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Chinese FDI and the African Health System

by

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Abstract: Numerous African governments are actively implementing diverse strategies to attract increased foreign direct investments (FDI) to bolster their economies. However, there remains an ongoing debate regarding the impact of FDI on economic development, particularly concerning healthcare. Furthermore, there is a notable lack of understanding regarding the influence of Chinese FDI on the African health system, despite China's substantial investments in the continent over the past two decades. Consequently, this study aims to explore the relationship between Chinese FDI and the health systems of 41 African countries spanning the years 2004 to 2018. Data from five health indicators are aggregated to create a composite variable. Additionally, this new indicator, along with FDI, will be regressed against variables representing health outcomes, such as life expectancy and infant mortality rate. This approach seeks to assess whether the effects of FDI on the structural health system translate into tangible improvements in health outcomes, thereby contributing to an overall enhancement in living standards. The findings demonstrate a positive and significant correlation between Chinese FDI and the African health system, as well as between the health system and health outcomes. However, the direct effects of FDI on health outcomes yield ambiguous results.

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1 Introduction

Foreign direct investments (FDI), as defined by the OECD (1996), refer to a type of international investment wherein an investor residing in one economy establishes a long-term interest and control over an enterprise resident in another country. The impact of FDI on the economy of the hosting nation can be characterized by mixed outcomes. On one hand, FDI can benefit developing countries by increasing their access to capital and generating spillover effects (Akadiri et al., 2019). Several studies in the literature have found a positive correlation between FDI and economic growth (Borensztein, Gregorio & Lee, 1998; Jude & Levieuge, 2014). On the other hand, there are authors who have presented evidence supporting the opposite perspective (Herzer, Klasen & Nowak-Lehmann D., 2008).

Foreign direct investments are highly valued by many African nations due to their crucial role in promoting economic development and facilitating integration into the global economy. This recognition stems from the understanding that domestic investments alone may not be sufficient to achieve the development objectives set by African countries. However, numerous challenges have hindered the investment climate in several African nations, including poor institutional quality, macroeconomic policy imperfections, weak legal systems, and a lack of transparency. In response to these obstacles, African nations have undertaken significant efforts to improve their investment climate over the past decade. These endeavors have involved the liberalization of investment regulations and the implementation of incentives aimed at attracting foreign investors. Additionally, concerted actions have been taken to strengthen the institutional framework necessary for a well-functioning market economy. As part of these initiatives, the African Peer Review Mechanism (APRM) was established in March 2003. The APRM operates as a voluntary and self-monitoring process consisting of five stages, all aimed at achieving mutually agreed goals and ensuring compliance with adopted political, economic, and corporate governance values, codes, and standards (Nnadozie, Katjomuise & Krüger, 2008).

The results of these efforts have been remarkable, as many African countries have experienced sustained economic growth rates of 5% or higher, thanks in part to increased foreign investment

inflows. These positive trends have contributed to an overall improvement in the region's economic performance since the mid-1990s (UNITED NATIONS, 1999). Furthermore, Africa experienced the highest rate of return on FDI inflows, reaching 11.4% between 2006 and 2011 (Odusola, 2018). Many examples of African companies exhibiting significant profits thanks to FDI can be found: for instance, Sonatrach¹ recorded a turnover of \$33.2 billion solely from oil and gas operations, MTN Group² achieved a turnover of approximately \$10 billion, and Dangote Group³'s turnover amounted to \$4.1 billion—all in the year 2017 (Odusola, 2018).

Nevertheless, it is important to note that the positive correlation observed between FDI and economic growth in African countries does not provide conclusive evidence regarding the impact of FDI on the African health system. The literature is, indeed, still debating the relationship between foreign direct investments and health in the continent.

1.1 Research Question

Despite the significant increase in FDI inflows in the African continent, their effect on countries' economic development remains debatable; their impact on the health sector is even more questionable. For this reason, the purpose of this paper is to examine the relationship between Chinese foreign direct investment and the African health system.

This choice of China is driven by the fact that even though most of the investments in the African continent have been historically dominated by the West, the last decades have seen a significant increase in China's investments in Africa. In 2021, approximately 4.99 billion U.S. dollars were directed from China to African countries, an increase from around 0.49 billion U.S. dollars in 2003. Furthermore, although in 2020 global FDIs decreased sharply because of the Covid-19 pandemic, Chinese FDI outflows increased against the trend, making China the

¹ Sonatrach is the national state-owned oil company of Algeria, and it is known today to be the largest company in Africa (Ayemba, 2020)

² MTN Group Limited is a South African multinational mobile telecommunications company, operating in many African and Asian countries. As of 2020, it is the 8th largest mobile network operator in the world, and the largest in Africa.

³ The Dangote Group is a Nigerian multinational industrial conglomerate.

largest international direct investor for the first time in history (Textor, 2022). The largest share of investment went to South Africa and the Democratic Republic of Congo.

Health-related investments were also significant, with China being among Africa's top 10 bilateral global health donors (Lin et al., 2016). This increased Chinese FDI corresponded to improved human development in Africa, as measured by the Human Development Index (United Nations, 2022).

The choice to focus on Chinese investments is also motivated by the fact that they could differ from the investments made by the West (Tang, Chen & Dollar, 2015). On the one hand, China's assistance has often been perceived as opportunistic, with various studies proving that most interventions are in natural resource-abundant countries with poor institutions (Asiedu, 2006; Cheung et al., 2012; Kolstad & Wiig, 2011). The Chinese policy of "no strings attached," i.e., not imposing ideologies and values on the receiving countries, has been criticized, especially by Western countries, which claim that this approach could further hinder human rights and encourage repressive regimes. On the other hand, various studies could not find evidence supporting the hypothesis that China targets health aid preferentially to resource-rich countries. According to Tang et al. (2015), while both Western and Chinese investments are more attracted to larger markets and natural resource-rich countries, the main difference between the former and the latter lies in the hosting countries' institutions: Western investments tend to concentrate in African nations that have stronger property rights and a better rule of law. In contrast, Chinese outward direct investments are indifferent to property rights or the rule of law environment.

In light of this perspective, the institutional advancements pursued by African countries to attract Western FDI may potentially become redundant, thereby impeding progress or even exacerbating the decline in institutional quality across the continent. A deteriorating institutional environment can have detrimental effects on health outcomes, with corruption, for instance, diverting funds that should ideally be allocated to the healthcare system (Akinlo & Sulola, 2019).

Consequently, it becomes imperative to recognize that the impacts of Chinese FDI on the health system may differ from those of Western counterparts. Gaining an understanding of the effects of Chinese investments on the African health sector assumes critical importance in order to assess potential disparities with other investors.

While most of the literature on the China-Africa relationship has focused mainly on Chinese aid or the general effect of FDIs, more attention should be given to China's role in the African health system, given its importance: ensuring improvements in living standards in developing countries heavily relies on the state of their healthcare systems. Furthermore, progress in the healthcare sector plays a crucial role in achieving the United Nations' Sustainable Development Goal of eliminating poverty.

The study will employ a panel data of 41 African countries between 2004 and 2018 to shed light on the direction of the relationship between the health system, FDI, and health outcomes. Therefore, it will contribute to the debate on whether foreign direct investments from China have a positive or negative effect on health.

To achieve this objective, the study will introduce a novel indicator that encapsulates the health system. This indicator will be constructed by combining information on health personnel and infrastructure across the 41 African countries. Subsequently, the indicator will be regressed against Chinese FDI inflows to determine the presence and direction of any correlation. To address the issue of omitted variable bias, variables affecting the health system will be added as controls. It is worth noting that the choice of this indicator is innovative, as it focuses on the “structural” part of the health system described by the Pan American Health Organization (2018).

It is important to recognize that higher health spending and improved healthcare infrastructure do not automatically equate to better health outcomes. To address this concern, the study will also examine the impact of the health system on health outcomes, proxied by life expectancy and infant mortality rate.

The remainder of the paper is organized as follows: this Section will conclude with the motivation and contribution of the study. An overview of the research context will be presented in the subsequent section. This will involve examining the relationship between Africa and China and the progression of Chinese investments in the continent. The theoretical framework will be outlined in Section 3, emphasizing relevant theories and prior research. Sections 4 and 5 will be dedicated to discussing data and methodology, respectively. Firstly, they will focus on the initial regression analysis, exploring the connection between Chinese foreign direct investment and the African health system. Subsequently, attention will shift to examining the

relationship between the health sector and health outcomes. Section 6 will thoroughly discuss the findings, while Section 7 will provide a conclusive summary.

1.2 Motivation and Contribution

Most of the debate concerning FDI focuses on its general effects on the hosting economies. Only a few studies⁴ analyze its effect on health, and most of them focus on health outcomes, such as the life expectancy (Immurana, 2021) and child health (Immurana et al., 2023) rather than the health systems. They also mainly focus on developing countries in general, without considering Africa alone. However, focusing only on the African continent is crucial, as the characteristics of African nations differ significantly from those of developed and other developing countries. As a result, combining them with other countries may not provide insights that would help develop policies tailored to the African context. Indeed, the status of the health system in the African continent is fundamental to guaranteeing living standards improvements in developing countries: poorer nations continue to be plagued with diseases for which treatments exist, such as malaria or tuberculosis. It is fundamental for African countries to improve the quality of their health system: policymakers and stakeholders face the daunting task of providing good quality, affordable, and equitable healthcare to over 2 billion people within the next three decades due to the continent's rapidly growing population. Achieving this goal will require significant investments in the health sector. Therefore, studying the impact of FDI on the health system might provide useful insights into the future development of this sector.

Furthermore, with Africa facing poor health outcomes despite its efforts to attract foreign direct investment, it is crucial to investigate the actual impact of FDI on health outcomes. This is particularly important given the findings from UNACTAD (2014) that some countries are willing to lower their health, environmental, and safety standards to attract FDI, while others have clauses in place that ensure existing regulations are not altered to the detriment of investors (Immurana, 2021).

⁴ See, for instance, Immurana (2021), Herzer and Nunnenkamp (2012), Nagel et al. (2015).

This study will contribute to the debate by introducing a new indicator representing the health system, which incorporates health personnel and infrastructure, to see the direct effect of FDI on the “structural” aspects of health. Additionally, the study will explore the influence of these "structural" aspects on health outcomes that have already been widely studied in the literature, such as life expectancy and infant mortality rate.

Furthermore, it is worth noting that limited research has been conducted on the specific relationship between China as an investor and Africa as a recipient, despite the growing investments and trading agreements between the two. Therefore, this study aims to fill this gap by focusing solely on Chinese FDI and its direct relationship with the health system indicator employed in this research. To the best of the author’s knowledge, no other study has examined the direct relationship between Chinese FDI and the health system indicator used in this research.

The majority of existing studies investigating the China-Africa relationship predominantly adopt qualitative approaches, while the few empirical studies available suffer from limited coverage in terms of both time and countries. Furthermore, these studies primarily concentrate on the broader impact of China's foreign direct investment on the economies and general well-being of recipient countries.

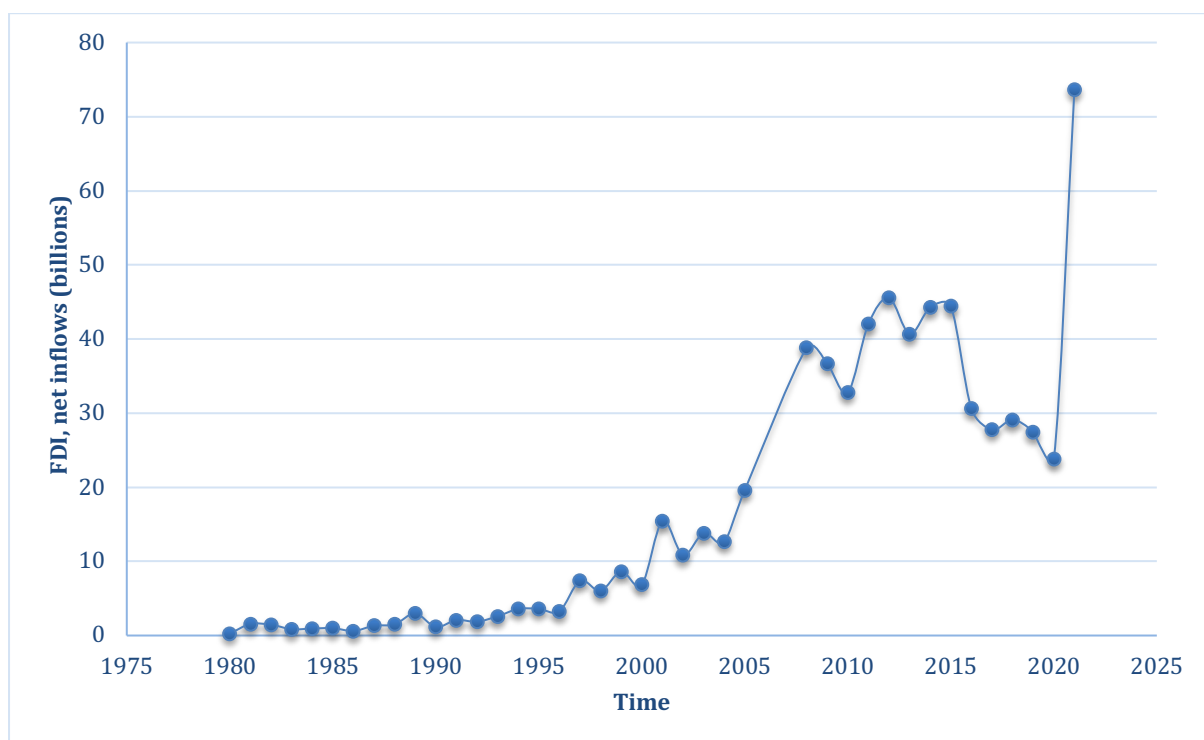
In light of these gaps, this study aims to make significant contributions to the existing literature in three distinct ways. Firstly, it will extend the coverage to include a broader range of countries. Secondly, it will specifically focus on the effects of FDI on the health sector by introducing a novel variable that captures the relevant aspects. Thirdly, this study will exclusively examine Chinese investments, rather than considering overall FDI, thereby offering a more targeted and nuanced analysis of the relationship between Chinese FDI and the health sector in Africa.

