different concepts and they are designed to give an answer for indicating vulnerability of the investor country. For data normalization, three widely-used normalization methods were discussed and minmax normalization was preferred over others in order to make all data to range in the same interval between 0 and 1.

It was also important to assign weights for each of 17 indicators. Analytical hierarchy process (AHP) was used to give weight values for each one of these 17 indicators. The Appendix part will have a wide discussion of how weightings are calculated for each indicator.

Lastly, the rationale behind case selection and a section on how one should interpret the findings of the vulnerability interdependence index are discussed.

Two case study chapters will follow this research design chapter. In the first case study chapter, four subsectors with different characteristics in terms of creating vulnerability will be
discussed in terms of what level of vulnerability these investment projects may create by
ccontributing to asset specificity and switching costs. The second case study chapter includes
three countries, which are selected among the top five trading partners of China i.e. Angola,
Ghana, Kenya, Nigeria, and South Africa. Three of these countries with the highest vulnerability
scores –Nigeria, Angola, and Kenya—will be discussed by presenting country profiles, their
bilateral trade with China, and Chinese investments in these countries.
CHAPTER V
CASE STUDY OF INVESTMENT SECTORS

Sectors and subsectors differ in creating vulnerability for the investor and host countries. This chapter examines investment sectors in order to understand the level of vulnerability each sector or subsector creates for the investor country. It compares the findings of the vulnerability interdependence index to the qualitative analysis of sectors and subsectors. It does so by using the data of Chinese investment projects in five African countries (Angola, Ghana, Nigeria, Kenya, and South Africa) as the sample data.

The transport sector has been a significant sector in the Chinese investments in Africa. China has invested in the transport sector in all years from 2005 to 2017. Within this sector, China tended to invest more in autos, rail, and shipping subsectors. There were 10 years, in which China invested in the autos subsector while the number is 8 for the rail subsector and 7 for the shipping subsector. Aviation has investments only in 2014 and 2016 although being a subsector of the transport sector.¹

Energy has been the second most steady among the main sectors in terms of the number of years of Chinese investments. China had investment projects in energy sectors in 10 years between 2005 and 2017. Within the energy sector, the gas subsector has been the most steady subsector with investment projects in seven years while there have been five years that China has had investment projects in hydro and oil subsectors and has also had four years in alternative and coal subsectors.²

¹ Scissors, “China Global Investment Tracker.”
² Scissors.
Table 12: Average Index Scores and Total Number of Investments for Main Sectors

(Sorted from Largest to Smallest According to Index Score)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Average Index Score</th>
<th>Total Number of Investments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>0.747</td>
<td>54</td>
</tr>
<tr>
<td>Metals</td>
<td>0.711</td>
<td>8</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.701</td>
<td>14</td>
</tr>
<tr>
<td>Technology</td>
<td>0.699</td>
<td>5</td>
</tr>
<tr>
<td>Energy</td>
<td>0.673</td>
<td>48</td>
</tr>
<tr>
<td>Entertainment</td>
<td>0.638</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0.615</td>
<td>3</td>
</tr>
<tr>
<td>Real estate</td>
<td>0.600</td>
<td>24</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.519</td>
<td>4</td>
</tr>
<tr>
<td>Finance</td>
<td>0.471</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments are Gathered by the Author from the CGIT Dataset³

Table 12 illustrates average index scores for the main investment sectors. According to this table, the transport sector causes the highest vulnerability for the investor country. Metals, which is a heavy industry sector, creates the second highest vulnerability. Although the energy sector might be associated with high vulnerability due to being highly asset specific and having high switching costs, it is ranked as the fifth most vulnerable sector.

The expectation for the finance sector’s vulnerability would be to have the lowest vulnerability score since it has the highest mobility among others as being a service sector. The findings of the vulnerability interdependence index affirm this expectation. It can also be expected that the agriculture sector would not create much vulnerability for the investor country.

³ Scissors.
since it is not asset specific and there are many alternative buyers/sellers in this sector. The agriculture sector is ranked the second lowest sector in terms of the vulnerability score.

Table 13: Average Index Score and Total Number of Investments for Subsectors
(Sorted from Largest to Smallest According to Index Score)*

<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Average Index Score</th>
<th>Total Number of Investments</th>
<th>Total Investment Amount (in million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Transport</td>
<td>Aviation</td>
<td>0.791</td>
<td>2</td>
<td>$865</td>
</tr>
<tr>
<td>2 Metals</td>
<td>Steel</td>
<td>0.767</td>
<td>1</td>
<td>$230</td>
</tr>
<tr>
<td>3 Transport</td>
<td>Rail</td>
<td>0.766</td>
<td>16</td>
<td>$35,480</td>
</tr>
<tr>
<td>4 Transport</td>
<td>Shipping</td>
<td>0.741</td>
<td>10</td>
<td>$5,130</td>
</tr>
<tr>
<td>5 Energy</td>
<td>Coal</td>
<td>0.739</td>
<td>4</td>
<td>$1,920</td>
</tr>
<tr>
<td>6 Transport</td>
<td>Autos</td>
<td>0.734</td>
<td>26</td>
<td>$10,898</td>
</tr>
<tr>
<td>7 Energy</td>
<td>Oil</td>
<td>0.734</td>
<td>5</td>
<td>$5,480</td>
</tr>
<tr>
<td>8 Metals</td>
<td>-</td>
<td>0.721</td>
<td>4</td>
<td>$1,180</td>
</tr>
<tr>
<td>9 Metals</td>
<td>Copper</td>
<td>0.713</td>
<td>2</td>
<td>$1,740</td>
</tr>
<tr>
<td>10 Utilities</td>
<td>-</td>
<td>0.701</td>
<td>14</td>
<td>$3,800</td>
</tr>
<tr>
<td>11 Technology</td>
<td>Telecom</td>
<td>0.699</td>
<td>5</td>
<td>$2,300</td>
</tr>
<tr>
<td>12 Energy</td>
<td>Gas</td>
<td>0.666</td>
<td>9</td>
<td>$6,490</td>
</tr>
<tr>
<td>13 Energy</td>
<td>Hydro</td>
<td>0.658</td>
<td>7</td>
<td>$7,880</td>
</tr>
<tr>
<td>14 Energy</td>
<td>Alternative</td>
<td>0.655</td>
<td>7</td>
<td>$1,310</td>
</tr>
<tr>
<td>15 Energy</td>
<td>-</td>
<td>0.655</td>
<td>16</td>
<td>$7,330</td>
</tr>
<tr>
<td>16 Entertainment</td>
<td>-</td>
<td>0.638</td>
<td>1</td>
<td>$120</td>
</tr>
<tr>
<td>17 Other</td>
<td>Industry</td>
<td>0.632</td>
<td>1</td>
<td>$1,940</td>
</tr>
<tr>
<td>18 Other</td>
<td>Medical</td>
<td>0.626</td>
<td>1</td>
<td>$290</td>
</tr>
<tr>
<td>19 Metals</td>
<td>Aluminum</td>
<td>0.613</td>
<td>1</td>
<td>$1,200</td>
</tr>
<tr>
<td>20 Real estate</td>
<td>Property</td>
<td>0.611</td>
<td>6</td>
<td>$4,240</td>
</tr>
<tr>
<td>21 Real estate</td>
<td>Construction</td>
<td>0.596</td>
<td>18</td>
<td>$11,980</td>
</tr>
<tr>
<td>Sector</td>
<td>Subsector</td>
<td>Average Index Score</td>
<td>Total Number of Investments</td>
<td>Total Investment Amount (in million US$)</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>---------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>22</td>
<td>Other</td>
<td>0.586</td>
<td>1</td>
<td>$240</td>
</tr>
<tr>
<td>23</td>
<td>Agriculture</td>
<td>-</td>
<td>4</td>
<td>$1,120</td>
</tr>
<tr>
<td>24</td>
<td>Finance</td>
<td>Banking</td>
<td>0.502</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>Finance</td>
<td>Investment</td>
<td>0.441</td>
<td>1</td>
</tr>
</tbody>
</table>

* Rows that do not have subsector information indicate average index score and total number of investment projects that fit into the main category but do not fit into a subcategory.

Source: Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments and Amounts are Gathered by the Author from the CGIT Dataset

In subsector rankings, there are some slight changes compared to their ranking among the main sectors. Investments in the energy sector, for example, create more vulnerability compared to any other subsectors of technology sector although technology is ranked as the third in the ranking of sector vulnerability. The two subsectors of the transport sector i.e. shipping and aviation respectively, are followed by the steel subsector. Energy’s two subsectors are ranked very high in subsector ranking. Albeit energy itself is ranked as the fifth most vulnerable sector among main sectors: Oil- and coal-related energy investment projects make the investor highly vulnerably interdependent.

In parallel to having the lowest rank in the main sector ranking, the finance sector’s subsectors also ranked very low. Two subsectors of it ranked as the lowest two subsectors among others in terms of their average vulnerability score.

The following sections will discuss how much vulnerability the subsectors of 163 investment projects create. It will do so by having a qualitative discussion of some selected subsectors. The selection criteria for them have been their importance or their vulnerability.

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4 Scissors.
score. Both, one of subsectors with the highest vulnerability interdependence scores and one of the lowest scores are selected. A public good-related subsector and a service subsector are also selected since they are expected to have different vulnerability levels compared to private good investments.

The subsector with the highest amount of investment value (rail subsector of the transport sector), a heavy industry subsector (metals subsector of the steel sector), a public good subsector (shipping subsector of the transport sector), and a service sector investment (banking subsector of the finance sector) are selected for a detailed analysis.

The following sections will delve into the details of the selected subsectors from the perspective of two concepts of the vulnerability interdependence index—asset specificity and switching costs—which are represented in 13 questions in the index. These two concepts are analyzed in detail with their subcategories. The selected four subsectors are ordered according to their vulnerability interdependence index score.

Ratification and compliance costs, proportionality, and issue linkages are excluded in qualitative analysis of sectors. The reason of excluding ratification and compliance costs is that they are the costs that a country’s legislative bodies pay since they measure whether an investor company’s country can ratify an agreement and whether parties can comply with the conditions of agreement. The reason of excluding proportionality is that it is also not sector-specific information. Rather, it comprises of two country’s trade data. The reason of excluding issue linkages is that it is also not a sector-specific information. It aims at understanding whether two countries can link different issues in their interdependent relationship.
Subsector 1: Metals – Steel

China had only one investment in the steel sector in its top five trading African countries between 2005 and 2017. South Africa has been the host country of this investment in November 2006. Sinosteel, which is a state-owned Chinese enterprise,5 made this investment by establishing a joint venture with Samancor Corporation, the world’s largest chrome ore owner.6 The total chrome ore reserves that this joint venture had with this investment is seven times of China’s domestic chrome ore reserves, meaning that it may be an important source of supply for China’s chrome ore demand.7

An important characteristic of this subsector is that it is the highest location asset specific subsector. It binds the investor country the most in terms of location asset specificity.

Location Asset Specificity

Investment projects in this sector tend to be highly location asset specific. In terms of location asset specificity, the first question is about mobility. Investments in the steel sector are answered to be not mobile. Though, it is not as immobile as a public good investment. Therefore, the coding was ‘2’ for this investment, which indicates immobility but not to the extent that a public good investment would have. Similarly, it is not amenable for decentralized production due to being not feasible in terms of transportation costs.8 End-products in this sector are precious products and they are located at the same production site with other production steps.

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7 Yu.
8 For production steps of chromium ore and steel, see International Chromium Development Association, “Discover Chromium - Ore Processing”; Alliance for American Manufacturing, STEEL.
In the index of vulnerability interdependence, location asset specificity of this sector is calculated as 0.772, which ranks as the second after utilities sector.

**Physical Asset Specificity**

In parallel to location asset specificity, investments in the metal sector are highly physical asset specific. Production in the steel industry requires investment in single-purposed equipment, which are special for production in its productive activity.\(^9\) Still, its physical asset specificity is not to the extent some sectors whose machines or tools cannot be used for other purposes. In this sector, a loader, a bulldozer, a backhoe or a dump truck can be used for other purposes. These type of machines can be used not only in the mining sector, but also they are useful in various sectors, including real estate construction, road construction, moving demolition waste or cleaning roads from snow. Also, some other machines that are used to extract the precious mineral from soil can be used for the production of other minerals.

The score of the metal sector for physical asset specificity is calculated as 0.867, which makes it ranked as the tenth most highly physical asset specific subsector among all 25 subsectors.

**Human Asset Specificity**

In the steel sector, human resources are one of asset specific components of the production. It requires a specialized, high-skilled workforce as a sector, in which there are a lot

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\(^9\) For productive equipment that are used in steel and chromium ore production, see World Steel Association, “Overview of the Steelmaking Process”; Niemcor, *Niemcor Chrome Mining South Africa*; Alliance for American Manufacturing, *STEEL*. 
of high-tech engineering machineries are used. There are, some parts of the production, that may not require high-skilled workforce, such as the mining process of production. In the mining process, low-skilled workforce can be used. However, it requires having a high-skilled workforce when the production comes to the processing stage of mineral. Since an important part of production requires a high-skilled workforce, it is considered to be requiring high-skilled workforce.