2 Context

2.1 FDI inflows in Africa

The West has historically prevailed as the greatest investor in the African continent. As shown in Figure 2.1, foreign direct investment inflows to the Sub-Saharan African region began increasing sharply in the second half of the 1990s, reaching a peak of US\$38.8 billion in 2008. This value represents a large increase from the US\$230 million in 1980. Most of the FDI (about 70 percent) was concentrated in selected countries, namely Angola, Nigeria, and South Africa. The rest was mainly invested in smaller countries such as Lesotho, Namibia, and Uganda (Krishna Srinivasan ; Basu Anupam, 2002).

Figure 2-1: FDI Inflows in SSA Countries, 1980-2021



Source: created by the author using data from the World Bank. Data on the vertical axis is expressed in billions US\$.

Following the repercussions of the financial crisis in 2008, FDI experienced a subsequent decline. However, there was a gradual recovery, leading to an increase in FDI inflows that peaked at US\$44.2 billion in 2015. Subsequently, FDI inflows began to diminish, eventually regressing to levels comparable to those observed in 2005 by the year 2020. This decline can be primarily attributed to the adverse effects of low oil prices and the persistent repercussions of the commodity bust, especially impacting major African economies heavily reliant on commodity exports (Yimer, 2023).

Surprisingly, in 2021, flows to Africa reached a record \$83 billion, with most of the investment happening in the South (UNCTAD, 2022). Indeed, foreign direct investment to Africa showed remarkable changes, with some regions seeing significant growth in investment flows. Southern Africa experienced a massive tenfold increase in FDI, reaching \$42 billion, driven primarily by a share exchange between Naspers and Prosus in South Africa⁵. Additionally, the region saw promising new project announcements, including a \$4.6 billion clean energy project by Hive Energy⁶ and a \$1 billion greenfield project by Vantage Data Centers⁷.

West Africa also saw significant growth in FDI: Nigeria, the largest recipient of FDI in West Africa, experienced a doubling of investment flows to \$4.8 billion, largely due to renewed investment in the oil and gas sectors. The region also saw a surge in international project finance deals, including the \$2.9 billion Escravos Seaport project⁸.

⁵ Technology investor Prosus and its South African parent Naspers completed a deal in August 2021 that allowed Prosus to buy 45% of Naspers shares, bringing its ownership in Naspers to 49% in all (Reuters, 2021).

⁶ Hive Hydrogen South Africa, a partnership between U.K energy company, Hive Energy, and South African energy companies BuiltAfrica, and Afrox, have announced plans to establish a \$4.6bn green ammonia plant in Gqeberha, South Africa. At least 20,000 jobs will be created in the region over the lifespan of the project (RenewAfrica.Biz, 2022).

⁷ Vantage Data Centers, a leading global provider of hyperscale data center campuses, began the construction of its first African campus in Johannesburg, South Africa, in October 2021, leveraging a US\$1 billion investment from existing financial partners (Freeman, 2021).

⁸ The \$2.9 billion Escravos Seaport Industrial Complex Project was promoted by Mercury Maritime Concession Company (MMCC) Limited, which announced that the project would help to decongest the Lagos ports while attracting about \$50 billion in FDI to Nigeria when completed. It would generate about 40,000 jobs upon completion and eliminate criminality such as piracy in the region, especially as the Nigerian Navy would be present to protect the business (Onyenucheya, 2021).

In East Africa, FDI increased by 35% to reach \$8.2 billion, with Ethiopia experiencing an impressive 79% growth in investment flows to \$4.3 billion. The country has become a central hub for China's Belt and Road Initiative, with four out of five international project finance announcements focused on renewable energy. Tanzania and Uganda also reported notable increases in FDI, with new greenfield project announcements tripling in 2021.

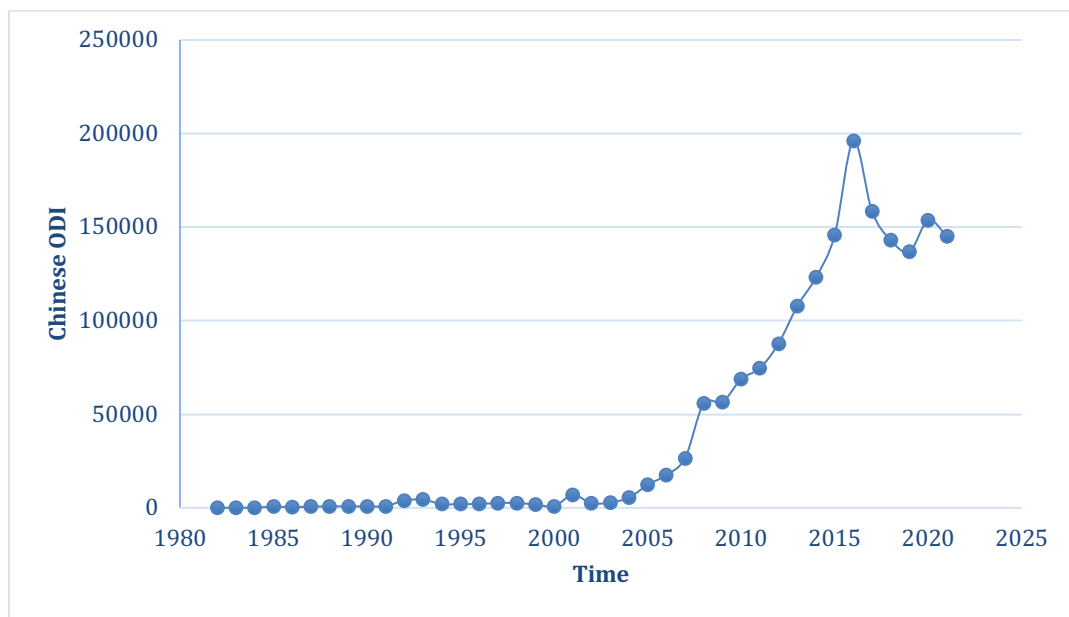
Meanwhile, Central African FDI remained flat at \$9.4 billion, with the Democratic Republic of Congo seeing a 14% increase in investment flows to \$1.9 billion, thanks primarily to investment in offshore oil fields and mining. North Africa experienced a 5% decline in FDI, reaching a total of \$9.3 billion, with Morocco seeing a 52% increase to \$2.2 billion, while Egypt, the second largest FDI recipient in Africa, saw a 12% drop to \$5.1 billion. However, new pledges from the Gulf States to invest \$22 billion in Egypt's economy and a tripling of announced greenfield projects to \$5.6 billion offer hope for increased FDI in the future (UNCTAD, 2022).

2.2 Chinese FDI and its commitment to Africa

The last two decades also saw a change in the order of investors. Indeed, while the West historically dominated the majority of investments in the African continent, China took over as one of the largest international investors. In a relatively short period, the country changed its way of engaging with the global community: its economic transformation in the past four decades has been closely linked to its openness to international trade and investment. Notably, a significant portion of China's reform measures revolved around trade liberalization and the facilitation of international investments. These reforms allowed China to go from representing only two percent of global GDP in the 1980s to hold the position of the largest economy in the world in terms of purchasing power parity (PPP) in 2016 (Garnaut, Song & Fang, 2018, p.545).

In 2016, China became the second-largest origin of outward investments after the United States (UNCTAD, 2017). China's approach towards outward direct investments (OFDI) can be divided into three stages: the "restricted" stage (1978–99), the "relaxed" stage (2000–16) and the "regulated" stage (2016 onwards) (Garnaut, Song & Fang, 2018, p.619), represented in Figure 2.2 below.

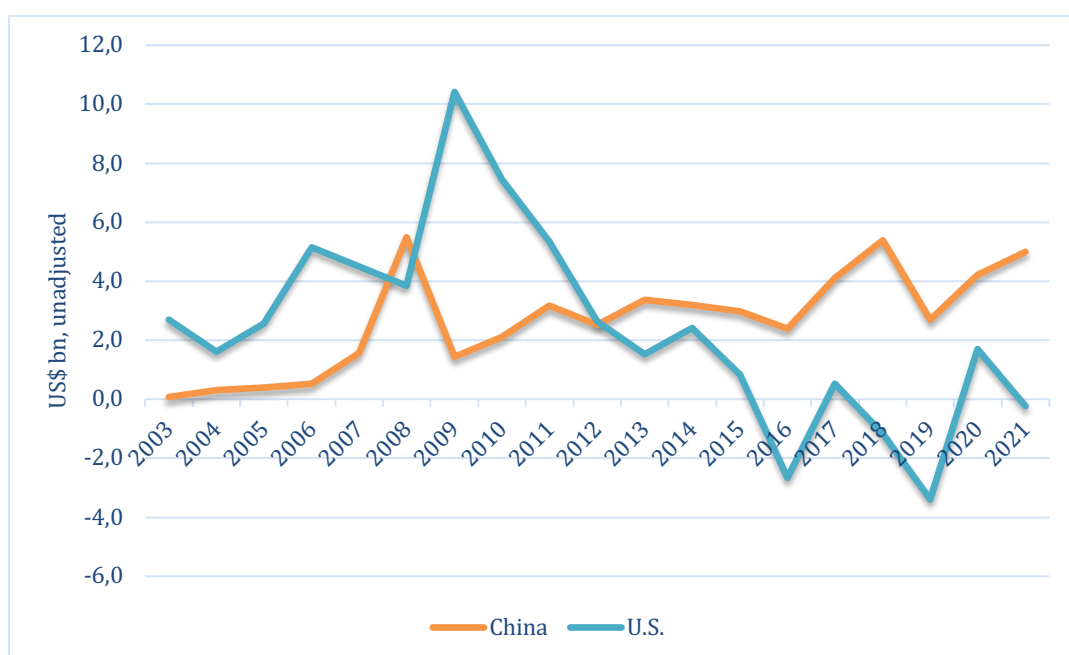
Figure 2-2: Chinese OFDI stock, 1980–2022.



Source: created by the author using data from UNACTADSTAT.

Concerning Chinese investments in Africa, they represent only a small part of the total OFDI. Out of US\$104.5 billion invested in 2021, only US\$2.4 billion went to Africa (CARI, 2023); however, China represents the second largest investor in the continent, after the United States. Figure 2.3 below shows the development of FDI flows to Africa from China and the United States.

Figure 2-3: Chinese FDI vs. US FDI to Africa, flow 2003-2021.



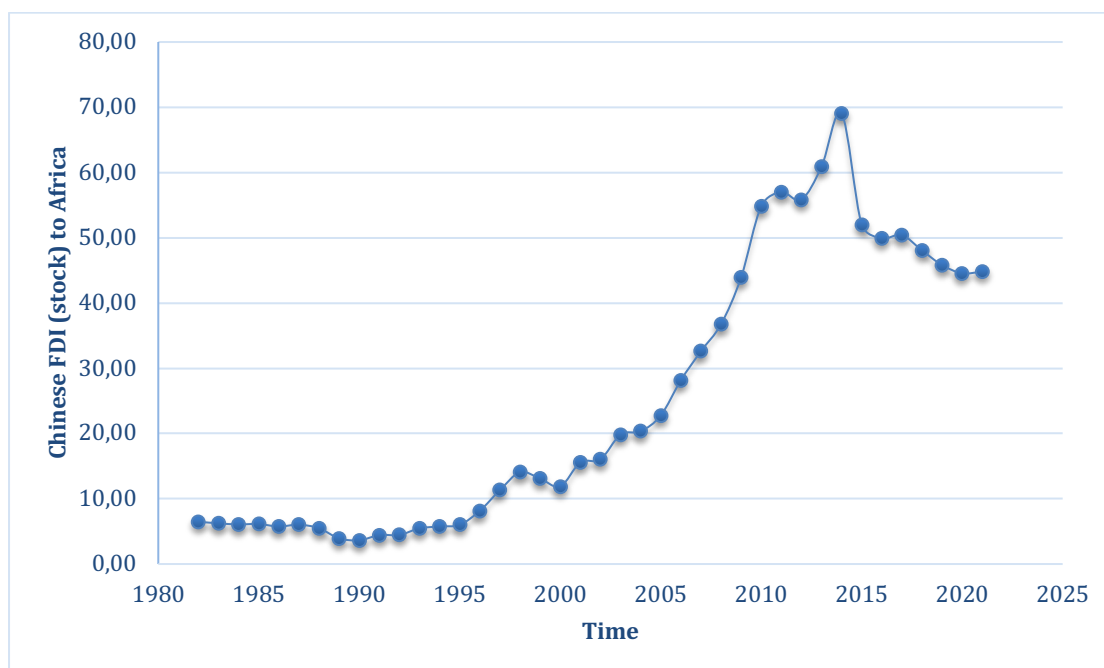
Source: created by the author using data from CARI.

As can be seen from Figure 2.3, the role of China in Africa is becoming more and more important. While some existing studies in the literature suggest that market-seeking, access to natural resources, and strategic assets are the primary drivers of Chinese investments on the continent, similar motivations can be observed when Western countries, such as the United States and Europe, are the primary investors (Drogendijk & Blomkvist, 2013). However, the key distinction between China and the West appears to lie in their approach to property rights within the host country. While Western investors tend to prioritize countries with strong property rights institutions, China shows relative indifference to the type of governing institutions in place. There is still a debate in the literature regarding the real motives behind these investments. On the one hand, the Chinese FDI outflows have been accused of opportunism and targeting resource-rich countries with poor institutions. Should this hold true, the effects of such investments might not yield positive outcomes, potentially exacerbating corruption and inequality. On the other hand, other studies have failed to find empirical evidence supporting these "accusations" and have even identified positive effects of Chinese investments on African countries⁹. Furthermore, Chinese investments demonstrate a diversified allocation between resource-rich and non-resource-rich countries, indicating a more varied approach.

Figures 2.4 and 2.5 display Chinese FDI to Africa and the sector division.

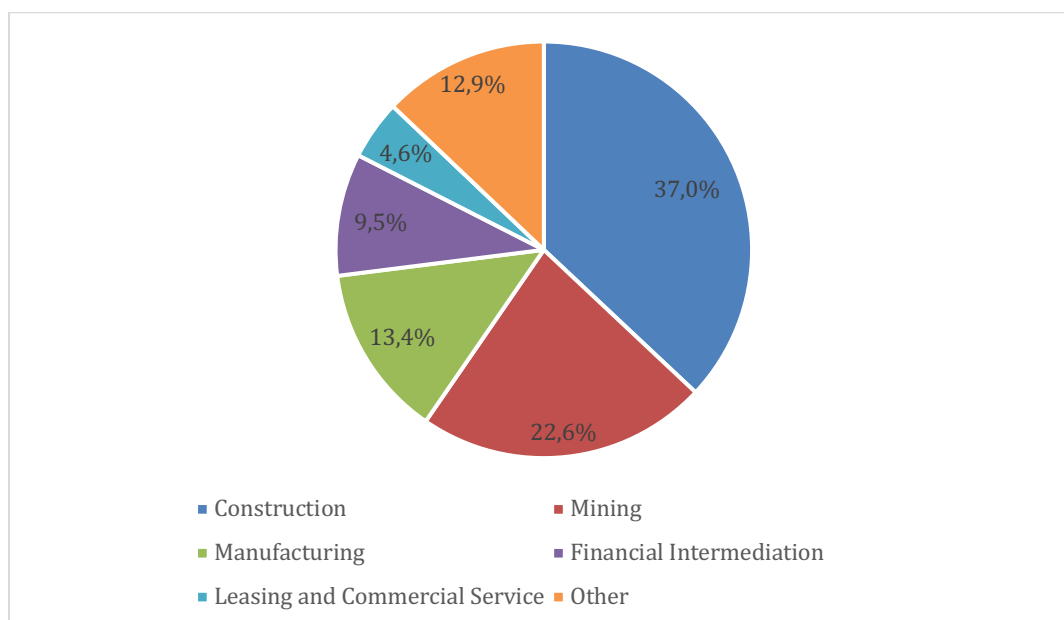
⁹ See, for instance, Atitianti & Dai (2022).

Figure 2-4: Chinese FDI (Stock) to Africa, 1980–2021.



Source: created by the author using data from UNACTADSTAT.

Figure 2-5: Chinese investments in Africa by sector (%), 2021.



Source: created by the author using data from UNACTADSTAT.

As can be seen, Chinese foreign direct investment in Africa is well-diversified, covering a wide range of sectors, including resource-oriented industries like mining and metals, as well as services and manufacturing. Furthermore, Chinese investment in Africa is spread across

multiple locations, including resource-rich nations like South Africa, Nigeria, and Angola, as well as agricultural exporters such as Kenya. The top 5 African destinations of Chinese FDI in 2021 were the Democratic Republic of Congo, Zambia, Guinea, South Africa and Kenya (CARI, 2023). China also provided funding and constructed numerous infrastructure projects throughout the continent, such as ports, roads, airports, and hospitals (Ernst & Young, 2017).

Chinese investments directly in the health sector were also significant, making China one of the largest contributors to developing the African health system (Lin et al., 2016). For instance, during the 2018 Beijing Summit and the 7th Ministerial Conference of the Forum on China-Africa Cooperation (FOCAC), the Chinese government pledged to assist in establishing the Africa CDC's headquarters¹⁰. This commitment has been fulfilled: the inauguration of the Phase I project for the construction of the African CDC headquarters took place on January 11th, 2023. This is not only one of many investments made by China to strengthen public health systems across the African continent, but it also highlights China's unparalleled dedication to enhancing healthcare infrastructure in the region.

Moreover, China has given importance to developing Africa's information and communications technology (ICT) infrastructure to improve the region's public health systems. Indeed, it has invested more than any other country in ICT, which can make the African health system more effective, long-lasting, and affordable (Odonkor, 2023).

¹⁰ The Africa CDC (African Centers for Disease Control and Prevention) is a specialized technical institution of the African Union (AU) that aims to strengthen the capacity and capability of Africa's public health institutions (Odonkor, 2023).

3 Theory and previous research

As mentioned in the previous section, there is an ongoing debate in the literature regarding the drivers and effects of FDI in Africa. The literature can be divided into studies examining the general effects of FDI on economic growth and studies focusing specifically on the health sector. As the impacts of FDI on growth can also have implications for the health system, both types of studies will be presented in this analysis.

3.1 FDI and Economic Growth

Understanding the connection between FDI and economic growth is crucial for this study, as the FDI can influence the healthcare system by providing greater resource availability for the nation to invest in the health sector.

It is widely accepted by the literature in growth theory that research and innovation are the engines of economic expansion. This idea implies that foreign direct investments increase growth through access to better technologies (Balcão Reis, 2001). Indeed, there are two key reasons why FDI inflows can impact the growth of developing nations: first, they act as a source of capital, which is normally scarce in developing economies. Therefore, they increase the capital stock available in the host countries. Second, introducing new technologies and human capital can positively impact productivity and output growth.

Various authors in the literature have found evidence to support this theory. For instance, Akadiri et al. (2019) studied the causal relationship between FDI and economic growth in 25 African countries while also taking into consideration trade openness. The results of the Granger causality test revealed the existence of a long-term equilibrium relationship between the variables under consideration. Moreover, they observed a bidirectional causality between foreign direct investment, trade openness, and economic growth. For this reason, both economic growth and trade openness will be inserted in the model presented in Section 5.

Other authors argued that the effect of foreign direct investment on growth depends on the specific characteristics of the host country.

For instance, Jude and Levieuge (2014) conducted a study exploring the relationship between FDI and economic growth, considering the influence of institutional quality. Their research revealed valuable insights regarding the threshold and heterogeneity of institutional quality that impact the growth effect of FDI. The findings indicate that enhancing the institutional framework is crucial prior to implementing FDI policies. It was observed that most aspects related to institutional quality, which positively influence FDI, require consistent efforts and do not yield immediate effects on investments. The authors argue that both foreign and domestic firms are more inclined to compete in an environment safeguarded by market rules. As the improvement of this environment necessitates time, it should be prioritized before focusing solely on FDI policies. In summary, the study underscores the importance of well-developed institutions in enhancing the effects of foreign direct investments. Consequently, variables representing institutional quality, such as government effectiveness and corruption, will be included in the model for a comprehensive analysis.

Yimer (2023) used an analytical classification of the African continent's economies, dividing them into fragile, factor-driven, or investment-driven, to examine whether the effects of FDI differ among the groups. Grouping the countries allows the author to consider the structural and behavioral differences among African countries. According to his results, in investment- and factor-driven economies, the impact of FDI on growth is notably positive over the long term. Still, it appears insignificant in the short term. Conversely, the effect of FDI on growth is insignificant in both the short and long term in fragile economies.

An example of the positive effects of FDI inflows can be found in China itself. The country has attracted large amounts of foreign investments in the last decades, contributing to its economic growth through four channels. They increased labor demand and, therefore, employment levels: the FDI enterprises in China employed a total of 27.71 million people in 2019, which is an increase of 2.9% compared to the previous year (China Statistical Yearbook, 2023). Furthermore, FDI inflows increased its fixed capital formation and acted as a transfer of technological and human capital development. Finally, knowledge spillovers improved productivity and efficiency in Chinese firms (Garnaut, Song & Fang, 2018, p.605).

According to Whalley and Xin (2010), China's foreign-invested enterprises were responsible for over 40% of China's economic growth in 2003 and 2004. The study suggests that if it were not for this influx of foreign direct investment, China's GDP growth rate would have been approximately 3.4 percentage points lower.

In contrast, Herzer et al. (2008) discovered that a positive correlation between the FDI and economic growth does not exist. Moreover, their research did not uncover any substantial evidence supporting a clear correlation between FDI and variables such as per capita income, education level, degree of openness, and financial market development. The authors argue that one of the most plausible explanations for the observed adverse effects is that the competitive presence of foreign firms might diminish the productivity of domestic firms.

3.2 FDI and Health

It can be seen from the aforementioned literature that the debate concerning the relationship between FDI and economic growth is still unsolved. Even less can be said about the effect of foreign investment on health, as very little has been done in this field.

Indeed, scholars continue to discuss the effects of FDI inflows on health and explore the underlying mechanisms behind these effects. Various mechanisms have been identified through which foreign direct investments could influence the health system.

Firstly, FDI has the potential to generate a positive impact on economic growth, which, in turn, can lead to higher per capita incomes and increased government funds available for investment. Increases in incomes might correspond to rising public and private investments in the healthcare industry (Immurana, 2021). However, while income per capita is expected to affect the health system positively (Borensztein, Gregorio & Lee, 1998), the literature still debates the existence and direction of the relationship between healthcare expenditure and health outcomes.

For instance, Akinlo and Suluola (2019) found that increases in healthcare expenditure do not translate into improvements in health outcomes, proxied by the under-five and infant mortality rates. They claimed that the negative relationship is caused by the high levels of corruption in these countries. On the other hand, it has been argued that higher public expenditures on health-

related inputs such as water sanitation, hospitals etc., can improve the health system, as confirmed by Outreville (2007). Furthermore, the author also found that direct FDI in the health sector contribute even more to its improvement. White, Hanmer & Lensink (2003) found a positive correlation between the variables in a panel of developing countries. Finally, Dollar and Burnside (1998) found no significant correlation between healthcare expenditure and health outcomes.

As indicated by Akinlo and Suluola (2019), corruption might limit the positive effects of healthcare expenditure. Additionally, Jude and Leveuge (2014) discovered that inadequate institutional quality, often indicated by corruption, can limit the positive effects of FDI. Consequently, corruption is expected to have a negative correlation with the health sector. Conversely, government effectiveness is regarded as another pathway through which FDI can enhance health outcomes (Jude & Leveuge, 2014).

FDI can also contribute to improving the health system by addressing inequality, thereby enhancing access to healthcare services for the less privileged. This notion is partially supported by the findings of Kaulihowa and Adjasi (2018), who analyzed the impact of FDI on inequality in 16 African countries. They identified a non-linear relationship between foreign investments and inequality, represented by a U-shaped pattern: initially, FDI inflows were associated with a decrease in income distribution inequality, but the impact diminished as FDI continued to rise. However, FDI could also increase inequality, as they are often associated with globalization, which often widens the income gap between skilled and unskilled workers. Consequently, increased inequality may result in an unfair distribution of healthcare resources, leading to poorer health outcomes (Nagel, Herzer & Nunnenkamp, 2015). Given the limitations in data availability, the model presented in this study will not incorporate measures of inequality.

As explained by Immurana (2021), corporate social responsibility activities undertaken by foreign firms might include social initiatives such as building hospitals, providing water supply for the community, and offering free medical screening and public health education, resulting in better health outcomes.

At the same time, some aspects of FDI could adversely affect health results: increased investments in the manufacturing and mining sectors might result in environmental degradation, negatively affecting health. This is demonstrated, for instance, by Wang et al.

(2020): they confirmed the pollution haven hypothesis¹¹ by employing a spatial econometric model to analyze panel data spanning from 1994 to 2015 for China's 29 provinces. FDI could also increase corruption to weaken the environmental standards of the host country, decreasing environmental quality even more significantly.

In line with the negative effects of FDI on health, Gilmore and McKee (2005) found that FDI can increase the import and consumption of harmful products such as tobacco. They examined 15 countries of the former Soviet Union from the 1960s to 2000. They concluded that FDI positively impacts cigarette consumption, and, in the absence of adequate measures, market liberalization might negatively impact health in the long run.

Moreover, and as explained by Herzer and Nunnenkamp (2012), introducing foreign direct investment could create unpredictability and intense competition among workers, leading to stress and potentially negative health outcomes. This is confirmed, for instance, by Rugulies et al. (2008), who found that job insecurity can predict a decline in health in employed women in Denmark.

Finally, Herzer and Nunnenkamp (2012) also noted that competition for FDI might limit the government's ability to finance public goods, as they might offer tax benefits at the cost of lower social expenditures to attract foreign investors.

3.3 FDI and Health in the African continent

While there has been limited research on the African continent, it is important to recognize that its unique characteristics may not necessarily align with broader developing country trends. Factors such as FDI flows differ greatly from the rest of the world and can be negatively impacted by issues such as corruption and conflict (World Economic Forum, 2021). As a result, African governments have been known to compromise their environmental and social

¹¹ According to the Pollution Haven Hypothesis, companies will try to avoid the costs of adhering to strict environmental regulations (as well as high energy costs) by establishing their production facilities in countries with more relaxed environmental standards (OECD, 2017).

standards to attract investment. Focusing specifically on African countries is crucial to fully understanding and addressing these challenges.

Immurana (2021) explored the effect of FDI on health in a panel of 43 African countries. The author used life expectancy at birth and death rate as proxies for health, while FDI flows were used as the main explanatory variable. According to his results, a unit base increase in FDI inflows increases life expectancy by 0.139% and 0.137% in the fixed and random effects models, respectively. The same test is repeated using the death rate as the dependent variable: the results indicate that a unit increase in net inflows of FDI decreases the death rate by 0.424% and 0.421%, using the fixed and random models, respectively. This further confirms the positive effects of FDI on health outcomes for African countries. Similar results were found by Immurana (2022) for an individual country case study in Ghana.