The workforce is high-skilled, but it is not immobile. Substitute workforce can be found elsewhere easily since the machineries that are used in this sector are likely to be not a type of machines whose engineering process might be kept as company secret by their producer companies. Many engineers are able to use these machines, which means a wide group of engineers may substitute the workforce that is required for any step of the production in this subsector.

The score of human asset specificity in the vulnerability interdependence index is 0.727, which makes it the sixth most human asset specific sector among others. The finding is consistent with the qualitative analysis.

Plant Asset Specificity

This subsection of asset specificity is about whether the production plants are specific to the productive purpose. Alternatively, they might be able to be repurposed for another productive purpose. In this subsector, physical plants are mostly dedicated. Even when they are not dedicated for the productive purpose, they are dedicated for a use in its subsector. For example, a chromium ore processing plant may be used for processing another mine that has similar characteristics.
Since the vulnerability index has only one indicator question for plant asset specificity with a yes/no question, the answer is given as yes (production plant is dedicated) for this subsector. Hence, the score for plant asset specificity in steel subsector is 1.0.

**Switching Costs**

Switching cost is defined as the costs associated with shifting to a different counterparty. It is measured in three sub-dimensions; relational switching costs, opportunity switching costs, and financial switching costs.

The first sub-dimension of switching costs is associated with oligopsony or oligopoly. In steel subsector, we cannot talk about oligopoly or oligopsony. There are a lot of producers and users of steel in the world.\(^\text{10}\) The second sub-dimension—opportunity cost—is about whether the investor can store some amount of supplied product in case this investor or the host country ends the relationship unexpectedly. All possible products in this subsector can be stored. This means that vulnerability of the investor is low in this subsector in terms of opportunity switching cost. The third sub-dimension—financial switching cost—aims at measuring whether the investor is bounded in terms of financial costs in case either the investor wants to switch to another counterparty or the host party wants to end the relationship. In this subsector, vulnerability that is caused by financial switching costs is high since the investor has to sink a significant amount of money before starting producing the first product.

The vulnerability interdependence index’s calculation for switching costs in this subsector is 0.3. The analysis above simply says that the investor party becomes vulnerable only in terms of financial switching costs. This is one-third of all three dimensions. The qualitative

analysis of metals subsector is quite consistent with the findings of the index about switching costs.

**Subsector 2: Transport – Rail**

Rail is the subsector in which China had the highest amount of investments in its five top-trading African partners. It is almost three-fold of the following subsector—which is the construction subsector—in terms of the investment amount. There are 16 investments in this subsector, where 12 of them are located in Nigeria. There are three companies invested in this subsector, China Railway Construction, China Communications Construction, and China Energy Engineering. All three companies are Chinese state-owned entities, which are supervised and managed by the State-owned Assets Supervision and Administration Commission of the State Council.\(^{11}\)

All 16 projects are railway construction projects with relative technological equipment and buildings. Only one investment is solely about railway technologies, whose value is $1.1 billion.\(^{12}\)

Investments of railway construction are regarded to be public-good investments as they have the same characteristics with public goods in terms of non-excludability and non-rivalrousness. Although they may be owned and operated by private companies, one cannot exclude others from using railway service and service will not expire no matter how many people use it.

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\(^{11}\) State-owned Assets Supervision and Administration Commission, “Directory.”

\(^{12}\) Scissors, “China Global Investment Tracker.”
Location Asset Specificity

Investments in this subsector have two groups of assets; one relates to construction issues such as the infrastructure of railway itself, stations, and related buildings while the other one relates to wagons and technological equipment that are required to operate invested railway. While the first group of assets are highly location asset specific, the second group of assets are highly mobile. Since the majority of investment amount is spent for the invested assets relate to the first group, the investment is considered to be a railway construction equipment. Only one investment, whose all amount is about technological equipment is considered to have mobile assets. All five indicators of asset specificity are answered according to the existence of these two groups of assets.

All investments for the first group of assets are done at the site where the investment is built. The output product, which is the transportation service for this subsector, also has to be served at the site of investment. For this reason, there cannot be decentralized production in this subsector, which is one indicator of location asset specificity.

In measuring value per unit of product, public goods are categorized differently than private good investments or investments in service sectors. Public goods are very heavy and difficult to relocate, which makes its value per unit weight of product pretty low. Low value per unit weight indicates that the investment is not feasible for offshoring, which in turn indicates a higher level of vulnerability for the investor.

Assets are generally co-located in the host country for railway investments in this subsector. Some parts of railway equipment, perhaps, may be produced in another country and then transported to the host country. Though, this study does not consider this option since it is not very feasible to do so. Instead, it considers that assets are generally co-located for railway
investments.

Investments in the rail subsector are not associated with energy products, which tend to be processed at the location where it is extracted from. It is considered to be one indicator of location asset specificity in the index. Investments in this subsector do not get a positive score from this dimension.

Rail subsector of the transport sector is a location asset specific subsector. Though, it is not to the extent that a heavy industry sector may have. This subsector has an index value of 0.826 for location asset specificity, which makes it ranked at the sixth place. The qualitative analysis is consistent with the findings of the index.

Physical Asset Specificity

The rail subsector is among the subsectors that have high physical asset specificity. Equipment that are used in this subsector’s productive activity are specialized for the productive purpose. A larger share of productive equipment’s value is spent on single-purposed equipment, which can only be useful when used for building a railway. Technological equipment that are used in railway investments are also unique for a use in investments in this subsector.

High share of fixed production costs is another dimension of physical asset specificity that cause an increase in the score of vulnerability interdependence index. Investments in the rail subsector have a higher share of fixed production costs compared to variable production costs. A railway (be it stations, railway or technological equipment) investor spends a significant share of money before starting production in the investment to get the first output product.

The vulnerability interdependence index score for this subsector is 1.0, which makes it ranked at the first place together with the shipping subsector and the utilities sector. The finding
of the index is consistent with what might be expected from this subsector’s physical asset specificity.

*Human Asset Specificity*

As mentioned in location asset specificity section, there are two groups of investment in this subsector. These two groups have different effect on human asset specificity. While infrastructure-related investments are not human asset specific, investments related to technological equipment of railways are generally human asset specific investments. As noted, there is only one investment from the second group whereas the first group has 15 investments in the five African countries.

The first group includes land reclamation, railway construction, and construction of train stations and related buildings. This type of investments does not require having an educated and high-skilled workforce. Hence, the workforce for these investments are highly mobile in two ways; they both can be substituted easily by using domestic workforce and can be moved to another country if the investor wants to do so.

Although the number of investments is very few for the second group, investments in this group are relatively human asset specific investments since they are technology-intensive investments. The production in this second group’s investments requires having high-skilled workforce whereas the workforce is mobile like in the first group.

The index score for this subsector’s human asset specificity is 0.045. It is the second least human asset specific subsector among 25 subsectors. Since there is only one technology-intensive subsector and 15 others are about railway and supportive components construction, this score is consistent with what we might expect to get.
Plant Asset Specificity

Physical plants, which are railways, train stations, other related buildings, and technological equipment, are dedicated for the productive purpose. Only a small portion of them might be used for other purposes, such as train stations and other related buildings. However, they would not be as useful as their use in rail subsector. Even they can be repurposed to use for other means, the majority of investment components is considered when making the decision whether the plants are asset specific. As the majority of money that spent for these investments goes to railways themselves, they are considered to be plant asset specific investments.

The index score for plant asset specificity of rail subsector is 1.0, which puts it to the first place together with 17 other subsectors.

Switching Costs

Switching costs are analyzed in three subcategories; relational, opportunity and financial switching costs. In this subsector, relational switching costs are pretty low because there are a lot of companies that may substitute for each other in rail sector. This subsector’s market is not associated with oligopsony or oligopoly. In other words, there is not a small number of buyers or sellers in this market. The investor can exit the host country’s market by selling its investment to another company that operates in this subsector.

As discussed above, this investment has characteristics of public goods and produces service as the output product. As is the case for service-producing investments, the investor becomes vulnerable from the perspective of opportunity switching costs. Service, by its nature, is not storable. The investor is not able to store some amount of the output product before switching to another counter-party in case it wants to switch.
The rail subsector contributes to investor’s vulnerability in terms of financial switching costs. As having the same characteristics with a public good, this subsector’s investments are associated with high sunk costs. The investor has liquidation problem in case it wants to cancel railway investment. Railways, train stations, and related buildings have liquidation problem. Only technological equipment might be liquidated.

This sector has relatively high switching costs. The score calculated by the vulnerability interdependence index for switching costs is 0.731. Rail subsector of transport sector is ranked as the fifth most vulnerable subsector in terms of switching costs.

**Subsector 3: Transport – Shipping**

The shipping subsector of the transport sector has the fourth highest vulnerability interdependence score among subsectors. It is also ranked sixth in the number of investment projects and ninth in the total amount of investments in this subsector. There are 10 projects that Chinese companies invested in this subsector in Angola, Ghana, Kenya, Nigeria, and South Africa. Nine of them are invested by China Communications Construction, which is a publicly-traded company and is overseen by the State-owned Assets Supervision and Administration Commission of China\(^{13}\) whereas one of them is a joint venture by China Merchants and China Development Bank, which are also state-owned entities.\(^{14}\) The detailed information are found for eight of these project and the details for the remaining two are extrapolated (assumed to be similar in terms of creating vulnerability). All of projects are about ports. While majority of them are greenfield investments that build new ports, some are brownfield investments that upgrades

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\(^{13}\) State-owned Assets Supervision and Administration Commission, “Directory.”

existing ports.

An important characteristic of port projects is that they are regarded as public good although they might be owned and operated by private companies. The reason of doing so is that they have the same characteristics with public goods as they are associated with non-excludability and non-rivalrousness. The following sections will discuss these 10 Chinese investment projects in terms of their asset specificity and switching costs that may have.

*Location Asset Specificity*

Ports are highly location asset specific investments. Since port investments are regarded as public good investments, they are coded to be extremely high or low. Assets in this subsector, for example, are coded to be infinite immobile. The majority of a port investment is about building infrastructure components, which are immovable. Transportation costs are coded to be infinite not amenable for decentralized production since port investments are regarded to be public good investments. Public good investments are generally not applicable for decentralized production since they are very likely to be built at one place.

There is no weight for public good investments and investments in this category are regarded to be extremely heavy. Hence, their value per unit weight of product should be regarded to be infinite low which makes these investments unfeasible for offshoring (indicates a higher level of vulnerability for the investor). In this question’s explanation, a detailed explanation exists for why public good investments should be coded as infinite low value per unit weight of product. The fourth question is coded as ‘no’ since this investment is not applicable to be production of natural (extracted) resources. The fifth question is coded as ‘yes’ for a reason, similar to the second question’s reasoning. Assets are generally co-located in shipping
investments, which can also be applied to port investments.

Be it a greenfield or a brownfield investment, all port investments are location asset specific investments. Hence, there is no variation in codification of the first five questions of location asset specificity in all investments in this subsector. The index score for location asset specificity is 0.852 for shipping subsector, which ranks it as the second among all 25 subsectors.

Physical Asset Specificity

Similar to location asset specificity, port investments have high physical asset specificity. A port investment requires investing in cranes. Cranes do not have a wide area of use. Such big machines cannot be used much for other purposes. Also, port investments require land reclamation to make the land and seaside suitable for using the purposes of a port. The reclaimed land and seaside have limited alternative uses that can be as efficient as having this area as a port if one party wants to cut the relationship and re-use the existing investment for other purposes.

The second indicator of physical asset specificity is whether the fixed production costs are high compared to variable production costs. In port investments, fixed production costs are very high, as is the case in many public good investments. Investor has to sink a lot of money before getting the first product from this investment, which is transporting the first container.

As a subsector that has pretty similar characteristics to public good investments, this subsector has 1.0 for physical asset specificity, the highest index score. It is ranked as the first in terms of physical asset specificity, undoubtedly.

Human Asset Specificity

In the shipping subsector of the transport sector, human resource is generally not a
specific asset. Many workers in this subsector can be substituted since it does not require a high-skilled workforce. Only crane operators should be high-skilled, but not to the extent that an engineering-intensive sector may have.

The workforce is mobile in two ways: the investor can move its existing workforce to another place if it wants to move its investment, and substitute workforce can be found easily as there is not specialized workforce in this subsector.

The index score for human asset specificity is 0 for the shipping subsector, which indicates that the human resource is not a specific asset in this group of investments.

*Plant Asset Specificity*

The assets in port investments are dedicated to the productive purpose. They can be repurposed for using other purposes, but they will not be much use. A port, for instance, can be used as a parking lot. However, the investment will not be as useful as using it as a port. Hence, it is considered as an asset dedicated to the productive purpose, meaning that investments in shipping subsector are plant asset specific investments.

The index score for shipping subsector’s plant asset specificity section is 1.0. It is ranked the first in terms of this dimension, together with 16 other subsectors.

*Switching Costs*

In this subsector, the relational switching costs are not high. The reason is that there are a lot of companies, which may substitute each other in terms of operating existing ports. The relational switching costs dimension is about whether the market is characterized by oligopoly or oligopsony. There is, definitely, no oligopsony in this subsector as there are many shipping
companies that buy port services from ports in various places of the world. The number of service providers also is not few in this subsector. If the investor company of port wants to end its relationship with the host country, then the host country may find another company to operate it easily.