Immurana et al. (2023) examined the effect of FDI on child health outcomes in 39 African countries from 1980 to 2018 and found that FDI positively affects child health. The main channel is GDP growth: they found that increases in income per capita lead families to provide better health inputs for children. Similarly, Salahuddin et al. (2020) found that FDI can reduce infant and under-five mortality rates in South Africa. Their findings do not align with Burns et al.'s Field (2017), who found the relationship between FDI and IMR insignificant. However, their analysis focused on 85 lower and middle-income countries rather than Africa alone, confirming the importance of examining FDI and health in the African continent separately from a general group of developing nations.

3.4 Contribution

As can be seen, the literature mainly focuses on the effect of FDI on health outcomes, represented by life expectancy, child mortality rates and mortality rates. To the author's knowledge, no study has examined the effect of foreign direct investments on the health system, defined as an organization of people, institutions and resources that are devoted to producing health actions (WHO, 2000). Hence, a comprehensive indicator capturing the performance of the health system will be developed and employed as the dependent variable in this study. The specific methodology for constructing this indicator will be elaborated upon in Section 4. The choice of using this new indicator relies on the fact that the health systems,

as defined by the WHO (2000), have been found to be positively correlated to health outcomes (Donabedian, 2005). Therefore, they could provide another channel through which FDI might improve health. Furthermore, the specific role of the health system is, to the author's knowledge, understudied in the literature concerning FDI and health.

The new variable is constructed using a set of indicators, namely medical doctors, hospital beds, hospitals, health centers, and nursery and midwifery personnel. According to the Pan American Health Organization (2018, p.35), the evaluation of the health system should be based on "structure," "process," and "outcomes." These concepts were initially focused on medical care quality but extended to health services' overall quality of care. This idea assumes that high-quality healthcare facilities enhance the probability of good health processes, increasing the likelihood of favorable health outcomes. The index created for this study focuses on the concept of "structure," i.e., those indicators that reflect the relatively fixed aspects of the system, such as the quality of material resources (buildings, equipment, and financial resources), human resources (quantity and qualifications), and organizational structure (arrangement of medical teams, quality control measures, and reimbursement methods). This justifies using the indicators mentioned above to create the dependent variable. The second part of the study will focus on the "outcome" aspect by analyzing life expectancy and IMR.

Thus, this study aims to examine the impact of Chinese FDI inflows on the health system, exploring the potential mechanisms through which this relationship unfolds. The effects of Chinese FDI on employment, income, health expenditure, corporate social responsibility, and corruption are identified as key factors that may drive this relationship.

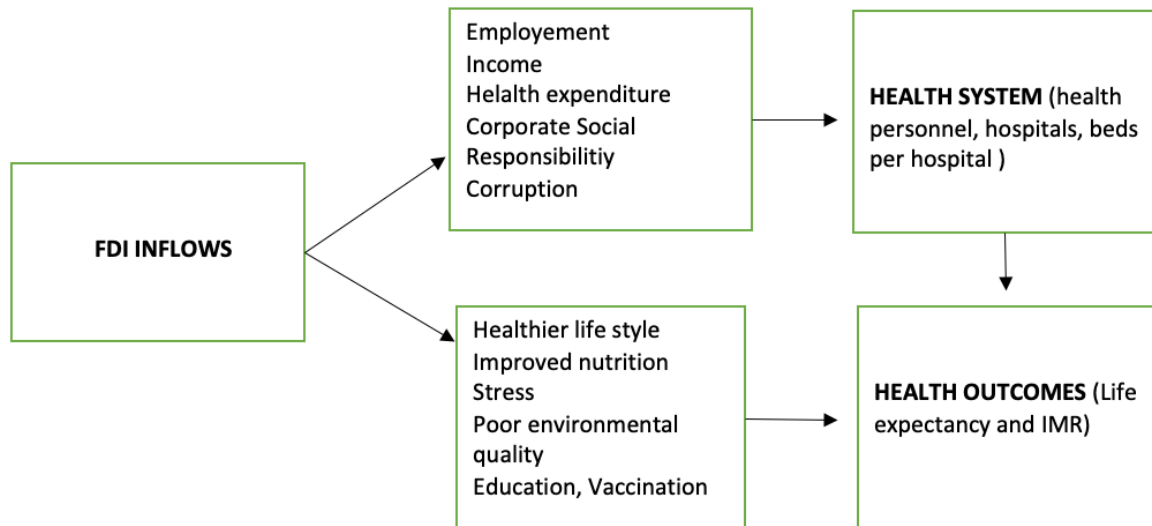
Since the health system alone does not provide insights into the quality of health outcomes, this study will also examine the relationship between the health system and key health outcome indicators, namely life expectancy and infant mortality rate.

Furthermore, the presence of FDI may also impact other factors, such as improved nutrition and healthier lifestyles resulting from increased per capita income (Immurana, 2021), stress due to investments that take place in the form of mergers and acquisitions, poor environmental quality, and changes in education and vaccination. These additional aspects can subsequently influence health outcomes.

A visual representation of the conceptual framework is presented in Figure 3.1 below, illustrating the interconnections and pathways under investigation.

The next Section will provide a detailed description of the methodology, linked with the theoretical framework provided in this Section.

Figure 3-1: Conceptual framework of the effect of FDI on health outcomes through the health system.



Source: created by the author, adapted from Immurana (2021).

4 Data

This section will describe the data and their sources. As the study focuses on two relationships, i.e., FDI-health system and health system-health outcomes, this Section will be divided accordingly.

4.1 Chinese FDI and African health system

The paper examines the effect of Chinese FDI in a sample of 41 African countries¹² in the period 2004-2018. The countries are chosen based on data availability.

The first part of the study analyzes the relationship between Chinese FDI and the African health system. The dependent variable is, therefore, an index that represents the health system. It is constructed using a set of indicators, namely medical doctors, hospital beds, hospitals, health centers, and nursery and midwifery personnel. All indicators are measured per 10,000 inhabitants, and the data is taken from the World Health Organization (WHO) database for the African region (Integrated African Health Observatory, iAHO¹³).

Not all indicators are available for all the countries and all the years observed in the panel; for this reason, all the measures are first normalized, summed, and finally divided by the number of indicators available per country every year. All observations for which only one indicator out of five was available were excluded from the dataset. The following Table 4.1 summarizes

¹² Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Central African Republic, Chad, Comoros, Cote d'Ivoire, Democratic Republic of Congo, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Republic of Congo, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, Togo, Uganda, Tanzania, Zambia, Zimbabwe.

¹³ The dataset is available at <https://aho.afro.who.int/data-and-statistics/af>

the number of observations available per indicator and the final number of observations available for the health system index.

Table 4-1: Summary of Health System Indicators

Indicator	Description	Observations
Medical Doctors	Includes generalists , specialist medical practitioners and medical doctors not further defined, in the given national and/or subnational area. Depending on the nature of the original data source may include practising (active) physicians only or all registered physicians.	293
Hospital Beds	The number of hospital beds available per every 10 000 inhabitants in a population. Regional and global estimates are based on population-weighted averages weighted by the total population.	80
Hospitals	Number of hospitals, including the following hospital categories: rural and district, provincial (second level referral), regional/specialized/teaching and research hospitals (tertiary care), from the public and private sectors, per 10,000 population.	72
Health Centers	Number of health centres from the public and private sectors, per 10,000 population.	71
Nursing and Midwifery Personnel	Number of nursing and midwifery personnel per 1 000 population, including professional nurses, professional midwives, auxiliary nurses, auxiliary midwives, enrolled nurses, enrolled midwives and related occupations such as dental nurses and primary care nurses	389
Health System	(Medical Doctors + Hospital Beds + Hospitals + Health Centers + Nursing and Midwifery Personnel) / Number of indicators available per country per year (from 2 to 5)	400

Source: created by the author using data from the iAHO.

To create the variable, the five indicators were collected individually for each year and each country, according to their availability. Table 4.1 displays the availability of indicators across countries and years, revealing that not all indicators were consistently present. Several steps were undertaken during the analysis to address this issue: each variable was first normalized to convert them on a similar scale. This was achieved using the Z-Score formula, expressed as follows:

$$x' = (x - \mu)/\sigma$$

Where x and x' are individual observations and their normalized version, respectively, μ and σ represent the sample's mean and standard deviation.

The normalization of the variables allowed them to be summed: each normalized indicator was therefore added to the others for every year and every country. Given that not all indicators were available across all years, a weighted sum was created by dividing the total sum by the

number of available indicators, constructing an average per period. The calculation can be expressed as follows:

$$\text{Healthsystem} = \frac{\text{Medical Doctors} + \text{Hospitals} + \text{Beds per Hospital} + \text{Health Centers} + \text{nursery and midwifery personnel}}{\text{Number of indicators available per country per year (from 2 to 5)}}$$

Therefore, the panel used in the study is unbalanced: only Mozambique and South Africa have data that covers all 15 years between 2004 and 2018; the other countries have, on average, around 10 years of data available.

The main explanatory variable is represented by the FDI inflows from China to Africa. The data is retrieved from the China Africa Research Initiative (CARI, 2023) database, which incorporates the FDI figures from the China Statistical Yearbooks, the Statistical Bulletins of China's Outward Foreign Direct Investment published by China's MOFCOM. The data is expressed in millions of US\$.

It is important to notice that inaccurate reporting is possible, as in most self-reporting statistics. Furthermore, Chinese reports have been known to be less reliable compared to those of developed and more democratic nations: FDI data can be misleading due to ambiguity regarding the destination country when capital transfers involve tax havens, and confidentiality provisions may restrict certain reporting. For instance, the data might be underestimated if acquisitions that include African assets, but took place in another jurisdiction, are not included. Due to data availability, FDI inflows are preferred over stock, even if the former might be more volatile and less accurate in the long run compared to the latter. As inflows, the variable can take negative values.

To avoid the issue of omitted variable bias, controls will be added to the equations. In particular, the model will include variables affecting the health system: income, health expenditure, trade, and institutional quality. The motivation behind the choice of this control can be found in the Theoretical framework presented in Section 3.

GDP per capita will be used as a proxy for income, and the data can be sourced from the World Bank's World Development Indicators (WDI) database (World Bank, 2023). The same database provides health expenditure and trade data: the former is measured as a percentage of GDP, while the latter is calculated by summing the country's imports to the exports and dividing by the GDP.

Government effectiveness and corruption will be used as a proxy for institutional quality. Data on both indicators are taken from the Worldwide Governance Indicators (WGI) database (Kaufmann & Kraay, 2023). The former analyzes the assessment of public service quality, the independence of the civil service from political influences, the quality of policy development and implementation, and the government's commitment to upholding these policies. The estimates range from approximately -2.5 (weak) to 2.5 (strong) government performance. The latter, called control for corruption in the WGI database, reflects the degree to which individuals in positions of public power exploit their authority for personal benefits, encompassing both minor and significant instances of corruption. It also considers the potential influence of elites and private interests on the state apparatus, commonly called "capture." It ranges from -2.5 (high corruption) to 2.5 (low corruption).

The first model will regress the explanatory variables described above on the dependent variable, i.e., the health system. Table 4.2 below displays the summary statistics of the variables included in the model.

Table 4-2: Descriptive Statistics Model One

Variable	Obs	Mean	Std. Dev.	Min	Max
Health System	394	-.063	.903	-1.22	3.754
FDIflows	394	66.777	267.986	-814.91	4807.86
GDPpc	394	2070.009	2674.503	95.483	14185.027
Health expenditure	394	5.478	2.166	2.476	19.727
Government effectiveness	394	-.655	.643	-1.788	1.161
Corruption	394	-.536	.642	-1.563	1.161
Trade	394	.509	.23	.137	1.568

Source: created by the author

The health system variable takes values between -1.22 and 3.754, with higher numbers corresponding to better health systems. The highest value for the index is registered in 2015 in Mauritius, while the lowest value can be found in Guinea in 2011. As can be seen from Table 2, most variables also take negative values: the fourth column of the table reports the minimum value of the variables, and in the case of *HealthSystem*, *FDIflows*, *Government effectiveness*, and *Corruption*, the value is negative. For this reason, their logarithmic form cannot be used to interpret the elasticities of the coefficients. Furthermore, it is worrying to notice that government effectiveness and corruption have a negative average of -0.655 and -0.436, respectively, indicating poor institutional quality in most of the countries considered in the sample.

The second model will also include other controls and some dummy variables of indicators that, according to the literature, might affect African countries' development and, consequently, their ability to provide a better health system. In line with Nunn's (2008) explanation, research focusing on the African continent may be influenced by regional variations. Hence, a dummy variable specifying the country's region will be included, and subsequent tests will be conducted, excluding regions that the literature suggests could impact the findings, specifically North Africa.

Furthermore, the legal origin (British or French) and the religion (Islamic or Christian) of a country are found to be correlated with the nation's development (Easterly & Levine, 2016; Nunn, 2008). For this reason, dummy variables representing the percentage of the Islamic population and a dummy indicating the legal origin are included in the model. Data on religion and the legal system is taken from Nunn (2008).

Finally, total natural resources rents (as a percentage of GDP) will be added to the model as further control; indeed, the relationship between natural resources and African development has been largely examined by the literature (see, for instance, Nunn (2008), Zallé (2019)). The data is taken from the WDI database (World Bank, 2023), and it represents the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.

4.2 Health System and Health Outcomes

The second part of the analysis will test the effect of the health system on the quality of health outcomes, proxied by life expectancy and infant mortality rate (Burns et al., 2017; Immurana, 2021; Nagel, Herzer & Nunnenkamp, 2015). As there is more data availability for the dependent variables used in this part of the study, the sample will include 44 countries in the same period, from 2004 to 2018. The tests will also be performed on the original sample as a robustness check. The life expectancy and IMR data are retrieved from the UN Population Division Data Portal (UNWPP, 2023) and will be used as dependent variables.

The main explanatory variable will be the health system. Additional controls based on the health population literature are added, namely, the percentage of the population who received the measles vaccine, gross primary school enrolment, income per capita, and the annual percentage of urban population growth (Burns et al., 2017; Immurana, 2021; Nagel, Herzer &

Nunnenkamp, 2015). All the data is retrieved from the World Bank’s World Development Indicators (WDI) database (World Bank, 2023). Government effectiveness, control for corruption, and health expenditure (as a percentage of GDP) will also be added as controls. Finally, FDI inflows will also be added as control to examine their direct effects on health outcomes.

Table 4.3 displays the summary statistics of the variables under study in the second model.

Table 4-3: Descriptive Statistics Model Two.

Variable	Obs	Mean	Std. Dev.	Min	Max
Life expectancy	409	59.861	6.613	43.71	76.59
IMR	409	54.634	23.437	11.69	126.8
Health system	409	-.037	.93	-1.22	3.754
FDIflows	409	68.526	266.837	-814.91	4807.86
GDPpc	409	2106.539	2647.266	95.483	14185.027
Government effectiveness	409	-.657	.634	-1.788	1.161
corruption	409	-.544	.639	-1.563	1.161
Health expenditure	409	5.467	2.171	2.476	19.727
Immunization	409	78.281	16.259	16	99
urban	409	3.684	1.356	-1.912	7.211
Education	374	103.6102	18.75193	46.6409	149.3075

Source: created by the author.

Once again, most variables include negative values: for this reason, their logarithmic forms cannot be considered. As in the previous table, government effectiveness and control of corruption have a negative average, indicating poor institutional quality. The average life expectancy in the sample is approximately 60 years, with a minimum of 43 years registered in Lesotho in 2004 and a maximum of 76 registered in Cabo Verde in 2017.

Due to missing data regarding the Education variable, some observations will be dropped. However, the variable will also be excluded, and the main sample will be examined as a robustness check.

The next Section will focus on the analytical framework and the empirical models.

5 Methodology

The study can be divided into two main analyses. The first examines the relationship between Chinese FDI and the African health system; the second focuses on the efficiency of the latter in improving health outcomes. Therefore, the section will be divided accordingly.

For both the analysis of the health system and the examination of health outcome indicators, a panel data methodology will be employed. This decision is driven by the numerous advantages of the panel data: combining time series and cross-sectional dimensions offers more information. Additionally, it enables control over individual heterogeneity and multicollinearity among the variables. Furthermore, employing this methodology increases the degrees of freedom, resulting in a more efficient estimation of the results. It is also considered more reliable than time series or cross-sectional methods.

In both cases, all the explanatory variables and controls added to the model are based on the literature and theoretical framework described in Section 3.

5.1 Chinese FDI and African Health System

This part of the study employs a panel data of 41 African countries over the period 2004 – 2018. The dependent variable is the health system, proxied by an index that includes medical doctors, hospital beds, hospitals, health centers, and nursery and midwifery personnel. The main explanatory variable is represented by Chinese FDI flows. Furthermore, controls that might affect the health system will be included in the model, following the literature described in Section 3.

The following econometric model can specify the first step of the analysis:

$$\begin{aligned} Healthsystem_{i,t} = & \beta_0 + \beta_1 FDI_{i,t} + \beta_2 GDPpc_{i,t} + \beta_3 Healthexpenditure_{i,t} + \\ & \beta_4 Goveff_{i,t} + \beta_5 Corruption_{i,t} + \beta_6 Trade_{i,t} + u_{i,t} \end{aligned}$$

Where i , t , and β_0 represent the individual countries, year, and intercept of the regression equation, respectively. The explanatory variable of interest is given by FDI inflows coming from China. Following the literature, the coefficient associated with this variable (β_1) is expected to be positive (Burns et al., 2017; Immurana, 2022; Immurana et al., 2023; Nagel, Herzer & Nunnenkamp, 2015). Indeed, FDI has the potential to foster economic growth and contribute to increased public spending on healthcare. Moreover, the rise in income levels from FDI can stimulate greater private investment in the health sector. Additionally, foreign companies operating within a country may actively participate in social initiatives that benefit local communities, such as establishing hospitals and healthcare centers.

However, its effects on corruption and pollution might mitigate its advantages and yield a negative correlation coefficient (Gilmore & McKee, 2005; Wang, Wang & Sun, 2020).

GDPpc is used as a proxy for income per capita, and its coefficient is also expected to be positive (Borensztein, Gregorio & Lee, 1998). Health expenditure, government effectiveness and trade (expressed as a percentage of GDP) are also expected to positively correlate to the health system (Akadiri et al., 2019; Jude & Levieuge, 2014). However, the literature on the relationship between healthcare expenditure and health outcomes has found mixed results (refer to Section 3.2). The corruption coefficient should be negatively correlated with the health system. Finally, $u_{i,t}$ represents the error term.

The analysis involves several steps. The first one consists of verifying how the variables affect each other, therefore examining the direction of the correlation. The three most used types of OLS models that can be applied in the case of panel data are pooled, fixed-effects (FE), and random-effects (RE) models. The first one is consistent with the usual assumptions for cross-sectional analysis, as it specifies constant coefficients: it is not much used in the literature regarding the health and FDI nexus, as it is very restrictive. Therefore, the test of overidentifying restrictions (Sargan-Hansen statistic) can be used to choose between the random and fixed effects model. The more commonly used Hausman test cannot be employed in this case, as it cannot handle cluster robust standard errors, which are used in all the estimations to deal with any possible heteroskedasticity and serial correlation. Indeed, the tests confirm the presence of both heteroskedasticity and serial correlation.

Assuming that there is an unobserved heterogeneity across individuals (in this case, countries), the fixed-effects model allows this individual-specific effect to be correlated with the

regressors, and it removes the impact of these time-invariant characteristics, which might influence or bias the explanatory variables.

On the other hand, the random-effects model assumes that individual-specific effects are distributed independently of the regressors. Given the specific characteristics of the model employed in this study, the fixed effects (FE) model is anticipated to be more suitable. To assess this hypothesis, the Sargan-Hansen statistics will be utilized. The null hypothesis for this test assumes that the random effects model is more efficient. Rejecting the null hypothesis would imply that the fixed effects model is a more appropriate choice. The results of the test indeed rejected the null hypothesis, providing evidence in favor of using the FE model. Robust standard errors will be used to address the issue of heteroskedasticity. The results of this regression are reported in Table 6.1.

Next, the regression analysis will incorporate additional control variables that influence the development of African countries and, consequently, the conditions of their health systems. Specifically, dummy variables will be included to indicate the geographical area of the countries, their legal origin (French or British), and their predominant religion (Christian or Islamic). Additionally, the model will incorporate the percentage of total natural resources rents as a proportion of GDP. These control variables aim to capture the various contextual factors that may impact the relationship under investigation, providing a more comprehensive analysis. For instance, evidence of how these characteristics affected African development can be found in Easterly and Levine, Nunn, and Zallé (2016; 2008; 2019). Due to data availability, some yearly observations will be dropped. The model will appear as follows:

$$\begin{aligned} Healthsystem_{i,t} = & \beta_0 + \beta_1 FDI_{i,t} + \beta_2 GDPpc_{i,t} + \beta_3 Healthexpenditure_{i,t} \\ & + \beta_4 Goveff_{i,t} + \beta_5 Corruption_{i,t} + \beta_6 Trade_{i,t} + \beta_7 NaturalResource_{i,t} \\ & + \beta_8 Geography_{i,t} + \beta_9 Islamic_{i,t} + \beta_{10} Legalorigins_{i,t} + u_{it} \end{aligned}$$

Where the coefficients from β_1 to β_6 have the same meaning as in the previous equation. β_7 will show how the percentage of natural resources rent is correlated to the health system. The variable Geography represents a set of four dummy variables: North, South, East, and West, and they all will take the value of one if the country belongs to the region described by the dummy and zero otherwise. The dummy “Central” is omitted to avoid multicollinearity. The Islamic and Legal Origins variables will take the value of one if the country has a majority of Islamic population and French origins, respectively. They will take the value of zero otherwise.

Once again, the Sargan - Hansen statistics for overidentifying restrictions will be applied to choose between the random and the fixed effects models. By definitions, dummy variables will be dropped in the fixed effects model to avoid multicollinearity; therefore, the RE model is preferred. Northern and Islamic countries will be dropped as robustness checks and following Nunn (2008), to assess whether they are driving the results. As heteroskedasticity is still present, robust standard errors are employed. All results are reported in Table 6.1.

It is important to notice that this model does not deal with the problem of endogeneity, i.e., the possibility that the variable representing Chinese FDI is correlated with the error term. Endogenous variables have values determined by other variables in the system, which may alter the validity of the results by causing inconsistent estimates (Glen, 2017). For this reason, the dynamic Generalized Method of Moments (GMM) technique developed by Arellano and Bover (1995) and Blundell and Bond (1998) will be used. This methodology addresses the endogeneity issue by including the lags of the variables as instruments (Ullah, Akhtar & Zaefarian, 2018). Furthermore, it controls for heteroskedasticity, serial correlation, and measurement errors in the data. The choice of applying the dynamic system GMM instead of the difference GMM is driven by the fact that if the panel is unbalanced, the difference GMM might weaken the results because it magnifies the gaps among the observations. Furthermore, the model includes two types of transformations: first-difference transformation (one-step GMM) and second-order transformation (two-step GMM). The former can lead to a substantial loss of observations when applying the first difference in the case of missing values: this can be avoided with the use of the two-step GMM, which subtracts the average of all future available observations of a particular variable (Ullah, Akhtar & Zaefarian, 2018). For this reason, the two-step system GMM is employed in this analysis.

The GMM model adopted using the command *xtabond2* in Stata also includes the Sargan – Hansen test to check the validity of the instruments and the Arellano – Bond test to exclude the presence of autocorrelation. In both cases, failure to reject the null hypotheses indicates that the instruments are valid and there is no second-order serial correlation. The failure to reject the null hypothesis of the Arellano – Bond test also implies that the moment conditions are correctly specified. The results of the GMM are reported in Table 6.2.

Lastly, to gain a deeper understanding of the underlying mechanisms through which FDI influences the health system, separate regressions will be conducted using the individual indicators used to construct the health system variable. It is important to note that this approach

will yield a smaller number of observations per indicator, which may introduce potential biases in the results. The detailed findings from these regressions can be found in Appendix A, providing additional insights into the specific relationships between FDI and each indicator.

5.2 Health System and Health Outcomes

The first part of the study examines how Chinese FDI affects the “structure” of the health system. The second focuses on how the “structure” can impact the quality of the outcome, i.e., life expectancy and infant mortality rate.

This part of the study will employ a panel dataset of 44 African countries¹⁴ from 2004 – 2018. The first dependent variable that will be employed is life expectancy at birth (*LE*), defined as “the average number of years of life expected by a hypothetical cohort of individuals who would be subject throughout their life to the age-specific mortality rates of a given period” (UNWPP, 2023). The use of life expectancy as an indicator of health quality can be found in most of the literature concerning the relationship between FDI and health (Refer to Section 3.2 and 3.3). The model can be expressed as follows:

$$\begin{aligned} LE_{i,t} = & \beta_0 + \beta_1 Healthsystem_{i,t} + \beta_2 GDPpc_{i,t} + \beta_3 Goveff_{i,t} + \beta_4 Corruption_{i,t} \\ & + \beta_5 Healthexpenditure_{i,t} + \beta_6 Immunization_{i,t} + \beta_7 Urban_{i,t} + \beta_8 Education_{i,t} \\ & + \beta_9 FDI_{i,t} + u_{i,t} \end{aligned}$$

Where i , t , and β_0 represent the individual countries, year, and intercept of the regression equation, respectively. The explanatory variable of interest is *Healthsystem*, which is expected to affect the health outcome positively. Indeed, Donabedian (2005) stressed the importance of health facilities to guarantee a better health outcome. The variable representing Chinese FDI will also be included, to see if they directly impact health outcomes.

The inclusion of the additional variables is guided by the existing literature on population health, as discussed in Sections 3.2 and 3.3. Among these variables, income per capita (GDPPpc) is anticipated to have a positive impact on the dependent variable. Higher incomes

¹⁴ Algeria, Angola, and Lesotho are added to the previous dataset due to more data availability.

are likely to encourage individuals to allocate more resources towards healthier inputs, such as healthier nutrition and vaccines (Salahuddin et al., 2020).

β_3 and β_4 are the coefficients capturing the effects of institutions, measured as government effectiveness and corruption. The former is expected to positively correlate to health outcomes, while the latter should negatively affect life expectancy (Jude & Leveuge, 2014).

Health expenditure is anticipated to have a positive impact on health outcomes by enhancing the quality and quantity of healthcare equipment and personnel, thereby increasing both the availability and effectiveness of healthcare services. However, as discussed in the theoretical framework in Sections 3.2 and 3.3, the literature has yielded mixed findings regarding the actual impact of higher health expenditures on health outcomes. Consequently, it is challenging to deduce from the existing literature the expected sign of the coefficient β_5 , which represents the relationship between health expenditure and the dependent variable.