In this subsector, there is no storage opportunity since it produces service as its output. This increases the level of investor’s vulnerability interdependence in terms of opportunity costs.

Financial switching costs are also very high for the investor party. Port investments are associated with high financial switching costs as they are characterized by high sunk costs. The vast majority amount of total investment amount has to be done before the investment starts operating. The variable costs, which are associated with producing a unit of product/service after the investment is completed, are very low in this subsector.

The index score for switching costs of this subsector is 0.75, which ranks it in the second place. While relational switching costs do not increase vulnerability, opportunity switching costs and financial switching costs increase investor’s vulnerability in this subsector.

**Subsector 4: Finance – Banking**

The banking subsector is associated with low vulnerability scores. This subsector is selected for a detailed examination because it provides an example to service-intensive investment. There is only one Chinese investment in Angola, Ghana, Nigeria, Kenya, and South Africa between 2005 and 2017. This investment was made in 2007 in South Africa by buying equities of an existing bank, meaning that it is a brownfield investment. Industrial and Commercial Bank of China Limited (ICBC) bought 20% stake of the South African Standard
The banking subsector is associated with low vulnerability. The score calculated by the vulnerability interdependence index for this subsector is 0.502, which ranks it as the second least vulnerable subsector after investment subsector of finance sector.

**Location Asset Specificity**

The banking subsector is a service subsector. As is the case for service sector investments, its assets are highly mobile. The vast majority of assets in banking sector is the money the bank has, which is the most liquidated form of any type of investments. Money can easily be moved if the bilateral relations get worse and one of the parties wants to cut the relationship. The remaining part of the investment that may relate to location asset specificity consists of banking buildings, armored vehicles, and some other minor assets. Except the buildings, most other assets are also mobile in this subsector. Since it is a service-sector investment whose assets are highly mobile, it is coded as infinite mobile in the codification process of the index.

In this subsector, service production is amenable to decentralized production. Some parts of production can be produced in another country and be offshored to the final place where the banking service is provided. Secure software is an important component of banking service, for example. This component can be produced elsewhere and moved to the final service location of the bank. Hence, investments in this subsector are infinitely amenable to decentralized

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15 ICBC, “ICBC Buys up 20pc of Standard Bank (South Africa).”
16 ICBC, “FAQs.”
production.

The value per unit weight of product is pretty high since as a service sector investment. Service sector investments are regarded to be infinitely light, which makes its value per unit weight infinitely high. Hence, the value per unit weight is considered to be infinite high for banking investments. This subsector’s investments are also not a type of extracted natural resources. This means that they do not contribute to the investor’s vulnerability from the aspect of being an extracted resource.

The last indicator of location asset specificity, whether the assets are generally co-located with other productive activities within a host country, also does not increase vulnerability of the investor party in this subsector. There are insurance companies which are generally co-located with banking service providers. Insurance is a complementary product of banking services but the discussion is about the banking sector itself. Assets do not need to be co-located within the host country for providing banking service. Also, in our specific investment case, the Chinese bank buys some shares of a South African bank. In such a case, the Chinese bank would have the vast majority of its assets (be it productive assets or non-productive assets) in its own country, meaning that they are not co-located.

As the discussion above illustrates, this subsector has a score of 0 for location asset specificity. It is the least location asset specific subsector among 25 subsectors.

*Physical Asset Specificity*

The asset specificity of investments in banking subsector is not high in this dimension of asset specificity as well. It does not require investing in specialized (single-purposed) equipment. Its buildings can be used for other purposes. Its armored vehicles can be useful in other areas.
The safe deposit boxes in banks can be used to store other precious material. Equipment that are used for providing service do not contribute to vulnerability as they can be repurposed for using in other areas.

Fixed production costs comprise a small portion of total production costs. Most of the costs arises as the productive activity occurs. Only aforementioned assets (bank buildings, armored vehicles, safe deposit boxes, etc.) are part of fixed production costs. On the other hand, variable production costs consist of labor costs, software costs, costs of banking transactions, etc.

The index score is 0 for this subsector’s physical asset specificity, which makes it ranked the last together with investment subsector of finance sector.

*Human Asset Specificity*

Workforce is valuable in the banking sector. Banks have to invest in high-skilled labor in order to not have losses due to mistakes of its personnel. Many staff members of banks have at least bachelor degrees. Managerial-level workforce is even more educated. They have master’s or doctoral degrees. Software engineers are another significant part of high-skilled labor in the banking subsector. Banks have to employ a significant number of software engineers to make their software system as much secure as possible.

Although it requires employing high-skilled workforce, the workforce is not immobile in this subsector. Substitute workforce is accessible in other countries. The investor can find substitute workforce to operate its investment in case it wants to move its investment out of the host country. Also, there is no limit on moving the existing investment together with the existing workforce. Thus, the workforce in the banking subsector is mobile in both ways.

The index score of the banking subsector for human asset specificity is 0.727, which
makes it ranked sixth together with eight other subsectors, which have the same score for human asset specificity.

Plant Asset Specificity

The physical plant that is used for providing banking service cannot be regarded as a plant that is dedicated to the productive purpose. Buildings of bank branches or head office buildings are main physical plants of banks. They can easily be repurposed for using in other areas. They can be used as an office building, as a school, as a hospital, etc.

The index score for plant asset specificity of the banking subsector is 0, which makes it ranked as the least vulnerable subsector in terms of plant asset specificity.

Switching Costs

Switching costs are low for investments in this subsector. There are many big and small market participants, many of which have operations in more than one country. Hence, there is no oligopoly or oligopsony in the banking subsector. This indicates that relational switching costs are very low for the banking investments.

Storability problem causes a problem for the investor. As a service sector investments, storability of the output product is not possible in banking investments. Since the investor cannot store some amount of the output product in the interim period between cutting the relationship and finding a new hosting party, investor’s vulnerability increases from this aspect.

Banking investments do not cause vulnerability from the aspect of financial switching costs. The assets in this subsector are not associated with high sunk costs. Many assets can easily be liquidated in case one of parties wants to cut their bilateral relationship. The investor can
liquidate existing assets—except some minor ones such as buildings—and can move its investment out of the host country if it wants to do so.

In sum, there is only opportunity switching costs for the investor in banking subsector of finance sector. There is no relational switching costs and financial switching costs since there are many market participants and assets can be liquidated easily. The vulnerability interdependence index calculated a score of 0.3 for this subsector’s switching costs.

**Conclusion**

This chapter analyzed four subsectors. They are selected according to their diversity in creating vulnerability for the investor party. Service sectors and public goods sectors are at the two extreme ends of the vulnerability interdependence scores. The first one is expected to cause the lowest vulnerability while the latter one is expected to create the most vulnerability for the investor. Hence, two subsectors that belong to these categories are selected for further analysis in this chapter. These subsectors have been the banking subsector and the shipping subsector.

In terms of location asset specificity, the heavy industry investments—which is represented by steel subsector of the metals sector—ranked as the first. The assets of investments in this subsector are difficult to relocate if there is a sudden disruption in the bilateral relationship between the investor and the host country. The investor binds itself in terms by having location-specific assets if it makes investment in this heavy industry sector. It is not surprising that the examined two subsectors of the transport sector, shipping and railway subsectors, have almost the same index score for location asset specificity. Shipping and railway subsectors are the eighth and the ninth most location asset specific subsectors. As would be expected, the banking subsector of the finance sector has the least location-specific assets. It has the lowest score for
Transport sector’s two subsectors, shipping and railway, are among the most physical asset specific subsectors. They have the highest index score. Having the characteristics of public goods contributes their index scores to be at the top. The steel subsector is almost at the middle of the list. Yet, its score is 0.867, which is pretty close to the highest score. This score ranks it as the 10th most physical asset specific subsector. As a service industry subsector, banking has the lowest score in terms of physical asset specificity. It has 0 as the index score. The ordering of physical asset specificity from the highest to the lowest for these four subsectors has a positive relationship with their categorization of being public good-related sector, private good-related sector, and service-related sector.

While the scores of location asset specificity and physical asset specificity correlate with each other, the scores of human asset specificity does not correlate with them. In the subsectors selected, the banking subsector and steel subsector have the highest human asset specificity. They have the same value. The rail subsector comes after them as it requires some level of technical expertise for its technological equipment. The shipping subsector is the least human asset specific subsector among all subsectors. Its workforce is low-skilled and can be substituted if necessary.

As for plant asset specificity, the banking subsector has a score of 0 whereas the other three subsectors have a score of 1.0. Rail, shipping, and steel subsectors have the same level of plant asset specificity since their assets are dedicated to the productive purpose.

The average scores for the asset specificity rank the four subsector from the highest to the lowest score as steel subsector, rail subsector, shipping subsector, and banking subsector.

In terms of switching costs, it is less costly for the investor to switch another counter-
party in the subsectors of finance and steel. Their scores of switching costs are the same and lower than the switching costs scores of two subsectors of the transport sector. What makes shipping and rail subsectors rank higher is that the storage problem of the end product and the liquidation problem of sunk assets.

The analysis of subsectors proved the robustness of the index. This chapter both helped to examine whether the scores are consistent with qualitative findings and to demystify the rationale behind the coding process by delving into the details of subsectors in regard to the contribution of asset specificity and switching costs to the vulnerability interdependence score. The following chapter will discuss the findings of the index in terms of country cases. The five African countries—Angola, Ghana, Kenya, Nigeria, and South Africa—will be analyzed from the aspect that their relationship with China causes vulnerability for the Chinese government or for them.
CHAPTER VI

CASE STUDY OF THREE AFRICAN COUNTRIES

China’s vulnerability in the African countries differs according to the sectors in which China made investments. This chapter provides a detailed analysis of China’s top three trading countries in terms of China’s vulnerability in these countries; Nigeria, Angola, and Kenya.

There is a difference between vulnerability score calculation of sectors and of countries. Different than the calculation process of vulnerability scores for sectors, amounts of investment projects are also included in the calculation of vulnerability scores for countries since vulnerability of a similar investment with an amount of $100 million and $10 billion would not be the same in terms of their contributions to vulnerability. Though, the amount is not needed for calculating a sector’s vulnerability since the score would be the same for the project whatever the amount is.

Inclusion of amounts in the calculation of vulnerability score have further steps from the initial index score calculation. As discussed in the Research Design chapter, vulnerability score of each investment project ranges from 0 to 1. Calculation of country-level vulnerability scores are done in two ways. In the first way, the amounts are used for getting weighted index scores for countries. This is to understand China’s vulnerability in a particular country. In the second way, the amounts are multiplied by country scores that are obtained in the first way. This way is used for comparing countries’ vulnerability levels.

The vulnerability interdependence index score for all Sub-Saharan African countries are calculated by extrapolating the index scores of China’s five top-trading African countries. It is considered to be sufficient for extrapolation because (1) average sector and subsector scores are suitable for generalization since investment projects in the same subsector give similar
vulnerability scores, (2) the total investment value in five African countries is 40% of the total investment value in all Sub-Saharan African countries ($119 billion out of $297 billion), and (3) the number of investments in five countries is 32% of the number of investments in all Sub-Saharan African countries (163 out of 507 investment projects). The available vulnerability data comprises of around one-third of total both in terms of the number of investments and the investment amounts. These amounts are considered to be adequate for extrapolation.

Though, there is a limitation of extrapolating the data for all Sub-Saharan African countries. There were not Chinese investments in some sectors and subsectors in the five African countries. Chemicals, logistics, and tourism, for example, were not among the sectors that China invested in Angola, Ghana, Kenya, Nigeria, and South Africa. The total number of investments is 18 out of 507, which makes 3.55% of all African investments. The total value of missing subsectors is $10.5 billion out of $296.9 billion, which makes 3.54% of all African investments. Although there is a limitation for extrapolation of data, this does not cause a major problem since it is quite low both as number of investments and as amount of investments.

The process for extrapolation is as follows:

1. Vulnerability interdependence index scores of 163 projects in Angola, Ghana, Kenya, Nigeria, and South Africa are used for getting an average score for each subsector,
2. These average subsector scores are attributed to each one of 344 investment projects (163 investments projects are excluded since they are among the 507 investment projects) in the Sub-Saharan African countries according to their subsectors,

The process for calculating country-level vulnerability scores is as follows:

1. Each investment’s share of investment amount is calculated by diving investment value of a particular project in a country by the total amount of investments in that country in
all years.

2. Extrapolated scores of each investment projects are multiplied by this weighted scores (obtained in the previous step).

3. All weighted scores are summed to get a country’s amount-weighted vulnerability interdependence score.

The process for calculating amount-weighted cross-country scores is as follows:

1. The obtained score as the result of the previous step is multiplied by the total amount of investments in a particular country to get this country’s amount-weighted cross-country score.

The findings of extrapolation, country-level score calculation, and amount-weighted cross-country score calculation for the 37 Sub-Saharan African countries are presented in Table 14.