Immunization against the measles and gross primary school enrolment, represented by the coefficients β_6 and β_8 , respectively, should positively correlate to the health outcome. Indeed, a more educated population is more aware of the benefits of health inputs such as vaccinations and medicines and is more prone to undertake healthier lifestyles (Immurana, 2021). Additionally, higher education might also imply higher availability of doctors and physicians. Due to limited data availability on education for all the years and countries included in the analysis, this control variable will be added in a separate regression, resulting in a reduced dataset.

The interpretation of the effect of urban population growth on health outcomes is also ambiguous. On the one hand, a growing urban population may be associated with increased health infrastructure and healthcare personnel and with higher productivity (Immurana, 2021; Salahuddin et al., 2020). On the other hand, if the rise in population is not accompanied by a proportional expansion of the health infrastructure and healthcare personnel, it could hinder access to the healthcare (Immurana, 2021). Furthermore, health risks associated with urbanization, such as diseases impacting slums and the urban poor and diseases linked to sedentary lifestyles, might worsen health outcomes (Nsoesie, 2020).

The analysis will follow the same methodology outlined in Section 5.1. To determine the appropriate model choice between random and fixed effects, the Sargan-Hansen statistics for overidentifying restrictions will be employed instead of the Hausman test. This is due to the

presence of heteroskedasticity and serial correlation in the data. Similar to the previous analysis, the null hypothesis is rejected, indicating that the fixed effects model is the more suitable option. Furthermore, the same tests will be conducted, this time incorporating the education variable. Once again, the results favor the fixed effects model as the more appropriate choice. Robust standard errors will be used to solve the problem of heteroskedasticity.

Similar to the health system analysis, the GMM model will be employed to address the issues of endogeneity and serial correlation. In this case as well, the dynamic and two-step system models are preferred over the difference, one-step GMM models, as they help avoid the loss of observations (Ullah, Akhtar & Zaefarian, 2018). The GMM model will be initially estimated without including the education variable. Subsequently, the sample size will be reduced to incorporate the last control variable in the regression. As the GMM model is considered more reliable than the fixed effects model in this context, only the results from the GMM model will be presented in the first two columns of Table 6.3, while the remaining results (fixed and random effects) will be included in Appendix B.

The same tests with the same explanatory variables will be carried out with a different dependent variable, i.e., the infant mortality rate. The latter has been widely used in the literature examining health outcomes (Immurana et al., 2023; Nagel, Herzer & Nunnenkamp, 2015; Salahuddin et al., 2020). Indeed, the IMR is considered more advantageous than other health measures for two main reasons: first, there is large data availability on infant mortality rates, both in developed and developing countries. Second, it is statistically more reliable than other health measures: unlike infant mortality rate, life expectancy estimates for developing countries may be unreliable due to their dependence on predictive equations, primarily because most of these nations lack complete vital registration systems (Nagel, Herzer & Nunnenkamp, 2015). The model can be expressed as follows:

$$\begin{aligned} IMR_{i,t} = & \beta_0 + \beta_1 Healthsystem_{i,t} + \beta_2 GDPpc_{i,t} + \beta_3 Goveff_{i,t} + \beta_4 Corruption_{i,t} \\ & + \beta_5 Healthexpenditure_{i,t} + \beta_6 Immunization_{i,t} + \beta_7 Urban_{i,t} + \beta_8 Education_{i,t} \\ & + \beta_9 FDI_{i,t} + u_{i,t} \end{aligned}$$

Similarly, the variable Education will be introduced at a later stage, requiring a reduction in the sample size to accommodate its inclusion. Notably, the Sargan-Hansen statistics test affirms that utilizing the random effects model is more suitable in this case. However, when the sample

is reduced and the variable Education is added, the fixed effects model once again becomes the preferred choice.

Finally, to address the issue of endogeneity and serial correlation, the dynamic two-step system GMM model will be employed. As before, only the results from the GMM model will be discussed in Columns 3 and 4 of Table 6.3, while the results from other models will be presented in Appendix B. This ensures a focused analysis while addressing potential endogeneity and serial correlation concerns.

5.3 Limitations

This Section examines the limitations inherent in the dataset and methodology used for the empirical analysis in this study. Despite the extensive efforts made to collect and utilize reliable data, it is essential to acknowledge the potential constraints and weaknesses that may impact the analysis and interpretation of the results.

The dataset used in this study contains information on the health system of 41 African countries in the period 2004-2018. The data obtained from the World Health Organization is widely recognized for its reliability and credibility. However, it is important to note that the dataset does not offer complete coverage for all countries or years under consideration. As a result, the panel structure is unbalanced, with varying degrees of data availability across countries and periods. Within the dataset, only two countries, Mozambique and South Africa, have complete data coverage spanning the entire 15-year period. The remaining countries have, on average, ten years of data available. This unbalanced panel structure poses potential limitations for comparative analysis and hinders a comprehensive examination of trends over time. Consequently, caution must be exercised when generalizing or drawing conclusions based on the dataset's findings.

Countries with less than six years of observations were excluded from the analysis to obtain more reliable results. This decision aimed to address the potential bias introduced by countries with limited data coverage, which could skew the results or compromise the validity of the findings. While this step was taken to enhance the robustness of the analysis, it further reduces the sample size and may limit the generalizability of the results.

Furthermore, the choice of the main explanatory variable presents some limitations: due to data availability, only FDI flows, rather than stocks, could be included in the analysis. Using FDI flows implicitly assumes that any effects of FDI are limited to the period in which the investment is made (Nagel, Herzer & Nunnenkamp, 2015). Consequently, it becomes challenging to draw conclusions about the long-term implications of FDI on the health systems of the African countries under study.

Furthermore, inaccurate reporting is possible: it has been observed that Chinese reports tend to be less reliable when compared to reports from developed and more democratic nations (Holz, 2003).

Finally, there are some limits concerning the methodology. The GMM model is used to solve the issue of endogeneity and serial correlation. However, as will be explained in Section 6.2, some first-degree serial correlation might still be present in the data. This should not alter the validity of the results as long as there is no second-order serial correlation (Andres & Vallelado, 2008).

While these limitations highlight the need for caution, it is important to note that they do not invalidate the overall study. Despite these constraints, the study still provides valuable insights into the relationships between FDI and health systems in African countries.

6 Results and Discussion

This Section will provide an analysis of the results obtained in the regressions described above. As in the previous Sections, the discussion will be divided into the health system analysis and the health outcomes analysis.

6.1 Chinese FDI and African Health System - Results

Table 6.1 displays the regression results on the effect of Chinese FDI on the African health system. As already mentioned, the fixed effects model is preferred over the random effects one, as indicated in the Sagan – Hansen test of overidentifying restrictions results. Robust standard errors are considered to deal with heteroskedasticity.

In the first column, the focus is on examining the relationship between Chinese outward FDI flows and the health system, without incorporating additional controls that may impact a country's development. The results indicate that the variable of interest, Chinese outward FDI flows, has a positive and statistically significant association at the one percent significance level. Specifically, the coefficient suggests that, on average and with other factors held constant (*ceteris paribus*), a one-unit increase in FDI corresponds to a 0.00023 increase in the health system. This finding underscores the potential positive impact of Chinese outward FDI on the health system.

The results in the first column also indicate that, from all other controls, only corruption plays a role and negatively correlates with the health system. More specifically, a unit increase in corruption is associated (*ceteris paribus*) with an average decrease of 0.39 units of the health system indicator. Corruption is generally recognized for its tendency to erode macroeconomic stability and create economic uncertainty. It can potentially weaken a country's investment climate by undermining state institutions, making investors hesitant to allocate funds to an uncertain market. Corruption distorts public funds, undermining the country's health system too (Salahuddin et al., 2020).

The rest of the controls are not statistically significant. However, some of them become significant when the second group of controls is added.

Table 6-1: Effects of Chinese FDI on the African Health System, FE and RE

VARIABLES	Dependent variable:		
	(1) Health system	(2) Health system	(3) Health system
FDIflows	0.000230*** (3.08e-05)	0.000242*** (2.79e-05)	0.000256*** (2.36e-05)
GDPpc	5.07e-06 (7.72e-05)	0.000157*** (3.35e-05)	0.000142*** (3.47e-05)
Healthexpenditure	0.0191 (0.0170)	0.00581 (0.00937)	0.0120 (0.0137)
Government effectiveness	0.0424 (0.260)	0.519*** (0.199)	0.661*** (0.256)
Corruption	-0.390** (0.168)	-0.386*** (0.138)	-0.432*** (0.166)
Trade	-0.108 (0.294)	0.0928 (0.190)	0.0635 (0.227)
Natural Resources Rents		6.04e-05 (0.00308)	0.000814 (0.00392)
Geography controls	No	Yes	Yes
Religion controls	No	Yes	Yes
Legal Origins controls	No	Yes	Yes
Restricted Sample (excluding North African and Islamic countries)	No	No	Yes
Constant	-0.319 (0.236)	-0.471** (0.188)	-0.447*** (0.163)
Observations	394	387	252
R-squared	0.176	0.731	0.745
Number of countries	41	41	25

Source: author's computation. Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results are reported in Column 2, while Column 3 displays the results of the restricted sample that excludes North African and Islamic countries. In all three cases, Chinese FDI positively correlates to the health system, and the variable always presents a one percent

significance level. When more controls are added, the coefficient of Chinese FDI becomes slightly stronger: a unit increase in the explanatory variable of interest correlates with, on average and *ceteris paribus*, a 0.00024 and a 0.00026 unit increase of the health system in models 2 and 3, respectively. Even if the effect on the health system is weak, it is positive and significant, indicating that there should be a deepening of efforts to attract greater foreign direct investments into Africa and maximize the advantages that come with it, given the health benefits it brings. Furthermore, these results align with most of the literature examining the relationship between FDI and the health outcomes (Immurana, 2021; Immurana et al., 2023; Nagel, Herzer & Nunnenkamp, 2015).

In columns 2 and 3, GDP per capita and government effectiveness become significant at a one percent significance level. They both positively correlated with the dependent variable, indicating that higher incomes per capita and improved government effectiveness are associated with a better health system. A higher income per capita is associated with higher demand for health inputs (infrastructure and health personnel included). The positive effects of government effectiveness and the negative effect of corruption align with Jude and Leveuge (2014)'s findings on the importance of institutional quality. Furthermore, the impact of corruption and government effectiveness is larger when North African and Islamic countries are excluded from the sample.

Health expenditure, natural resource rents, and trade are insignificant in all the models.

It is important to acknowledge that certain explanatory variables, particularly FDI, may exhibit endogeneity. The endogeneity arises from the fact that FDI could impact the efficiency of the health system, while simultaneously, a well-functioning health system might serve as an indicator of robust institutions or favorable economic conditions, attracting more FDI. The presence of endogeneity introduces the potential for biased estimates and restricts the ability to establish a causal relationship through the regression analysis.

The dynamic two-step Generalized Method of Moments (GMM) is applied to solve this issue. The results are reported in Table 6.2.

Table 6-2: Effect of Chinese FDI on African Health System, GMM

VARIABLES	(1) Health system	(2) Health system	(3) Health system
FDIflows	0.000174*** (3.26e-05)	0.000137*** (1.01e-05)	0.000117*** (1.68e-05)
GDPpc	-0.000111*** (1.95e-05)	-0.000241*** (1.68e-05)	-0.000167*** (1.69e-05)
Health expenditure	-0.00292 (0.0513)	0.00641 (0.0157)	0.0161 (0.0229)
Government effectiveness	0.745*** (0.158)	0.469*** (0.115)	1.271** (0.554)
Corruption	1.468*** (0.138)	-0.127 (0.233)	-0.121 (0.398)
Trade	-0.872** (0.444)	-0.0403 (0.239)	0.800 (0.488)
Natural Resources		0.00864*** (0.00228)	-0.000142 (0.00172)
Geography Controls	No	Yes	Yes
Religion Controls	No	Yes	Yes
Restricted Sample (excluding North African and Islamic countries)	No	No	Yes
Constant	1.916*** (0.262)	-2.296* (1.357)	0.0703 (0.305)
Arellano-Bond test for AR(1)	-2.63***	0.006***	0.022**
Arellano-Bond test for AR(2)	-0.29	0.146	0.585
Sargan-Hansen Test	0.229	1.000	1.000
Observations	394	387	252
Number of countries	41	41	25

Source: author's computation. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The three tests reported at the end of the table are necessary to verify the validity of the model. The Arellano-Bond test for first-order autocorrelation, AR (1), has a null hypothesis of autocorrelation: the null is rejected in all the cases, implying no first-order autocorrelation among the variables. In the Arellano-Bond test for second-order serial correlation, AR (2), the null hypothesis indicates that the differenced error terms are not second-order serially

correlated. Therefore, failure to reject the null implies that there is no second-order autocorrelation. As this is the case in all three models, the moment conditions are correctly specified. Finally, the Sargan-Hansen test for over-identifying restrictions tests the null hypothesis of the overall validity of the instruments used: failure to reject the null supports the choice of the instruments. As can be seen from Table 6.2, the null is rejected in all three models, indicating that they are appropriate to perform this analysis, and their results are more reliable than the ones obtained from the previous regressions.

In the first model, which includes all observations but excludes the second group of controls, the impact of Chinese foreign direct investments on the health system appears slightly smaller compared to the fixed effects model. Nevertheless, it remains statistically significant at the one percent significance level and displays a positive correlation with the dependent variable. To be specific, a one-unit increase in FDI is associated with, on average and *ceteris paribus*, a 0.0017 unit increase in the health system indicator.

Furthermore, all the variables, except for health expenditure, are now significant. As the results of the literature on health expenditure are mixed, this supports the body of research that has found no significant correlation between these variables, underscoring the complexity and varied nature of the relationship between health expenditure and health outcomes (Dollar & Burnside, 1998; Filmer & Pritchett, 1997).

Adding the geography and religion controls (Column 2) slightly weakens the FDI coefficient, but it is still positive and statistically significant. In this case, a one-unit increase in Chinese FDI correlates, on average and *ceteris paribus*, with 0.00013 units increase in the health system indicator. Health expenditure, Corruption, and Trade are insignificant. GDP per capita and government effectiveness are statistically significant and similar to the values of Column 1. Natural resource rents become significant and positively correlated to the health system. Therefore, higher rents from natural resources (as a percentage of GDP) will probably be invested in projects that will also benefit the health system.

However, this variable becomes negative and statistically insignificant if North African and Islamic countries are excluded from the sample, indicating that this group was driving the results related to the effects of natural resources. The other significant coefficients are similar but slightly weaker than Column 2. In the case of Chinese FDI, a one-unit increase is correlated

with, on average and *ceteris paribus*, 0.00012 units increase in the health system indicator. Government effectiveness becomes larger but less significant.

Surprisingly, GDP per capita negatively correlates with the health system. In the three models, a one-unit increase in the explanatory variable corresponds to a 0.0001, a 0.0002, and a 0.0016 decrease in the health system indicator. This might indicate that an increase in income per capita does not necessarily correspond to an increase in private health expenditure. For instance, Dritsaki and Dritsaki (2023) found a negative correlation between GDP per capita and health expenditure when the human capital level is low.

Overall, Chinese FDI inflows have a weak but positive effect on the African health system. To gain a deeper understanding of the relationship between FDI and the health system, it is valuable to examine the specific outcomes of the individual variables that comprise the health system indicator (provided in Appendix A). Unfortunately, the availability of data is limited, preventing the use of the GMM model due to missing lag values. Consequently, fixed and random effects models are employed. Furthermore, due to the scarcity of data and the potential presence of endogeneity, it becomes challenging to analyze the individual indicators. This underscores the rationale behind constructing a new variable and emphasizes its reliability in drawing meaningful conclusions. The effects of Chinese investments in health infrastructure and health personnel are positive. China's commitment to the African continent can be linked to the improvements in all the indicators forming the dependent variable of this study: China's commitment to establishing Africa CDC's headquarters included constructing and improving various health infrastructures. Furthermore, China is the country that made the most investment in the information and communications technology (ICT) sector, which can improve the quality of health services (Odonkor, 2023).

Moreover, China pledged to enhance medical and health cooperation with the African continent. As stated in an article released by the State Council Information Office of China (2021), the dispatch of Chinese medical teams stands out as one of the most extensive and successful collaboration projects involving numerous African countries. For instance, through the Brightness Action initiative, Chinese medical teams have conducted 34 cost-free clinical programs, successfully restoring eyesight for approximately 10,000 African cataract patients. Furthermore, China focuses on helping African countries strengthen medical specialties, training 20,000 African medical personnel. It has helped 18 African countries establish 20 centers in different medical specialties, covering cardiology, critical care medicine and trauma.

6.2 Health System and Health Outcomes – Results

Unless a relationship between the health system and the health outcome is found, the results presented in the previous section cannot provide information regarding the effect of FDI on African people's well-being. Consequently, this part of the study will shift its focus towards examining how the efficiency of the health system can influence health outcomes, as indicated by life expectancy and infant mortality rate. Additionally, the models will incorporate the variable representing Chinese FDI to evaluate its direct effects on health outcomes. By exploring these relationships, we can gain a deeper understanding of the intricate dynamics between FDI, health system efficiency, and health outcomes among African populations.

Table 6.3 reports the results of the regression between health outcomes and the health system. Columns 1 and 2 show the results for life expectancy, with and without the control of education, respectively. Columns 3 and 4 present the results for the IMR. As can be seen from the Arellano-Bond test of first-order serial correlation reported in Columns 1 and 2, the null of no first-order autocorrelation cannot be rejected. Andres and Vallelado (2008) explain that some first-degree autocorrelation might be expected, and its presence should not invalidate the results as long as there is no second-order autocorrelation. In this case, failure to reject the null hypothesis of second-order serial correlation, AR (2), confirms that there is only first-order autocorrelation. Furthermore, the failure to reject the null hypothesis of the Sargan-Hansen test for over-identifying restrictions implies that the choice of the instrument is still valid. For these reasons, the GMM model remains preferable over the fixed effects model due to the validity of instruments in addressing endogeneity concerns, which have the potential to impact the results of the fixed effects model.

Consequently, the discussion will focus on the results of the GMM to interpret the effects of the health system. Results from the fixed and random effects model can be found in Appendix B. Furthermore, the tests will be repeated for the initial sample (41 countries) and the result can be found in Appendix C.

Table 6-3: Effects of the Health System on Health Outcomes, GMM.

VARIABLES	(1) Life expectancy	(2) Life expectancy	(3) IMR	(4) IMR
Health system	0.991*** (0.107)	1.012*** (0.191)	-0.334 (0.311)	-2.247** (1.006)
FDIflows	-0.000278*** (3.80e-05)	0.000116 (9.05e-05)	0.000147** (5.80e-05)	0.000223 (0.000201)
GDPpc	0.00104*** (5.72e-05)	0.000790*** (0.000140)	-0.00189*** (0.000158)	-0.00170*** (0.000297)
Government effectiveness	0.00972 (0.306)	0.0597 (1.609)	-15.20*** (1.496)	-4.523 (3.054)
Corruption	-6.968*** (0.348)	-6.020*** (1.808)	16.89*** (1.452)	4.065*** (1.573)
Health expenditure	-0.367*** (0.0595)	-0.274* (0.165)	1.715*** (0.239)	2.100*** (0.198)
Immunization	0.137*** (0.00777)	0.140*** (0.0388)	-0.734*** (0.0419)	-0.806*** (0.0332)
Urban	-1.536*** (0.115)	-2.022*** (0.382)	0.740*** (0.237)	0.910** (0.455)
Education		-0.118 (0.0868)		-0.0783 (0.0480)
Constant	51.15*** (0.917)	65.53*** (8.671)	102.3*** (3.295)	112.4*** (7.881)
Arellano-Bond Test AR(1)	-0.50	-0.56	0.90	1.28
Arellano-Bond Test AR(2)	1.31	1.38	0.27	0.60
Sargan- Hansen	0.933	0.316	0.959	1.000
Observations	409	374	409	374
Number of countries	44	41	44	41

Source: author's computation. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As can be seen from the table, the health system coefficient is always statistically significant and positively correlated to life expectancy. This indicates that an increase in the health system indicator is connected to a rise in health outcomes. More specifically, a one-unit increase in the health system indicator correlates with, on average and ceteris paribus, a 0.99-unit rise in life expectancy. If education is included in the model, a one-unit increase in the health system is associated with a 1.01-unit growth in life expectancy. These results align with the idea that health facilities are fundamental to guarantee an improved health outcome (Donabedian, 2005).

Indeed, a rise in the number of health personnel and in the hospitals and beds available is expected to bring positive effects on the general healthcare quality.

Column 1 reports a weak but negative and statistically significant relationship between health outcomes and FDI inflows: more specifically, a one-unit increase in FDI inflows correlates with a decrease of 0.0003 units of life expectancy. On the one hand, these results align with the findings of Herzer and Nunnenkamp (2012), whose study supports the existence of a negative relationship between foreign direct investments and health outcomes. On the other hand, these findings differ from the results of Immurana (2021), and Nagel et al. (2015), who found a positive direct link between life expectancy and FDI. As these studies examined the effects of general FDI on life expectancy, some differences in Chinese FDI might deteriorate health outcomes. For instance, the negative relationship can be explained by the fact that foreign investments might hinder environmental quality, as demonstrated by Wang et al. (2020). Indeed, many Chinese companies invest in sectors such as manufacturing, mining or extractive, and forestry activities (Ernst & Young, 2017), which might negatively affect the environmental quality and, thus, health. Furthermore, new mergers and acquisitions accompanying FDI might increase stress and competition among workers, which in turn deteriorates health outcomes (Herzer & Nunnenkamp, 2012). Therefore, the positive effect of FDI on health happens through the health system, but not directly. However, it is worth noting that the relationship between FDI and life expectancy, as observed in Column 1, appears to be weak. Once the education control is incorporated into the model in Column 2, the relationship becomes statistically insignificant. This indicates that education may play a crucial role in mediating the effects of FDI on health outcomes.

GDP per capita is always statistically significant and positively correlated to health outcomes. This finding underscores the notion that higher income levels per capita can prompt individuals to seek improved health inputs and access higher-quality healthcare. It aligns with the prevailing literature, which consistently establishes a positive correlation between economic growth and health (refer to Sections 3.2 and 3.3). For instance, a Harvard analysis in the United States (Reuell, 2016) demonstrated that there is a large difference in life expectancy between the richest and the poorest, and there is no income above which higher income is not associated with greater longevity and no income below which less income is not associated with lower survival. The positive relationship between GDP per capita and health outcomes suggests that

economic prosperity can contribute to better overall health conditions within a population (Thomas & Frankenberg, 2002).

Results concerning institutional quality's effect on health align with the literature (Jude & Leveuge, 2014): government effectiveness positively correlates to life expectancy. However, its coefficient is not significant. Furthermore, the corruption coefficient is negative and statistically significant in both Columns 1 and 2, confirming the detrimental effect of corruption on health outcomes (Akinlo & Sulola, 2019).

Health expenditure is negative and statistically significant in both GMM models, including and excluding the control for education. As mentioned, the literature concerning health expenditure and outcomes found mixed results. The findings of this study align, for instance, with Akinlo and Suluola (2019)'s, who found similar results for a panel of 10 Sub-Saharan African countries. They attributed the negative relationship to the high degree of corruption and the fungibility of public health expenditures in those countries. Similar results can also be found in Ouattara and Issa (2012).

In line with Immurana (2021)'s results, the percentage of the population vaccinated against measles has a strong positive and statistically significant effect on life expectancy in both Columns 1 and 2. Other studies in the literature find a positive correlation between immunization and life expectancy. For instance, Brazil's large increase in life expectancy experienced by Brazil between 1940 and 1998 has been found to be the result of a reduction in deaths due to vaccine-preventable infectious diseases (Ballalai, 2017).

The coefficient of urban population growth is negatively correlated to health outcomes. As already mentioned, the literature's interpretation of its effect is ambiguous. In this case, an increase in population might not be accompanied by a proportional expansion of the health infrastructure and healthcare personnel, leading to negative health outcomes. According to Salahuddin et al. (2020), the relationship between urban population and health depends on the ability of the country to incorporate the increase in the population by providing the necessary improvements in infrastructure, environment and protection services.

Surprisingly, the effect of education is negative, but statistically insignificant. An increase in gross primary school enrolment is expected to increase the population's awareness of the importance of health inputs such as vaccination. However, the results in the literature are mixed: for instance, Dursun et al. (2018) found that increased levels of education correspond

to worse health outcomes for males in middle-income and low-educated countries. Conversely, Zajacova and Lawrence (2018) found that higher educational levels correspond to longer lives.

Overall, the explanatory variable of interest (health system) indicates that investments in the health system play an important role in determining positive health outcomes: the positive effects of FDI can be transmitted to health outcomes through their effects on the health system, while their direct effect is slightly negative.

As a further check, the same tests will be carried out using the infant mortality rate (IMR) as a proxy for the health outcomes (Immurana et al., 2023; Salahuddin et al., 2020). The results of the GMM regressions are reported in Columns 3 and 4 of Table 6.3. The results of the fixed and random effects are displayed in Appendix B.

Similar to the previous regression, the inability to reject the null hypothesis of first-order autocorrelation in the Arellano-Bond test suggests the presence of serial correlation at the first-degree level. However, as mentioned earlier, the GMM model remains the preferred choice over fixed or random effects models as long as there is no second-order serial correlation, as indicated by the non-rejection of the null hypothesis in the second Arellano-Bond test. Consequently, the subsequent discussion will primarily focus on the results obtained through the GMM model.

The findings provide confirmation of the positive effects of the health system on health outcomes, particularly when the control for education is included. Notably, the health system indicator exhibits a negative correlation with the infant mortality rate (IMR), indicating that an improvement in the health system is associated with a decrease in infant mortality. These results underscore the importance of a robust and efficient health system in contributing to positive health outcomes, particularly in reducing infant mortality rates. This aligns with Donabedian (2005)'s idea that a more efficient health system should increase health outcomes. When the education control is excluded, the indicator is not statistically significant.

Excluding the education control, Chinese foreign direct investment (FDI) inflows demonstrate significance and a positive correlation with the dependent variable, indicating that an increase in FDI is associated with a rise in the infant mortality rate. Contrary to the findings of Immurana et al. (2023) and Salahuddin et al. (2020), who examined the impact of FDI on infant mortality rate across African countries in a panel analysis and discovered a negative correlation, the

direct effect of FDI on life expectancy appears to be negative when compared to its influence through the health system.

On the contrary, results reported in Column 4 align with the aforementioned literature: a one-unit increase in the health system indicator corresponds to, on average and *ceteris paribus*, a 2.25-unit decrease in the IMR. This outcome suggests a positive impact of the health system on health outcomes. Notably, the direct effect of foreign direct investment is deemed insignificant, indicating that its influence on health outcomes operates primarily through its positive effect on the health system.

The coefficients for GDP per capita and measles vaccine utilization are negative and statistically significant in both Columns 3 and 4, indicating that an increase in these variables correlates with a decrease in infant mortality rate, hence better health outcomes. Government effectiveness negatively affects the IMR only when education control is excluded; otherwise, it is insignificant. Education is also negative but insignificant.

As can be seen from Appendix C, the results concerning the independent variable of interest hold when the sample is reduced to its initial size. The only difference lies in the variable FDI, which is always significant. This means that the three countries included in the new sample, namely Algeria, Angola, and Lesotho, were the main cause of insignificance of the variable.