**Table 14: Vulnerability Interdependence Index Scores, Number of Investments, and Investment Amounts of the Sub-Saharan African Countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>Cross-Country Index Score (Amount-Weighted)</th>
<th>Country-Level Index Score</th>
<th>Number of Investments</th>
<th>Investment Amount (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>37,231</td>
<td>0.700</td>
<td>44</td>
<td>$53,156</td>
</tr>
<tr>
<td>Angola</td>
<td>16,761</td>
<td>0.654</td>
<td>41</td>
<td>$25,637</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>14,961</td>
<td>0.676</td>
<td>44</td>
<td>$22,140</td>
</tr>
<tr>
<td>Kenya</td>
<td>12,464</td>
<td>0.685</td>
<td>35</td>
<td>$18,190</td>
</tr>
<tr>
<td>Zambia</td>
<td>10,578</td>
<td>0.690</td>
<td>37</td>
<td>$15,330</td>
</tr>
<tr>
<td>D.R. Congo</td>
<td>9,224</td>
<td>0.706</td>
<td>16</td>
<td>$13,060</td>
</tr>
<tr>
<td>Congo</td>
<td>7,752</td>
<td>0.703</td>
<td>22</td>
<td>$11,030</td>
</tr>
<tr>
<td>South Africa</td>
<td>7,585</td>
<td>0.592</td>
<td>19</td>
<td>$12,820</td>
</tr>
<tr>
<td>Tanzania</td>
<td>6,579</td>
<td>0.683</td>
<td>18</td>
<td>$9,630</td>
</tr>
<tr>
<td>Country</td>
<td>Cross-Country Index Score (Amount-Weighted)</td>
<td>Country-Level Index Score</td>
<td>Number of Investments</td>
<td>Investment Amount (million US$)</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
<td>---------------------------</td>
<td>-----------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Ghana</td>
<td>6,557</td>
<td>0.712</td>
<td>24</td>
<td>$9,210</td>
</tr>
<tr>
<td>Chad</td>
<td>6,309</td>
<td>0.762</td>
<td>8</td>
<td>$8,280</td>
</tr>
<tr>
<td>Mozambique</td>
<td>6,291</td>
<td>0.675</td>
<td>15</td>
<td>$9,320</td>
</tr>
<tr>
<td>Uganda</td>
<td>5,914</td>
<td>0.702</td>
<td>12</td>
<td>$8,430</td>
</tr>
<tr>
<td>Cameroon</td>
<td>5,620</td>
<td>0.698</td>
<td>21</td>
<td>$8,050</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>5,402</td>
<td>0.666</td>
<td>19</td>
<td>$8,110</td>
</tr>
<tr>
<td>Guinea</td>
<td>5,211</td>
<td>0.691</td>
<td>9</td>
<td>$7,540</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>4,580</td>
<td>0.765</td>
<td>9</td>
<td>$5,990</td>
</tr>
<tr>
<td>Niger</td>
<td>4,287</td>
<td>0.729</td>
<td>6</td>
<td>$5,880</td>
</tr>
<tr>
<td>South Sudan</td>
<td>3,912</td>
<td>0.714</td>
<td>9</td>
<td>$5,480</td>
</tr>
<tr>
<td>Senegal</td>
<td>2,986</td>
<td>0.728</td>
<td>6</td>
<td>$4,100</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>2,331</td>
<td>0.655</td>
<td>11</td>
<td>$3,560</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>2,194</td>
<td>0.686</td>
<td>6</td>
<td>$3,200</td>
</tr>
<tr>
<td>Namibia</td>
<td>1,948</td>
<td>0.711</td>
<td>4</td>
<td>$2,740</td>
</tr>
<tr>
<td>Mali</td>
<td>1,834</td>
<td>0.722</td>
<td>7</td>
<td>$2,540</td>
</tr>
<tr>
<td>Djibouti</td>
<td>1,318</td>
<td>0.766</td>
<td>4</td>
<td>$1,720</td>
</tr>
<tr>
<td>Gabon</td>
<td>1,282</td>
<td>0.705</td>
<td>7</td>
<td>$1,820</td>
</tr>
<tr>
<td>Madagascar</td>
<td>1,239</td>
<td>0.720</td>
<td>5</td>
<td>$1,720</td>
</tr>
<tr>
<td>Botswana</td>
<td>998</td>
<td>0.648</td>
<td>5</td>
<td>$1,540</td>
</tr>
<tr>
<td>Mauritius</td>
<td>762</td>
<td>0.663</td>
<td>3</td>
<td>$1,150</td>
</tr>
<tr>
<td>Benin</td>
<td>723</td>
<td>0.695</td>
<td>3</td>
<td>$1,040</td>
</tr>
<tr>
<td>Malawi</td>
<td>569</td>
<td>0.703</td>
<td>3</td>
<td>$810</td>
</tr>
<tr>
<td>Rwanda</td>
<td>548</td>
<td>0.660</td>
<td>5</td>
<td>$830</td>
</tr>
<tr>
<td>Liberia</td>
<td>518</td>
<td>0.751</td>
<td>4</td>
<td>$690</td>
</tr>
<tr>
<td>Togo</td>
<td>375</td>
<td>0.695</td>
<td>2</td>
<td>$540</td>
</tr>
<tr>
<td>Eritrea</td>
<td>362</td>
<td>0.725</td>
<td>2</td>
<td>$500</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>242</td>
<td>0.655</td>
<td>2</td>
<td>$370</td>
</tr>
<tr>
<td>Country</td>
<td>Cross-Country Index Score (Amount-Weighted)</td>
<td>Country-Level Index Score</td>
<td>Number of Investments</td>
<td>Investment Amount (million US$)</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------</td>
<td>---------------------------</td>
<td>----------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>37 Sao Tome</td>
<td>199</td>
<td>0.737</td>
<td>2</td>
<td>$270</td>
</tr>
<tr>
<td>AVERAGE/TOTAL</td>
<td>5,342</td>
<td>0.698</td>
<td>489</td>
<td>$286,423</td>
</tr>
</tbody>
</table>

Sorted from Largest to Smallest According to Amount-Weighted Cross-Country Index Score

China’s top five trading partners (marked as bold) have calculated index scores. Index scores of other countries are estimated scores.

**Source:** Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments and Investment Amounts are Gathered by the Author from the CGIT Dataset

The table shows that rankings of countries in country-level index score and in amount-weighted cross-country index score are different. For example, China has the highest level of vulnerability in Nigeria (see amount-weighted cross-country index score column) while Djibouti has the highest score for country-level index score. This shows that Nigeria is the country where China is the most vulnerably-interdependent among all Sub-Saharan African countries. Djibouti is the country where China has the types of investment that create the most vulnerability. If total investment amounts of Nigeria and Djibouti would be the same, Djibouti would be the country where China is the most vulnerably-interdependent. The reason of this is sectors of Chinese investments in Djibouti creates more vulnerability compared to sectors of Chinese investments in Nigeria.

China’s top five trade partners ranked mostly at the top of the ranking according to amount-weighted cross-country index scores: Nigeria ranked first; Angola ranked second; Kenya ranked fourth; South Africa ranked eighth; and Ghana ranked 10th within 37 Sub-Saharan African countries.

They also are among the countries that had the highest number of Chinese investments.

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1 Scissors, “China Global Investment Tracker.”
All of them ranked at the top 10: Nigeria ranked first, Angola ranked third, Kenya ranked fifth, Ghana ranked sixth, and South Africa ninth in terms of the number of investments the Chinese companies invested in these countries.

In the ranking of total investment amounts, only Ghana has slightly missed the top 10 of the list. It ranked as the 11th country. The other four countries are among the top 10 countries that received the highest aggregate amount of Chinese investments. Nigeria ranked first, Angola ranked second, Kenya ranked fourth, South Africa ranked seventh, and Ghana ranked 11th in terms of total amounts of Chinese investments from 2005 to 2017.
Figure 11: Comparison of Country-Level Amount-Weighted Index Score, Number of Investments, and Investment Amounts

Source: Created by the Author With the Data Drawn from the CGIT Dataset\(^2\) and Calculated by the Vulnerability Interdependence Index

Figure 11 illustrates the relationship between vulnerability scores, number of investments, and investment amounts. As it can be seen from the chart, there is no relationship between vulnerability score and number of investments or investment amounts. Yet, number of investments and investment amounts are relatively high.

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\(^2\) Scissors.
investments and investment amounts have similar increase or decrease trends.

What vulnerability score consists of the multiplication of average index score of sectors and investment amounts. Hence, the vulnerability scores listed in Table 14 and illustrated in Figure 11 are way different than vulnerability scores of countries without the investment amounts. If the investments amounts are not included as the multiplier, the top ten countries with the highest vulnerability scores would be (1) Djibouti, (2) Sierra Leone, (3) Chad, (4) Liberia, (5) Sao Tome, (6) Niger, (7) Senegal, (8) Eritrea, (9) Mali, and (10) Madagascar. In vulnerability interdependence scores with investments amounts included, none of these countries takes place in the top 10 countries. This clearly shows why it is necessary and useful to include investment amounts as multiplier when calculating a country’s vulnerability interdependence score rather than using a project’s vulnerability interdependence score solely.

The following sections will analyze countries by (1) giving some basic information about the country which might be associated with attracting investments i.e. population, GDP per capita, and other important points about the country (2) looking at the bilateral trade that they have with China, (3) Chinese investments in these countries, and (4) an assessment of the selected country’s vulnerability based on the information provided in sections (1), (2), and (3).

This chapter also serves as the showcase of the vulnerability interdependence index where the findings will be discussed and analyzed according to sectors of Chinese investments in the selected countries. What constitutes higher or lower levels of vulnerability will be discussed by presenting the types of Chinese investment projects that the selected countries hosted.

**Country 1: Nigeria**

Nigeria is the country where China became the most vulnerable among the Sub-Saharan
African countries. China has had 44 investment projects between 2005 and 2017, with a total investment amount of $53.16 billion.

The country is well-known with its large population, oil and natural gas reserves, and other mineral reserves. It is the most populous and the largest economy among the Sub-Saharan African countries.

Country Profile

Nigeria is the most populous country among the Sub-Saharan African countries with a population of 191 million in 2017, accounting for one-fifth of all Sub-Saharan African population. Also, it has the 7th largest population in the world.\(^3\) It is one of the countries with the largest youth population in the world, meaning that it has a potential of exponential growth in economics.\(^4\) The population between the ages of 0 and 24 makes the 62.15% of the overall population.\(^5\)

It is the largest economy among the Sub-Saharan African countries with the GDP of $375.7 billion. Nigeria had an important growth rate in its GDP in the last decade. Its GDP has risen 126% from 2007 to 2017.\(^6\)

Important natural resources in this country include natural gas, petroleum, tin, iron ore, coal, limestone, niobium, lead, and zinc.\(^7\)

The country holds vast crude oil reserves. The proven crude oil reserves of Nigeria are 37,453 million barrels, which rank it as the country of the ninth largest crude oil reserves in the

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\(^3\) World Bank, “World Bank Open Data.”
\(^4\) World Bank, “Nigeria Overview.”
\(^7\) Central Intelligence Agency, “The World Factbook - Nigeria.”
It is also ranked ninth in terms of its proven natural gas reserves in the world. It has a natural gas reserves of 5,627 billion standard cubic meters. In terms of its exports of crude oil and natural gas, it is ranked eighth and 11th in 2017 with the amounts of 1.8 million barrels per day and 32.5 billion cubic meters.

Oil has a significant share within Nigeria’s exports in parallel with its reserves. The amount of crude oil exports was 73 percent of its total exports in 2016. Next two largest shares trailing after crude oil belong to petroleum gas and refined petroleum with the shares of 15 percent and 1.8 percent. All three petroleum products make 90 percent of Nigeria’s exports. Beside petroleum products, gold is another prominent exported material. Gold’s share within all Nigerian exports is 1.8 percent. Though, the amount of Nigeria’s gold exports is pretty low within world’s largest gold exporters with 0.21 percent.

The share of population with access to electricity was 42.7% in 2000 and rose 59.3% in 2016. In terms of telecommunication, its ranking is high compared to its rankings in other areas. 81 in each 100 people have subscription to mobile cellular. Nigeria is ranked ninth in the world in terms of access to mobile cellular with this percentage.

The country profile shows a country with a significant mass, around half of which is among the ages of 0 and 24. The facts above indicates that Nigeria is an important player in the world oil market and in the world natural gas market. It both holds a great amount of oil and natural gas reserves and exports them. Other than oil and natural gas, Nigeria has some other

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9 OPEC, 112.
10 OPEC, 59, 117.
12 OEC, “Countries That Export Gold (2016).”
important mineral resources i.e. tin, iron ore, coal, limestone, niobium, lead, and zinc. These facts may be attractive for a country like China, who is looking for resources to meet its domestic demand for energy and mineral resources.

Bilateral Trade

Mineral products comprise an important share in Nigeria’s exports to China. They have the largest share within the total exports with a percentage of 68. Almost half of this amount is crude petroleum. It has the highest export volume with an amount of $257 million, constituting 31 percent of total exports. Products of petroleum gas make 30 percent of total exports. Almost 8 percent of total Nigerian sales is other mineral products such as niobium, tantalum, vanadium, and zirconium ore, lead ore, zinc ore, and manganese ore.\(^{15}\)

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\(^{15}\) OEC, “Products That Nigeria Exports to China (2016).”
Table 15: Products that Nigeria Exported to China in 2016

<table>
<thead>
<tr>
<th>Export Volume (US$)</th>
<th>Percentage</th>
<th>Commodity</th>
<th>Commodity Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>257,296,550</td>
<td>31.0%</td>
<td>Crude Petroleum</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>185,864,472</td>
<td>22.0%</td>
<td>Rough Wood</td>
<td>Wood Products</td>
</tr>
<tr>
<td>113,977,159</td>
<td>14.0%</td>
<td>Propane</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>95,020,253</td>
<td>11.0%</td>
<td>Natural Gas</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>39,088,536</td>
<td>4.7%</td>
<td>Butanes</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>32,579,818</td>
<td>3.9%</td>
<td>Niobium, Tantalum and Vanadium Ores</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>17,505,392</td>
<td>2.1%</td>
<td>Cocoa Beans</td>
<td>Foodstuffs</td>
</tr>
<tr>
<td>11,633,366</td>
<td>1.4%</td>
<td>Lead Ores</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>9,340,214</td>
<td>1.1%</td>
<td>Zinc Ores</td>
<td>Mineral Products</td>
</tr>
<tr>
<td>8,151,289</td>
<td>1.0%</td>
<td>Polyethylene</td>
<td>Plastics and Rubbers</td>
</tr>
</tbody>
</table>

Source: Compiled by the Author with the Data Drawn from the Observatory of Economic Complexity16

China is the destination for only 2.3 percent of Nigeria’s exports. It is a very small share compared to other countries. The largest three buyers of Nigerian products are India, the U.S., and Spain with the percentages of 18, 12, and 8.7.17 Similarly, China has a very small share in Nigeria’s crude oil exports. The share of China is only 0.95 percent. The largest three buyers of Nigerian crude oil are India, the U.S., and Spain with the percentages of 22, 14, and 8.6. An African country—South Africa—follows the largest three buyers as the fourth country.18

Nigeria’s exports to China has a similar share with commodities it exports to all countries. When Nigeria’s natural resources and the share of China within its exports are taken

16 OEC.
18 OEC, “Export Destinations of Crude Petroleum from Nigeria (2016).”
into account, it can be concluded that China does not have a special partnership with Nigeria in
terms of natural resources although Nigeria has precious energy resources for China i.e. oil and
natural gas. China has not taken the precious natural resources yet but it does not mean that its
imports of energy products will have the same trend in the future. Nigeria is an important
supplier of energy resources that China needs for its rising energy demand.

The reverse side of the bilateral relationship—China’s exports to Nigeria—consist of
various products. China sells to Nigeria whatever it sells to other countries as the world’s
factory. The largest share belongs to machine exports with a 29 percent. Machines exports
include telephones, electrical transformers, stone processing machines, electric generating sets,
video displays, liquid pumps, insulated wire, valves, and computers. The second largest share
belongs to textile exports with a 17 percent. Textile includes raw materials for textile production
as well as men and women suits. Metal exports is the third largest group in China’s exports to
Nigeria. It has a share of 12 percent. Aluminum plating, iron structures, coated flat-rolled iron,
and aluminum bars are what metal exports comprises of. Transportation equipment and plastics
and rubbers come fourth and fifth with percentages of 7.4 percent and 7.3 percent. The remaining
export commodities also vary; chemical products, footwear and headwear, stone and glass, paper
goods, and foodstuffs.19

Traded goods between the two countries show that there is not a special relationship
between the two countries in terms of their bilateral trade. China does not have a significant
share within Nigeria’s natural resource sales. Similarly, Nigeria does not buy a particular good
from China. Its imports from China diversified.

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19 OEC, “Products That China Exports to Nigeria (2016).”
Chinese Investments in Nigeria

The Chinese companies had 44 investments in Nigeria between 2005 and 2017. The total investment amount has been $53.16 billion between these years. Country-level amount-weighted index score for China’s vulnerability in Nigeria was 0.7 as presented in Table 14.

Table 16: Number of Investments, Total Investment Amounts, and Vulnerability Score of Subsectors in Nigeria

<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Number of Investments</th>
<th>Total Amount (million US$)</th>
<th>Subsector's Vulnerability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>.</td>
<td>6</td>
<td>$3,710</td>
<td>0.665</td>
</tr>
<tr>
<td>Energy</td>
<td>Gas</td>
<td>4</td>
<td>$3,770</td>
<td>0.680</td>
</tr>
<tr>
<td>Energy</td>
<td>Hydro</td>
<td>1</td>
<td>$1,290</td>
<td>0.753</td>
</tr>
<tr>
<td>Energy</td>
<td>Oil</td>
<td>2</td>
<td>$2,670</td>
<td>0.778</td>
</tr>
<tr>
<td>Real estate</td>
<td>Construction</td>
<td>5</td>
<td>$2,990</td>
<td>0.629</td>
</tr>
<tr>
<td>Real estate</td>
<td>Property</td>
<td>1</td>
<td>$1,910</td>
<td>0.666</td>
</tr>
<tr>
<td>Technology</td>
<td>Telecom</td>
<td>3</td>
<td>$1,650</td>
<td>0.721</td>
</tr>
<tr>
<td>Transport</td>
<td>Autos</td>
<td>6</td>
<td>$4,916</td>
<td>0.777</td>
</tr>
<tr>
<td>Transport</td>
<td>Rail</td>
<td>12</td>
<td>$28,300</td>
<td>0.777</td>
</tr>
<tr>
<td>Transport</td>
<td>Aviation</td>
<td>1</td>
<td>$680</td>
<td>0.837</td>
</tr>
<tr>
<td>Transport</td>
<td>Shipping</td>
<td>3</td>
<td>$1,270</td>
<td>0.742</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>44</td>
<td>$53,156</td>
<td></td>
</tr>
</tbody>
</table>

Source: Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments and Investment Amounts are Gathered by the Author from the CGIT Dataset20

The subsector with the highest vulnerability score is aviation subsector of transport sector—also ranked at the top of subsector ranking in the previous chapter. It is followed by other subsectors of the transport sector. Telecom subsector and oil subsector are ranked trailing

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20 Scissors, “China Global Investment Tracker.”
after transport sector’s subsectors. The projects that created the least vulnerability for China have been in the construction subsector.

Their effect on China’s overall vulnerability against Nigeria—cross-country amount-weighted index score—has almost the same ranking with their total amount since the index value for comparing how much a subsector creates vulnerability for China in total is calculated as its average vulnerability score times the total investment amount.

Nigeria is known with its natural resources. Chinese investments regarding natural resources are few. There are two investments of buying stakes of oil mining licenses. One project in oil subsector and one project of the energy sector (with no subsector). One of them is buying stakes of oil mining license from Nigeria’s petroleum company, SAPETRO in 2006 and a second one from Total, a French multinational company, in 2012. While the first investment had an amount of $2.27 billion, the second one’s amount was $2.5 billion.21 These two investments make 5.02 percent of all Chinese investments in Nigeria from 2005 till 2017. Also, they are the fourth and sixth largest investments China had in Nigeria. Considering the characteristics of oil subsector, we can conclude that this is a significant amount within the amount of other investment projects. More precisely, China has shown interest in Nigerian oil in terms of making investments.

Other investments in the energy sector includes five natural gas-fired power plant investments, one natural gas processing plant investment, one natural gas pipeline investment, two hydropower plant investments, one thermal power station investment, and one investment regarding transmission lines and relevant substations. These other investments of the energy sector are mostly about Nigeria’s energy infrastructure (transmission lines and substations).

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Investing in cement is an indicator of having an intent to invest in other infrastructure investments. Vast majority of Chinese investments in Nigeria’s real estate sector are cement plant investments. All investments in construction subsector of the real estate sector are construction of cement plants. The total investment value for cement plant investments make $2.99 billion, which is the 5.7 percent of all Chinese investments in Nigeria.

Investments in the technology sector consists of one security camera installation investment and two high-tech cell phone technology installation investments.

An important share of projects belong to the transport sector. Its share is 65.5 percent within all Chinese investments in Nigeria. Investments in autos subsector are all about road construction or road rehabilitation. Chinese companies have spent $4.92 billion for building Nigeria’s roads. One investment in aviation subsector is about building new terminals for the airports in five different cities of Nigeria, which has an amount of $0.68 billion. Rail subsector has the highest share within all subsectors with a share of 53.7 percent. The total amount spent for rail investments is $28.26 billion. Vast majority of these investments are about railway building while some of them are about upgrading and modernizing existing railways. There are three investment in shipping subsector. Two of them are about building ports while one is about buying stakes of an existing port from another company.

**Conclusion**

Nigeria is one of the most prominent countries in Sub-Saharan Africa. The points that make it a prominent African country are its population, the share of young population, its large economy, its energy and other mineral resources, and the number and amount of Chinese investments.
Chinese investments are mostly clustered in the transport sector, which also has the highest vulnerability score among the sectors China has investments in Nigeria. Public good investments are expected to create more vulnerability compared to private good investments, as discussed in the previous chapter. All investments in the transport sector have the characteristics of public goods. Investments in this sector mostly aim at easing transportation by building new roads, ports, railways, and airports. Easing transportation contributes facilitating trade in an important way. Hence, China may finally aim at expanding its share in Nigeria’s trade by making a lot of investments regarding transportation infrastructure.

Nigeria has vast amount of oil and natural gas reserves. Although it might be a good place for China to meet an important portion of its rising energy demand, there is not much Chinese investments regarding Nigeria’s oil resources. There are only two investments of China buying some share of oil mining license. These two investments’ amount only consist of 5 percent of the amount of all Chinese investments in Nigeria.

In parallel with the fewness of its investments regarding oil mining, China does not have a special place in Nigeria’s oil exports. Its share within Nigeria’s crude oil exports is only 0.95 percent.

A prominent category of investments is cement plant construction investments. China may aim at using the output product of these investments in its other investments. Most of other investments—except oil mining, transportation, and cement plant construction investments—are infrastructure-related investments. They mostly aim at electrifying the country either by investing in transmission line and substations, or constructing power stations.
Country 2: Angola

Angola is a country known with its oil production in Africa. Although its oil reserves are less than the country with the largest proven oil reserves—Nigeria, it is the largest producer of oil in its continent.

Angola is the country where China became the second most vulnerable in Sub-Saharan Africa. It invested 41 projects with a total investment amount of $25.64 billion between 2005 and 2017.

Country Profile

Similar to Nigeria, Angola is also well-known with its oil reserves. It has the second largest proven oil reserves in Africa and 17th largest in the world with an amount of 8,384 million barrels of oil.\(^{22}\)

The population of Angola is 29.8 million according to the 2017 data –ranks the country ninth within the Sub-Saharan African countries.\(^{23}\) Angola has a young population, which might be an igniter for further economic growth if this young population is used appropriately. People between the ages 0 and 25 makes 66.37 percent of the Angolan population.\(^{24}\)

Angola is one of big economies among the Sub-Saharan African nations. The size of Angolan economy ranks it third within the Sub-Saharan African nations. It comes after Nigeria and South Africa. Its GDP is $124.209 billion.\(^{25}\) After the end of its four decades-long civil war in 2002, it became the second fastest growing economy in Sub-Saharan Africa according to the

\(^{23}\) World Bank, “World Bank Open Data.”
\(^{24}\) Central Intelligence Agency, “The World Factbook - Angola.”
\(^{25}\) World Bank, “World Bank Open Data.”
average annual growth rates of GDP between 2002 and 2017. Increase in crude oil production, construction efforts aftermath of the long-lasted civil war, and agriculture are important factors that supported economic growth. Though, global economic recession, low oil prices, the depreciation of kwanza (Angolan currency), lower than expected growth in non-oil sectors stalled the Angolan economy in recent years. Its average growth rate between 2012 and 2017 is 3.27 percent, which ranks the country 34th among the Sub-Saharan African countries.

Angola’s important natural resources include petroleum, diamonds, iron ore, phosphates, copper, feldspar, gold, bauxite, and uranium.

The country has the second largest petroleum reserves in Africa. Although, its reserves are less than Nigeria, Angola was the first in terms of crude oil production in 2015, 2016 and 2017. The amount of produced crude oil is 1,632 thousand barrels per day in 2017, which ranks the country at the top within African countries and 12th in the world.

The vast majority of Angola’s exported products consists of petroleum products and diamond. The share of petroleum products within Angola’s exports is 91 percent while diamond’s share is 7.5 percent.

China buys the largest amount of Angolan exports. The share of exports to China is 49 percent. Other top export destinations of Angola are the U.S., India, and South Africa; with the shares of 10 percent, 7.1 percent, and 5 percent respectively.

Angola presents a similar profile with Nigeria. Both have important crude oil reserves,

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26 World Bank.
28 Central Intelligence Agency.
33 OEC.
have young population, and are among the top economies of Africa. Although its population is not very high among other African nations, it poses an advantage for further economic growth with its young population. Angola has fewer proven oil reserves compared to Nigeria—which holds the largest crude oil reserves in Africa, but it produces more petroleum products than Nigeria. Angola’s oil production level might be an important factor to attract China’s attention.

**Bilateral Trade**

The trade between Angola and China is dominated by Angola’s petroleum products sales to China. Although China and Angola had a very similar country profiles, their foreign trade patterns are way different than each other. Crude petroleum make 99.3 percent and all petroleum products make 99.8 percent of all Angolan exports to China. It does not include various products different than Nigeria, whose crude petroleum sales make only 31 percent of its exports to China.

The fact that China almost only buys crude petroleum does not mean that China buys all crude petroleum from Angola. China’s has the largest share among the buyers of Angolan crude petroleum with a share of 54 percent. The next largest buyers are the U.S., India and South Africa with the shares of 10 percent, 6.7 percent, and 5.6 percent.34

The reverse side of the trade relations – China’s exports to Angola—has similarity with what China exports to Nigeria. China sells various products. The largest group of products is machines with a share of 28 percent. China sells telephones, electrical control boards, electrical transformers, insulated wires, video displays, computers and other machinery products in this category. Textile exports makes 12 percent of total Chinese exports to Angola. In this category, China sells men’s suits, women’s suits, used clothes, house linens, and other textile products.

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34 OEC, “Export Destinations of Crude Petroleum from Angola (2016).”
The other groups of products are metals with 12 percent, footwear and headwear with 8 percent, and mineral products with 7.1 percent. It is noteworthy that China sells mineral products to Angola. All of these mineral products consists of refined petroleum.\textsuperscript{35} China buys crude oil and sells refined petroleum to Angola in return.

The bilateral trade between China and Angola shows that Angola sells almost only petroleum products to China whereas its imports from China are diversified. Angola sells more than half of its oil to China. It indicates that China has a somewhat special place in Angola’s oil sales.

\textit{Chinese Investments in Angola}

China had 41 investment projects in Angola, trailing after 44 investment projects in Nigeria and 44 projects in Ethiopia. The total invested amount is $25.6 billion. Country-level index score of Angola is 0.654 as presented in Table 14. It ranks 35\textsuperscript{th} in terms of country-level index score, which means that the sector and amount of investments that China made in Angola does not create high levels of vulnerability.

\textbf{Table 17: Number of Investments, Total Investment Amounts, and Vulnerability Score of Subsectors in Angola}

<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Number of Investments</th>
<th>Total Amount (million US$)</th>
<th>Subsector's Vulnerability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td>2</td>
<td>$280</td>
<td>0.497</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td>2</td>
<td>$1,200</td>
<td>0.616</td>
</tr>
<tr>
<td>Energy</td>
<td>Alternative</td>
<td>1</td>
<td>$200</td>
<td>0.695</td>
</tr>
<tr>
<td>Energy</td>
<td>Gas</td>
<td>1</td>
<td>$990</td>
<td>0.661</td>
</tr>
<tr>
<td>Energy</td>
<td>Hydro</td>
<td>2</td>
<td>$3,570</td>
<td>0.647</td>
</tr>
</tbody>
</table>

\textsuperscript{35} OEC, “Products That China Exports to Angola (2016).”
<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Number of Investments</th>
<th>Total Amount (million US$)</th>
<th>Subsector's Vulnerability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Oil</td>
<td>2</td>
<td>$2,260</td>
<td>0.710</td>
</tr>
<tr>
<td>Entertainment</td>
<td></td>
<td>1</td>
<td>$120</td>
<td>0.638</td>
</tr>
<tr>
<td>Other</td>
<td>Education</td>
<td>1</td>
<td>$240</td>
<td>0.586</td>
</tr>
<tr>
<td>Real estate</td>
<td>Construction</td>
<td>8</td>
<td>$6,890</td>
<td>0.563</td>
</tr>
<tr>
<td>Real estate</td>
<td>Property</td>
<td>2</td>
<td>$1,790</td>
<td>0.590</td>
</tr>
<tr>
<td>Technology</td>
<td>Telecom</td>
<td>1</td>
<td>$270</td>
<td>0.635</td>
</tr>
<tr>
<td>Transport</td>
<td>Autos</td>
<td>5</td>
<td>$1,012</td>
<td>0.755</td>
</tr>
<tr>
<td>Transport</td>
<td>Rail</td>
<td>1</td>
<td>$1,830</td>
<td>0.811</td>
</tr>
<tr>
<td>Transport</td>
<td>Aviation</td>
<td>1</td>
<td>$185</td>
<td>0.745</td>
</tr>
<tr>
<td>Transport</td>
<td>Shipping</td>
<td>3</td>
<td>$2,400</td>
<td>0.735</td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td>8</td>
<td>$2,400</td>
<td>0.698</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>41</strong></td>
<td><strong>$25,637</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments and Investment Amounts are Gathered by the Author from the CGIT Dataset

The subsector with the highest vulnerability score among China’s investments in Angola is transport sector’s rail subsector. Investments in other subsectors of the transport sector create the next highest vulnerability scores. Ranking of subsectors according to vulnerability score is rail subsector, autos subsector, aviation subsector, and shipping subsector. The next highest vulnerability score belongs to oil subsector, which is expected to be important in China’s investments in Angola since oil is the commodity which takes a very large place in Angola’s exports to China. Agriculture, construction, and education are the subsectors that create the least vulnerability for China in its investments in Angola.

Investments in the transport sector are almost all about facilitating transportation by building new roads, railways, ports, and airports or expanding the capacity of the current ones.

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36 Scissors, “China Global Investment Tracker.”
Oil is a notable subsector in Angola as the country is the largest exporter of petroleum products. China had two investments in oil subsectors, both are related to buying stakes in oil exploration blocks. China bought oil mining licenses in May 2006 and in June 2013. Two of these investments make 8.8 percent of all investments.

Other investments in the energy sector according to their vulnerability scores are one garbage power generation project in alternative subsector, one gas-fired power plant project in gas subsector, one hydro power plant in hydro subsector, and two electrification projects, which are not attributed to a subsector since they do not fit into any subsector but fits into the energy sector. The amount of all investments in the energy sector is $7.42 billion, which makes 28.9 percent of all Chinese investments in Angola.

The utilities sector has investments regarding electricity and drinking water infrastructure of Angola. There are four electrification investments, whose total investment amount is $1.93 billion; four drinking water supply investments with a total investment amount of $0.68 billion; and one investment about roads, drinking water, drainage system, and sewage system with a value of $0.61 billion.

There are 11 investment projects about construction, seven of which are in construction subsector while two are in property subsector, one is in education and one is in entertainment subsectors. The total amount of construction projects are $8.78 billion.

The profile of Chinese investments in Angola shows that China mostly invested in Angola’s infrastructure with three investment projects exceptions. Two of these three projects are in oil subsector, which are about buying stakes of oil mining licenses whereas one of them is about cement plant construction.
Conclusion

Angola is an important country in the Sub-Saharan African region. It is important because it holds the second largest oil reserves and is the top producer of crude oil among the African nations. It has a young population. It is a rising economy, whose GDP is always in the rise owing to growth in oil production and reconstruction efforts since its four decades-lasted civil war ended in 2002.

China has invested in Angola almost completely in infrastructure projects. Angola is in need of infrastructure for the vast majority of the country after its civil war ended. China, with its identity as an investor that is interested in building Africa’s infrastructure, is interested in Angola’s infrastructure as well. It has various infrastructure in various subsectors, including agricultural investments, power plant investments, stadium construction investment, house building investments, high-technology network system investment for mobile phone, electrification investments, drinking water supply investments, and transportation investments.

The relationship between China and Angola is somewhat special. China is the largest buyer of Angolan petroleum products. Angola exports more than half of its oil to China. It is the second largest recipient of Chinese investments among the Sub-Saharan African countries. Despite China is by far the largest importer of Angolan oil, it had only two investments regarding oil mining licenses which had a total amount of $2.26 billion.

Country 3: Kenya

Important characteristics of Kenya is different than characteristics of Nigeria and Angola. China does not have an interest in Kenya’s energy resources since there is no production of petroleum products. As will be told in “Chinese Investments” section, China is interested in
conducting oil exploration in the continent.

**Country Profile**

Kenya has neither a country with rich energy resources nor exports a significant portion of its goods to China. It differs from Nigeria and Angola in their relations with China from this aspect. Nigeria and Angola hold vast energy resources and China is an important destination for their exports.

Although it is an important player in its region—East Africa, indicators show that it is a relatively modest country within the Sub-Saharan African nations. Its population is around 50 million, which ranks Kenya as the sixth most populous country in Sub-Saharan Africa.37

The young population between the ages of 0 and 24 makes 59.2 percent of the total population in Kenya.38 It indicates that the country has a potential of further economic growth if the young population is used appropriately.

Agriculture is the backbone of Kenya’s economy. Around one-third of GDP comes from agricultural activities, in which around 75 percent of the whole population has affiliations either working full-time or part-time in agricultural activities. Tourism is also a significant source of economic input in Kenya. Despite there are some high visible terrorist attacks in touristic places of Kenya between 2013 and 2015, the sector recovered and rebounded again in 2016 and 2017.39

The country is in need of infrastructure investments.40 Kenya is also found to be the most attractive second African country for investors. Investors think that its growing economy and

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37 World Bank, “World Bank Open Data.”
39 Central Intelligence Agency.
emerging ICT sector as well as its pragmatic government in its relations with investors facilitate their business in the country.\footnote{ICA, “Which African Countries Are Most Attractive for Investment- and Why?”; ICA, “Infrastructure Financing Trends in Africa -2016,” 68.} In 2016, Kenya got the most investment from the members of the Infrastructure Consortium for Africa, which includes the top investors of the world.\footnote{ICA, “Infrastructure Financing Trends in Africa -2016,” 40.}

### Bilateral Trade

The bilateral trade between China and Kenya is heavily dominated by China’s sales to Kenya compared to Kenyan exports to China. While the amount of China’s exports is $5,588 million, Kenya exports only $97 million to China in 2016.\footnote{World Trade Organization, “World Integrated Trade Solution (WITS) | Data on Export, Import, Tariff, NTM.”} In other words, their bilateral trade comprises 98 percent of China’s sales to Kenya and 2 percent of Kenya’s sales to China. For this reason, this section will start with an analysis of what China sells to Kenya.

China was the origin of 35 percent of Kenyan imports in 2016. The next four import origins of Kenya are India with 16 percent, Japan with 4.5 percent, the United Arab Emirates with 4.0 percent, and South Africa with 3.5 percent.\footnote{OEC, “Kenya (KEN) Exports, Imports, and Trade Partners.”}

The commodities that China sells to Kenya is similar to its sales to Nigeria and Angola. The group of commodities that China exports to Kenya with their shares are: machines with 27 percent, textiles with 24 percent, metals with 12 percent, plastics and rubbers with 6.3 percent, and miscellaneous with 5.3 percent. Within the machines group, China sells telephones, electric generating sets, insulated wire, computers, video displays, etc. As textile product, it sells women’s and men’s suits, fabric, shirts, cotton, t-shirts, etc. The major products in the metals
group are steel bars, iron structures, flat-rolled steel, etc.\textsuperscript{45}

China has a very small place in Kenya’s export destinations. Only 1.9 percent of Kenyan exports destines in China. The top five buyers of Kenyan products are the United States with 11 percent, the Netherlands with 9.9 percent, Uganda with 9.4 percent, Pakistan with 8.4 percent, and the United Kingdom with 8.2 percent. Kenya’s top export products are tea with 23 percent, cut flowers with 14 percent, coffee with 4.7 percent, titanium ore with 2.3 percent, non-knit men’s suits with 2.2 percent, and tropical fruits with 2.1 percent.\textsuperscript{46}

Kenya’s exports to China, which is only two percent of their bilateral trade, consists of various commodity groups. Mineral products make 65 percent of Kenya’s exports while animal hides make 16 percent, vegetable products make 7.7 percent, textiles make 5.7 percent, animal products make 2.6 percent, and plastics and rubbers make 2.5 percent. Within mineral products, Kenya exports consist of titanium ore (41 percent of total exports) and niobium, tantalum, vanadium and zirconium ore (24 percent of total exports).

The bilateral trade between Kenya and China does not show a special trade relationship. Neither China has an important place in Kenya’s sales nor it buys a significant amount of a product. The only noticing point about their trade relationship is that China is the origin of slightly more than one-third of Kenyan imports. Though, it does not convey a special meaning since China has the same share for other countries as well, as the world’s factory.

\textit{Chinese Investments in Kenya}

China had 34 investment projects in Kenya, with a total investment amount of $17.9

\textsuperscript{45} OEC, “Products That Kenya Imports from China (2016).”
\textsuperscript{46} OEC, “Kenya (KEN) Exports, Imports, and Trade Partners.”
billion. It is the fifth Sub-Saharan African country in terms of the number of Chinese investments. The top four countries with the highest number of investments are Nigeria (44 investments), Ethiopia (44 investments), Angola (41 investments), and Zambia (37 investments). In terms of making China vulnerable, it ranks as the fourth country, coming after Nigeria, Angola, and Ethiopia.

Table 18: Number of Investments, Total Investment Amounts, and Vulnerability Score of Subsectors in Kenya

<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Number of Investments</th>
<th>Total Amount (million USD)</th>
<th>Subsector's Vulnerability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td>1</td>
<td>$640</td>
<td>0.487</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td>6</td>
<td>$1,690</td>
<td>0.647</td>
</tr>
<tr>
<td>Energy</td>
<td>Alternative</td>
<td>4</td>
<td>$620</td>
<td>0.662</td>
</tr>
<tr>
<td>Energy</td>
<td>Hydro</td>
<td>2</td>
<td>$2,110</td>
<td>0.653</td>
</tr>
<tr>
<td>Energy</td>
<td>Coal</td>
<td>1</td>
<td>$1,010</td>
<td>0.695</td>
</tr>
<tr>
<td>Other</td>
<td>Industry</td>
<td>1</td>
<td>$1,940</td>
<td>0.632</td>
</tr>
<tr>
<td>Real estate</td>
<td>Construction</td>
<td>2</td>
<td>$390</td>
<td>0.595</td>
</tr>
<tr>
<td>Real estate</td>
<td>Property</td>
<td>2</td>
<td>$430</td>
<td>0.578</td>
</tr>
<tr>
<td>Transport</td>
<td>Autos</td>
<td>9</td>
<td>$2,940</td>
<td>0.728</td>
</tr>
<tr>
<td>Transport</td>
<td>Rail</td>
<td>3</td>
<td>$5,350</td>
<td>0.709</td>
</tr>
<tr>
<td>Transport</td>
<td>Shipping</td>
<td>1</td>
<td>$480</td>
<td>0.767</td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td>2</td>
<td>$300</td>
<td>0.706</td>
</tr>
</tbody>
</table>

**TOTAL** | 34 | $17,900 |

Source: Index Scores Are Created by the Vulnerability Interdependence Index, Total Number of Investments and Investment Amounts are Gathered by the Author from the CGIT Dataset\(^{47}\)

The subsector that makes China the most vulnerable is shipping, which has a vulnerability score of 0.767. Two other subsectors of the transport sector follows it; autos with a

\(^{47}\) Scissors, “China Global Investment Tracker.”
vulnerability score of 0.728 and rail with a vulnerability score of 0.709 comes after shipping subsector. These three subsector holds the characteristics of public goods. Another sector that has the characteristics of public goods, utilities, trails after three subsectors of the transport sector with a vulnerability score of 0.706. The fifth subsector that makes China the most vulnerable is coal subsector of the energy sector.

The least vulnerable subsectors for China in its investments in Kenya are agriculture, property, and construction subsectors. Their respective vulnerability scores are 0.487, 0.578, and 0.595.

In the transport sector, China had six road construction investments, three road rehabilitation/modernization investments, two railway investments, one investment regarding technological equipment used in railways, and one port investment. The total amount of investments in the transport sector makes half of the total amount of the all Chinese investments in Kenya.

There is one electrification and one drinking water supply investment project in the utilities sector with a relatively small investment amount, whose value is $300 million.

The energy sector consists of two hydro power plant investments, one geothermal power plant investment, one coal-fired power plant investment, two wind power plant investments, two photovoltaic power plant investments, and five electrification investments. The total amount of these projects make $5.43 billion. Hydro power plant investment comprises $1.75 billion and coal-fired power plant investment comprises $1.01 billion of the total investment amount in the energy sector.

There is no Chinese investment in Kenya’s energy resources since there is no economically viable oil or natural gas resources in the country. But this does not mean that China
is not interested in finding oil in the country. China had an agreement with Kenya for conducting “oil exploration in six blocks covering 115,343 sq km in north and south Kenya”.48

Industry subsector in the other sector category has one investment regarding construction of industrial park for creating a special economic zone. It a public good-type investment which includes infrastructure building for the high-end special economic zone and has an investment amount of $1.94 billion.

Investment projects of the real estate sector entail two house construction projects, one mall construction and one cement plant construction investments. Their total amount makes $0.82 billion. The agriculture sector has one investment project for irrigation system, which has an investment amount of $0.64 billion.

Chinese investment projects in Kenya are indicator of China’s intent to contribute Kenya’s infrastructure. The vast majority of investments are about strengthening Kenya’s infrastructure. There is only two exceptions—irrigation system investment and cement plant construction investment. The latter one also aims at supporting other investment projects, meaning that it contributes strengthening Kenya’s infrastructure.

Conclusion

Subsectors that make China the most vulnerable in its investments in Kenya are all subsectors of the transport sector. Shipping, autos, and rail creates the highest vulnerability for China respectively. The utilities sector trails after them. Both the transport sector and the utilities sector have characteristics of public goods, which—as described in the previous chapter—are expected to create the highest levels of vulnerability for the investor.

48 Barber and England, “China’s Africa Scramble Finds Welcome in Kenya.”
Kenya does not have a significant point that might attract China. China, in parallel with other investor countries that invested in Kenya, is interested in strengthening Kenya’s infrastructure. For this purpose, China had many infrastructure-related investments in Kenya from 2005 to 2017.

The number of Chinese investments in the two leading sectors of Kenya i.e. agriculture and tourism is very few. China had only one investment project in the agriculture sector and did not have any investment project in the tourism sector.

Conclusion

This chapter started with an important finding of the dissertation. It presented the findings of the vulnerability interdependence index in Table 14. The table had 37 Sub-Saharan African countries. Chinese investment projects in five of these countries are analyzed in detail and coded for the 17 questions of the vulnerability interdependence index in order to get an index score. The index scores are extrapolated by using investment projects in these five countries for the remaining 344 investment projects in the remaining 32 African countries. Table 14 presented the findings by ranking countries according to their cross-country amount-weighted index scores. The findings indicate that China became the most vulnerable in Nigeria among the Sub-Saharan African nations in terms of making investments. Other four countries that followed Nigeria are Angola, Ethiopia, Kenya, and Zambia.

A discussion of three countries followed China’s vulnerability scores in Sub-Saharan Africa. These three countries are among the China’s top trading five countries. The top three countries that make China the most vulnerable i.e. Nigeria, Angola, and Kenya are selected.

Nigeria is the country with the richest proven oil reserves although it became the second
highest oil producer in the last couple of years. It has the largest population in Africa with a very large share of young population. Furthermore, it is the largest economy among the Sub-Saharan African countries in terms of their GDPs. Chinese investments in this country is not different than Chinese investments in other African countries. China mostly invested in infrastructural projects in Nigeria with a few exceptions. These exceptions include buying stakes in two oil mining licenses. Even though China bought oil mining licenses, their bilateral trade does not reflect this. China does not have a status of favored nation in terms of Nigeria’s oil sales. Albeit around one-third of Nigerian exports to China is crude petroleum and other one-third is petroleum gas (propane and natural gas), it does not take a significant place in Nigeria’s exports since China’s share is only 2.3 percent within the whole Nigerian exports.

Angola is another major African player in the global oil market. It became the top oil producer in its continent in 2015, 2016, and 2017 albeit it holds the second richest oil reserves trailing after Nigeria. Different than its relations with Nigeria, China had a special place in Angola’s oil sales. Angola exports 54 percent of its crude petroleum to China.

The special trade relationship between China and Angola is not reflected in Chinese investments in Angola. Investment projects of Chinese companies are similar to their investment projects in other African countries. They have invested in infrastructure projects in Angola as well. There are only two investments regarding the rights of oil exploration.

Kenya is found to be the second most attractive country for making infrastructure investments. China’s investments are in line with other countries’ investments in Kenya. Investors from various countries focused on strengthening Kenya’s infrastructure. Chinese investments are also about building infrastructure.

Different than Nigeria and Angola, Kenya does not have a special commodity that China
is in need of. Hence, their bilateral relationship is unable to be examined from the perspective of whether they provide a favored nation status to China in their exports. Yet, the reverse side of their bilateral trade provides China a favored nation status to some extent. Kenya has been a marketplace for Chinese products. China has been the origin of 35 percent of Kenya’s imports in 2016.

These three countries did not rank in the top five in terms of country-level amount-weighted index score. Nigeria’s score is 0.7 for this score while Angola has 0.654 and Kenya has 0.685 as country-level index score. These scores rank them as 19th, 35th, and 26th respectively within 37 Sub-Saharan African countries. What makes these countries ranked at the top in the ranking of cross-country amount-weighted index score are the total amount China has sunk in these countries. The more China invests in a country, the more it became vulnerable. For this reason, China became more vulnerable in these countries.
CHAPTER VII
CONCLUSION

This dissertation contributed to the literature by suggesting an index to measure Keohane and Nye’s well-known vulnerability interdependence theory and applying this index to the Sino-African relations to understand in which countries China became vulnerable. The index used 163 Chinese investment project cases in its top five trading partners in Sub-Saharan Africa; South Africa, Angola, Nigeria, Ghana, and Kenya respectively. It also used country-level data for two of its indicators.

The study started by presenting a general background of China increasing its presence in the African continent. The reason of its presence in the region is dominated by its outward financial activities. China started to increase in investing in other countries after the beginning of the 1990s, with its well-known state policy of “going global”. This policy has urged both private companies and state-owned enterprises to start new operations or extend their existing operations in foreign countries.

The second chapter reviewed Keohane and Nye’s vulnerability interdependence theory by differing it from sensitivity interdependence and complex interdependence. The origins of this theory was also reviewed in this chapter. In that respect, Hirschman’s work on the effect of foreign trade on exercising power, Wagner’s unexploited bargaining power concept, and Vernon’s obsolescing bargaining model are analyzed. This chapter also introduced five concepts that are considered to be the best measures of vulnerability interdependence i.e. asset specificity, switching costs, costs of ratification and compliance, proportionality, and issue linkages. Most of these five concepts are borrowed the economics literature and updated to make them applicable to country-level analysis. The questions of the vulnerability interdependence index are derived
from the discussion of these concepts in this chapter.

The third chapter included research design. It started with presenting the 17 questions of vulnerability interdependence index. These questions are discussed in terms of how they relate and contribute to an investor country’s vulnerability and what answer some particular investment types should have for these questions. After questions were introduced, the relevant datasets are discussed and the reason why the dataset of China Global Investment Tracker was selected was explained. Also, dataset selection process for other data was also described. Reliability and validity checks trailed after the narrative about choosing the right dataset.

After reliability and validity checks, index construction methods were discussed. Additive aggregation method is preferred for vulnerability interdependence index because the 17 questions are designed to give answer that can be added on each other to give a vulnerability score. A discussion on data normalization methods followed index construction method. Minmax normalization method is selected for normalizing each answer of 17 questions since it makes answers of all questions ranged from 0 to 1.

In an additive aggregation index, it was important to determine weighing of each indicator question. Analytical hierarchy process was used for determining the weights of each indicator in a consistent way. Appendix section have a discussion of details for how analytical hierarchy process is run to obtain weights of indicators.

In the case study of subsectors, four subsectors with different characteristics in terms of creating vulnerability for the investor party were analyzed in detail. They were analyzed according to the degree they are location asset specific, physical asset specific, human asset specific, and plant asset specific. Also, their contribution to higher or lower levels of switching costs was discussed.
The second case study chapter picked three countries among China’s top five trading partners in the African continent according to the level of vulnerability they create for China. Nigeria, Angola, and Kenya are examined in detail by delving into their country profiles, bilateral trades with China, and characteristics of Chinese investments that they hosted in their countries. A last section assessed the first three sections in order to understand what may attract China to invest in these countries and whether China’s sector selection is determined by other characteristics of a particular country.

The case studies of Nigeria, Angola, and Kenya have some common points. It was important to examine Nigeria and Angola since they are Africa’s top two oil producers. While China had a significant amount of oil trade with Angola, the same trend did not work for Nigeria. China has not had a special place in Nigeria’s oil sales. There might be various reasons why China is unable to receive Nigerian oil while it gets an important amount of Angolan oil although it has almost the same amount of investments in both countries. But, considering Kenya as well, it is important to stress that China made investments in infrastructure in these three countries whatever the amount of natural resources they held or whatever they sell to China. Even though infrastructure investments create higher levels of vulnerability for China, it continues investing in infrastructure investments.

The findings of the index indicate that China became vulnerable in its relations with the African nations as hypothesized in the introduction chapter. The index also found that investments in heavy industries, such as industries related to steel production or mineral production are ranked within the top investment cases with the highest vulnerability scores.

China’s investments increase China’s vulnerability in each one of the African countries. Though, China also benefits from these countries — either by providing strong infrastructure in
these countries or getting direct benefits from them to some extent like supplying some part of its demand to petroleum products or other mineral resources. The analysis of this dissertation indicates China benefits from investing in Africa although its level of vulnerability rises with the investments it make. The benefits it has might either be getting something in return like oil or other mineral products or having a developing marketplace for its products. The three country case studies showed that China received oil from Angola and Nigeria in return for investing in these countries while Kenya has been a useful marketplace for Chinese goods in return for Chinese investments in strengthening infrastructure.

One should be cautious in interpreting the results of the vulnerability interdependence index. There might be other elements that diminish the level of investor country’s vulnerability. For example, the way China finances its investments in Africa is important to consider when assessing its vulnerability. Most of the money that is used in these investments is supplied by loans that China provides to host countries. These loans are advantageous for the African recipients compared to the loans provided by other major financer countries or institutions: China does not look at the economic size of recipient country when considering whether to provide loans whereas the size of economy is a criteria for other major financiers; and there is less wait-time for Chinese loans compared to loans come from other loan providers.

Stepping back and looking at the big picture of vulnerability interdependence theory provide us the understanding that China ought to adjust its foreign policy towards these African countries since its investments in these countries make China more and more vulnerable. Though, as the analysis of Chinese investments in Sub-Saharan Africa since 2005 and the background chapter on the Sino-African relations showed there is no significant change in Chinese foreign policy despite its rising level of vulnerability in these countries. The chief reason
of this is that China might aim at getting other benefits like having economic influence with the money it gives away.¹

The fact that China does not change its foreign policy toward the African countries although it is getting more vulnerable with the investments Chinese companies make indicates a limitation of this study: large economies are not hurt by the money it gives away to the extent that a mid-size or small economy would be hurt. Large economies tend to have more issues to link with their investments as they might target getting other political, diplomatic or economic benefits by investing. A large-scale economy would have a wider range of topics in its foreign policy agenda. This limitation makes it difficult to contrast two countries with large economy despite they have the same particular project in the same host country under the same conditions. The index would find the same vulnerability score for those two countries. However, as pointed out in the previous page, one should be cautious about taking other possible elements into consideration when assessing the vulnerability score for an investor country: “Where predictions based on patterns of asymmetrical interdependence are incorrect, one must look closely for the reasons. They will often be found in the bargaining process that translates power resources into power over outcomes.”²

Assessing a complete vulnerability of interdependent parties would also require what parties are able to do in the absence of relations. The index of vulnerability interdependence does not aim at illustrating a complete picture of vulnerability. It, rather, only aims at measuring the level of vulnerability for interdependent parties by looking at investments.

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¹ Parker and Chefitz, “Debtbook Diplomacy.”
² Keohane and Nye, Power and Interdependence, 16.
REFERENCES


APPENDIX

Weighing of Index Indicators by Using Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is used to weigh each indicator in additive composite indices. It is developed by Thomas Saaty\(^1\) in the late 1980s with a concern of “the scaling problem and what sort of numbers to use, and how to correctly combine the priorities resulting from them”\(^2\).

The weighing of indicators is presented on page 139. The calculation of weights is based on author’s expertise in the vulnerability interdependence literature. Some concepts’ literature might weigh more on a subcategory while this study might give more weight on another subcategory, for example. Importance of categories, subcategories, or questions for vulnerability interdependence index has been the primary consideration point for their weight values. Also, data availability is considered in the decision-making process of weighing. Although the best available dataset is used for each question, some datasets may not represent their respective question exactly. For example, the weight of issue linkages question kept at a low point compared to others due to unavailability of a dataset to represent it completely. Rationale behind weight calculation for some indicators is explained below.

The central issue in AHP is assigning a comparison value for each pair of indicators. For example, a buyer may need to make decision for buying a printer based on its price, service availability, auxiliary equipment availability, printing speed and printer color. Probably, these specifications would not have equal weight for this buyer; they would have different importance levels for making a decision on which printer to buy. In order to apply AHP to the decision-making process of this buyer, one should prepare a table for pairwise comparison of each

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specification. Then, the buyer should make a decision how important one of each of two specifications over another. Saaty suggests to give a number from 1 to 9, higher number indicating that this indicator is more important. For example, the buyer may think that price is 7 times more important than service availability. Then, the buyer should write 7 to the price-service availability cell and 1/7 to the service availability-price cell. Similarly, printing speed may be 9 times more important than printer color. Then, the table should be filled as in the example table below. If any two specification has equal importance, than 1 should be given to both of them as in the example of service availability and auxiliary equipment availability in the following table.

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Service Availability</th>
<th>Auxiliary Availability</th>
<th>Printing Speed</th>
<th>Printer Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>1</td>
<td>7</td>
<td>1/3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Service Availability</td>
<td>1/7</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Auxiliary Availability</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Printing Speed</td>
<td>1/2</td>
<td>1/3</td>
<td>1/3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Printer Color</td>
<td>1/7</td>
<td>1/5</td>
<td>1/7</td>
<td>1/9</td>
<td>1</td>
</tr>
</tbody>
</table>

Next steps of calculation is (1) getting sum of each column, (2) dividing the value by the sum to obtain a percentage value, and (3) averaging percentage values in all rows. These average values are called as criteria values. They indicate the importance degree of an indicator for the decision-maker. There are more steps of calculation for obtaining consistency ratio to understand whether the decision-maker is consistent in his/her preferences for each two indicators. These steps are (1) multiplying importance scores (values shown in Table 19) by the criteria values, (2)
getting the sum of each row which is called as weighted sum value, (3) dividing weighted sum value by criteria weights, (4) getting average of these values (which gives us the $\lambda_{max}$ value), (5) calculating consistency index value by dividing the difference between $\lambda_{max}$ and the number of compared elements by the number of compared elements minus 1 ($\frac{\lambda_{max}-n}{n-1}$), and (6) getting the consistency ratio by dividing consistency index value by random index value which is a consistency index of a randomly generated pairwise index. If the calculated consistency ratio is between 0 and 0.1, then the decision-maker is consistent in his/her importance levels for all pairwise comparisons of any two elements.

Consistency ratio is calculated for all subcategories in the vulnerability interdependence index. The vulnerability interdependence is provided in the following chart in branch view to better understand pairwise comparisons for each subcategories. The pairwise comparisons are made for:

- Subcategories of the main index; asset specificity, switching costs, ratification and compliance costs, proportionality (indicator 16), issue linkages (indicator 17),
- Subcategories of asset specificity; location asset specificity, physical asset specificity, human asset specificity, plant asset specificity (indicator 10),
- Subcategories of location asset specificity; indicators 1 to 5,
- Subcategories of physical asset specificity; indicators 6 and 7,
- Subcategories of human asset specificity; indicators 8 and 9,
- Subcategories of switching costs; relational switching costs (indicator 11), opportunity switching costs (indicator 12), financial switching costs (indicator 13),
- Subcategories of ratification and compliance costs (indicators 14 and 15).

Instead of determining an importance value for each pairwise comparison, an importance
value between 1 and 9 is given to each indicator. For example, importance value for asset specificity is 9, importance value for switching cost is 9, importance value for ratification and compliance costs is 3, importance value for proportionality is 7, and importance value for issue linkages is 6. Importance value of each pairwise comparison is calculated by dividing these values. For example, the value of importance for a pairwise comparison of asset specificity and proportionality is calculated as $9/7=1.286$. Calculating importance values by using this method makes the AHP completely consistent. Hence, there is no consistency ratio concern in this method as importance values are calculated by each indicator’s importance value.

Table 20 shows below the indicators of vulnerability interdependence index in the branch view to illustrate all pairwise comparisons of the index.

**Table 20: Pairwise Comparison Table for Subcategories of the Vulnerability Interdependence Index**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Asset Specificity</th>
<th>Switching Cost</th>
<th>Ratification and Compliance Cost</th>
<th>Proportionality</th>
<th>Issue Linkages</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Specificity</td>
<td>1.00</td>
<td>9/9</td>
<td>9/3</td>
<td>9/7</td>
<td>9/6</td>
<td>9</td>
<td>0.265</td>
</tr>
<tr>
<td>Switching Cost</td>
<td>9/9</td>
<td>1.00</td>
<td>9/3</td>
<td>9/7</td>
<td>9/6</td>
<td>9</td>
<td>0.265</td>
</tr>
<tr>
<td>Ratification and Compliance Cost</td>
<td>3/9</td>
<td>3/9</td>
<td>1.00</td>
<td>3/7</td>
<td>3/6</td>
<td>3</td>
<td>0.088</td>
</tr>
<tr>
<td>Proportionality</td>
<td>7/9</td>
<td>7/9</td>
<td>7/3</td>
<td>1.00</td>
<td>7/6</td>
<td>7</td>
<td>0.206</td>
</tr>
<tr>
<td>Issue Linkages</td>
<td>6/9</td>
<td>6/9</td>
<td>6/3</td>
<td>6/7</td>
<td>1.00</td>
<td>6</td>
<td>0.176</td>
</tr>
</tbody>
</table>

Table 20, Table 21, Table 22, Table 23, Table 24, Table 25, and Table 26 show pairwise comparisons for each one of categories shown in Figure 12.
Figure 12: Vulnerability Interdependence Index In Branch View
### Table 21: Pairwise Comparison Table for Subcategories of Asset Specificity

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Location Asset Specificity</th>
<th>Physical Asset Specificity</th>
<th>Human Asset Specificity</th>
<th>Plant Asset Specificity</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Asset Specificity</td>
<td>1.00</td>
<td>1.29</td>
<td>1.29</td>
<td>1.80</td>
<td>9</td>
<td>0.085</td>
</tr>
<tr>
<td>Physical Asset Specificity</td>
<td>0.78</td>
<td>1.00</td>
<td>1.00</td>
<td>1.40</td>
<td>7</td>
<td>0.066</td>
</tr>
<tr>
<td>Human Asset Specificity</td>
<td>0.78</td>
<td>1.00</td>
<td>1.00</td>
<td>1.40</td>
<td>5</td>
<td>0.066</td>
</tr>
<tr>
<td>Plant Asset Specificity</td>
<td>0.56</td>
<td>0.71</td>
<td>0.71</td>
<td>1.00</td>
<td>5</td>
<td>0.047</td>
</tr>
</tbody>
</table>

### Table 22: Pairwise Comparison Table for Subcategories of Location Asset Specificity

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Question 1</th>
<th>Question 2</th>
<th>Question 3</th>
<th>Question 4</th>
<th>Question 5</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1</td>
<td>1.00</td>
<td>1.80</td>
<td>3.00</td>
<td>2.25</td>
<td>1.50</td>
<td>9</td>
<td>0.028</td>
</tr>
<tr>
<td>Question 2</td>
<td>0.56</td>
<td>1.00</td>
<td>1.67</td>
<td>1.25</td>
<td>0.83</td>
<td>5</td>
<td>0.016</td>
</tr>
<tr>
<td>Question 3</td>
<td>0.33</td>
<td>0.60</td>
<td>1.00</td>
<td>0.75</td>
<td>0.50</td>
<td>4</td>
<td>0.009</td>
</tr>
<tr>
<td>Question 4</td>
<td>0.44</td>
<td>0.80</td>
<td>1.33</td>
<td>1.00</td>
<td>0.67</td>
<td>3</td>
<td>0.013</td>
</tr>
<tr>
<td>Question 5</td>
<td>0.67</td>
<td>1.20</td>
<td>2.00</td>
<td>1.50</td>
<td>1.00</td>
<td>6</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Question 1: Are the assets or productivity mobile?  
Question 2: Are transportation costs amenable to decentralized production?  
Question 3: Is the value per unit of end-product’s weight high?  
Question 4: Is it the production of a natural (extracted) resource?  
Question 5: Are the assets generally co-located with other productive activities within a host country?
### Table 23: Pairwise Comparison Table for Subcategories of Physical Asset Specificity

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Question 6</th>
<th>Question 7</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 6</td>
<td>1.00</td>
<td>1.50</td>
<td>9</td>
<td>0.040</td>
</tr>
<tr>
<td>Question 7</td>
<td>0.67</td>
<td>1.00</td>
<td>6</td>
<td>0.026</td>
</tr>
</tbody>
</table>

Question 6: Does production require investment in specialized (single-purpose) equipment?  
Question 7: Are fixed production costs (as percent of total costs) high or low?

### Table 24: Pairwise Comparison Table for Subcategories of Human Asset Specificity

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Question 8</th>
<th>Question 9</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 8</td>
<td>1.00</td>
<td>2.67</td>
<td>8</td>
<td>0.048</td>
</tr>
<tr>
<td>Question 9</td>
<td>0.38</td>
<td>1.00</td>
<td>3</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Question 8: Does production require a specialized, high-skilled workforce?  
Question 9: Is the workforce mobile?

### Table 25: Pairwise Comparison Table for Subcategories of Switching Costs

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Relational</th>
<th>Opportunity</th>
<th>Financial</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational</td>
<td>1.00</td>
<td>0.83</td>
<td>0.56</td>
<td>5</td>
<td>0.066</td>
</tr>
<tr>
<td>Opportunity</td>
<td>1.20</td>
<td>1.00</td>
<td>0.67</td>
<td>6</td>
<td>0.079</td>
</tr>
<tr>
<td>Financial</td>
<td>1.80</td>
<td>1.50</td>
<td>1.00</td>
<td>9</td>
<td>0.119</td>
</tr>
</tbody>
</table>
Table 26: Pairwise Comparison Table for Subcategories of Ratification and Compliance Costs

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Question 14</th>
<th>Question 15</th>
<th>Importance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 14</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
<td>0.044</td>
</tr>
<tr>
<td>Question 15</td>
<td>1.00</td>
<td>1.00</td>
<td>7</td>
<td>0.044</td>
</tr>
</tbody>
</table>

Question 14: Does information asymmetry favor investing party or hosting party?
Question 15: Is there an existing regime to monitor compliance among contracting parties?
Nurullah Ayyilmaz was born and raised in Bandırma, Turkey. After graduating from Bandırma Anatolian Teacher Training High School in 2007, he started his undergraduate studies at Okan University in Istanbul, Turkey. He graduated from Okan University with two bachelor degrees, one major in International Relations in 2012 and the other one in International Trade in 2013. In the academic year of 2010-2011, he studied two semesters at Zeppelin University in a lovely city of Germany, Friedrichshafen, from where he holds an Erasmus Student Exchange Certificate. Nurullah started his graduate studies in the Graduate Program in International Studies at Old Dominion University in 2013. He received a Master of Arts degree in Spring 2016 and will receive his PhD degree with a concentration in modeling and simulation and in conflict and cooperation fields from the same program in December 2018.