The results of both models reveal a positive and statistically significant relationship between corruption, urban population growth, and health expenditure, suggesting their detrimental impact on infant mortality rates. Corruption will likely affect public spending and reduce resource allocation in the health sector. Moreover, a population surge can adversely affect health outcomes unless accompanied by appropriate infrastructure and services. Additionally, the observed negative effect of health expenditure aligns with the findings of Akinlo and Suluola (2019) in their study involving ten Sub-Saharan African countries.

Overall, the findings demonstrate a positive relationship between the health system and health outcomes, emphasizing the beneficial impact of attracting foreign investments on the health system. However, it is noteworthy that the direct effects of foreign direct investment on health outcomes are negative. This highlights the crucial need for African governments to strike a balance between attracting FDI and ensuring that these investments align with health priorities, contributing to equitable, accessible, and high-quality healthcare for their populations. By

doing so, governments can maximize the benefits of FDI while safeguarding the well-being of their citizens.

7 Conclusions

The purpose of this study was to examine the relationship between Chinese outward foreign direct investments and the African health system in the period 2004-2018, which saw a large increase in investments coming from China. The motivation for this study arises from the fact that while numerous studies have investigated the influence of FDI on socioeconomic indicators, particularly economic growth, health outcomes have received minimal attention. Furthermore, even fewer studies have focused on the “structure” of the health system rather than health outcomes such as life expectancy and infant mortality rates.

To capture the "structural" aspects of the health system, a new variable was constructed by combining five indicators: medical doctors, hospital beds, hospitals, health centers, and nursery and midwifery personnel. The relationship between Chinese FDI inflows and this newly formed health system indicator was then examined through regression analysis. To address the concern of omitted variable bias, several control variables were introduced based on existing literature. These controls encompassed income per capita, health expenditure, trade, and institutional quality. Additionally, a second model was employed, incorporating further controls related to the development of African countries. These additional controls consisted of dummy variables representing geographical, religious, and legal origin differences among the countries under study. Furthermore, a variable capturing natural resource rents was included in the model to account for their potential influence.

To address endogeneity concerns, the Generalized Method of Moments (GMM) approach was employed, chosen over fixed effects Ordinary Least Squares (OLS) due to its ability to mitigate endogeneity issues by utilizing lagged values of the variables as instruments. The findings revealed a positive and statistically significant association between the health system indicator and Chinese FDI, affirming the beneficial impact of FDI on healthcare. This relationship persisted even after incorporating controls related to development. Consequently, it is imperative for African governments to intensify their efforts in attracting and retaining higher levels of foreign direct investments, as they have the potential to contribute significantly to the advancement of their health systems.

The subsequent phase of the study examined the relationship between the health system and health outcomes, aiming to determine whether the favorable effects of FDI on the health system extend to influencing health outcomes. In this regard, the newly constructed health system indicator was regressed against variables representing health outcomes, specifically life expectancy and infant mortality rate. Including the FDI variable in the model allowed for distinguishing between its direct impact and its influence transmitted through the health system. Furthermore, the study drew on the population health literature to incorporate additional controls that could potentially affect the dependent variables. These encompassed income per capita, immunization, urban population growth, health expenditure, institutional quality, and education. Once again, the use of the GMM is preferred.

The findings reveal a positive association between the health system and life expectancy, as well as a negative correlation between the health system and infant mortality rate. These results suggest that a robust health system contributes to improved health outcomes by promoting longer life expectancy and reducing the infant mortality rate. However, the direct impact of FDI inflows on health outcomes is not as pronounced. In most cases, the results indicate a negative or insignificant effect of foreign direct investments on health outcomes. This suggests that the negative factors associated with FDI, as highlighted in the literature, such as detrimental environmental impacts, increased workplace stress, or inefficient allocation of public and private health expenditures, tend to outweigh the positive effects. Moreover, it underscores that the positive influence of FDI on health outcomes is predominantly mediated through its impact on strengthening the health system.

Hence, it is crucial for African governments to not only focus on attracting and expanding foreign direct investments but also to take proactive measures to enhance their direct effects on health outcomes. This can be achieved through the implementation of regulations and controls to ensure that investments align with health priorities. Additionally, governments can encourage foreign social corporate responsibility initiatives that directly impact health outcomes, going beyond their contributions to the health system alone. Furthermore, policymakers can explore targeted incentives to attract FDI in sectors that have a significant influence on health.

Moreover, incorporating health impact assessments into the evaluation process for FDI projects can be instrumental. This involves assessing the potential health consequences, both positive and negative, of proposed investments. By considering the broader health implications, policymakers can make informed decisions and mitigate any adverse effects while maximizing the benefits to population health.

Overall, African governments should strike a balance between attracting foreign direct investment and ensuring that investments align with health priorities.

References

- Akadiri, A., Güngör, H., Akadiri, S. & Bamidele-Sadiq, M. (2019). Is the Causal Relation between Foreign Direct Investment, Trade and Economic Growth Complement or Substitute? The Case of African Countries, *Journal of Public Affairs*
- Akinlo, A. E. & Sulola, A. O. (2019). Health Care Expenditure and Infant Mortality in Sub-Saharan Africa, *Journal of Policy Modeling*, vol. 41, no. 1, pp.168–178
- Alexander Ayertey ODONKOR. (2023). Does Chinese Investment Strengthen African Health Systems? - The Business & Financial Times, Available Online: <https://thebftonline.com/2023/03/07/does-chinese-investment-strengthen-african-health-systems/> [Accessed 27 April 2023]
- Andres, P. de & Vallelado, E. (2008). Corporate Governance in Banking: The Role of the Board of Directors, *Journal of Banking & Finance*, vol. 32, no. 12, pp.2570–2580
- Arellano, M. & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Components Models, *Journal of Econometrics*, vol. 68, no. 1, pp.29–51
- Asiedu, E. (2006). Foreign Direct Investment in Africa: The Role of Natural Resources, Market Size, Government Policy, Institutions and Political Instability, *The World Economy*, vol. 29, no. 1, pp.63–77
- Atitianti, P. A. & Dai, Q. (2022). Does Chinese Foreign Direct Investment Improve the Welfare of Africans?, *Journal of African Business*, vol. 23, no. 4, pp.964–983
- Ayemba. (2020). Sonatrach Signs Dry Gas Marketing Deal until 2042 - African Mining Brief, Available Online: <https://africanminingbrief.com/2020/03/10/sonatrach-signs-dry-gas-marketing-deal-until-2042/> [Accessed 16 May 2023]
- Balcão Reis, A. (2001). On the Welfare Effects of Foreign Investment, *Journal of International Economics*, vol. 54, no. 2, pp.411–427
- Ballalai, I. (2017). Vaccination and Longevity, *Revista Brasileira de Geriatria e Gerontologia*, vol. 20, pp.741–742
- Blundell, R. & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models, *Journal of Econometrics*, vol. 87, no. 1, pp.115–143
- Borensztein, E., Gregorio, J. D. & Lee, J.-W. (1998). How Does Foreign Direct Investment Affect Economic Growth?, *Journal of International Economics*
- Burns, D. K., Jones, A. P., Goryakin, Y. & Suhrcke, M. (2017). Is Foreign Direct Investment Good for Health in Low and Middle Income Countries? An Instrumental Variable Approach, *Social Science & Medicine*, vol. 181, pp.74–82
- CARI. (2023). China Africa Research Initiative, *China Africa Research Initiative*, Available Online: <http://www.sais-cari.org> [Accessed 27 April 2023]

- Cheung, Y.-W., de Haan, J., Qian, X. & Yu, S. (2012). China's Outward Direct Investment in Africa, *Review of International Economics*, vol. 20, no. 2, pp.201–220
- China Statistical Yearbook 2019. (2023). , Available Online: <http://www.stats.gov.cn/sj/ndsj/2019/indexeh.htm> [Accessed 4 May 2023]
- Dollar, D. & Burnside, A. C. (1998). Aid, the Incentive Regime, and Poverty Reduction, SSRN Scholarly Paper, 597236, Available Online: <https://papers.ssrn.com/abstract=597236> [Accessed 10 May 2023]
- Donabedian, A. (2005). Evaluating the Quality of Medical Care, *The Milbank Quarterly*, vol. 83, no. 4, pp.691–729
- Dritsaki, M. & Dritsaki, C. (2023). The Relationship Between Health Expenditure, CO2 Emissions, and Economic Growth in G7: Evidence from Heterogeneous Panel Data, *Journal of the Knowledge Economy*, [e-journal], Available Online: <https://doi.org/10.1007/s13132-023-01349-y> [Accessed 11 May 2023]
- Drogendijk, R. & Blomkvist, K. (2013). Drivers and Motives for Chinese Outward Foreign Direct Investments in Africa, *Journal of African Business*, vol. 14, no. 2, pp.75–84
- Dursun, B., Cesur, R. & Mocan, N. (2018). The Impact of Education on Health Outcomes and Behaviors in a Middle-Income, Low-Education Country, *Economics and Human Biology*, vol. 31, pp.94–114
- Easterly, W. & Levine, R. (2016). The European Origins of Economic Development, *Journal of Economic Growth*, vol. 21, no. 3, pp.225–257
- Ernst & Young. (2017). EY's Attractiveness Program Africa: Connectivity Redefined
- Filmer, D. & Pritchett, L. (1997). Child Mortality and Public Spending on Health : How Much Does Money Matter?, 1864, *Policy Research Working Paper Series*, [e-journal], Available Online: <https://ideas.repec.org/p/wbk/wbrwps/1864.html> [Accessed 11 May 2023]
- Freeman, M. (2021). Vantage Data Centers Expands to Africa with US\$1 Billion Flagship Johannesburg Campus in Continent's Largest Data Center Market - Vantage Data Centers, Available Online: <https://vantage-dc.com/news/vantage-data-centers-expands-to-africa-with-us1-billion-flagship-johannesburg-campus-in-continents-largest-data-center-market/> [Accessed 25 May 2023]
- Garnaut, R., Song, L. & Fang, C. (eds). (2018). China's 40 Years of Reform and Development: 1978–2018, 1st edn, [e-book] ANU Press, Available Online: <https://press.anu.edu.au/publications/series/china-update-series/china's-40-years-reform-and-development-1978-2018> [Accessed 22 February 2023]
- Gilmore, A. & McKee, M. (2005). Exploring the Impact of Foreign Direct Investment on Tobacco Consumption in the Former Soviet Union, *Tobacco Control*, vol. 14, no. 1, pp.13–21
- Glen, S. (2017). Hausman Test for Endogeneity (Hausman Specification Test), *Statistics How To*, Available Online: <https://www.statisticshowto.com/hausman-test/> [Accessed 10 May 2023]
- Herzer, D., Klasen, S. & Nowak-Lehmann D., F. (2008). In Search of FDI-Led Growth in Developing Countries: The Way Forward, *Economic Modelling*, vol. 25, no. 5, pp.793–810

- Herzer, D. & Nunnenkamp, P. (2012). FDI and Health in Developed Economies: A Panel Cointegration Analysis, 1756, *Kiel Working Papers*, [e-journal], Available Online: <https://ideas.repec.org/p/zbw/ifwkwp/1756.html> [Accessed 4 May 2023]
- Holz, C. A. (2003). “Fast, Clear and Accurate”: How Reliable Are Chinese Output and Economic Growth Statistics?, *The China Quarterly*, vol. 173, pp.122–163
- Immurana, M. (2021). How Does FDI Influence Health Outcomes in Africa?, *African Journal of Science, Technology, Innovation and Development*, vol. 13, no. 5, pp.583–593
- Immurana, M. (2022). An Empirical Analysis of the Effect of Foreign Direct Investment on Population Health in Ghana, *International Social Science Journal*, vol. 72, no. 245, pp.787–798
- Immurana, M., Iddrisu, A.-A., Owusu, S. & Yusif, H. M. (2023). Foreign Direct Investment and Child Health Outcomes in Africa, *Cogent Economics & Finance*, vol. 11, no. 1, p.2164565
- Jude, C. & Leveigue, G. (2014). Growth Effect of FDI in Developing Economies: The Role of Institutional Quality
- Kaufmann & Kraay. (2023). WGI 2022 Interactive > Home, Available Online: <https://info.worldbank.org/governance/wgi/> [Accessed 8 May 2023]
- Kaulihowa, T. & Adjasi, C. (2018). FDI and Welfare Dynamics in Africa, *Thunderbird International Business Review*, vol. 60, no. 3, pp.313–328
- Kolstad, I. & Wiig, A. (2011). Better the Devil You Know? Chinese Foreign Direct Investment in Africa, *Journal of African Business*, vol. 12, no. 1, pp.31–50
- Krishna Srinivasan ; Basu Anupam. (2002). Foreign Direct Investment in Africa: Some Case Studies
- Lin, S., Gao, L., Reyes, M., Cheng, F., Kaufman, J. & El-Sadr, W. M. (2016). China’s Health Assistance to Africa: Opportunism or Altruism?, *Globalization and Health*, vol. 12, no. 1, p.83
- Nagel, K., Herzer, D. & Nunnenkamp, P. (2015). How Does FDI Affect Health?, *International Economic Journal*, vol. 29, no. 4, pp.655–679
- Nnadozie, E., Katjомуise, K. & Krüger, R. (2008). NEPAD’s APRM and the Investment Climate in Africa
- Nsoesie, E. (2020). Technology, Data, and Urban Health in Africa - Idea Hub at BUSPH, *Idea Hub*, Available Online: <https://www.ideahub.org/research-data/technology-data-and-urban-health-in-africa/> [Accessed 17 May 2023]
- Nunn, N. (2008). The Long Term Effects of Africa’s Slave Trades, *Quarterly Journal of Economics*, vol. 123, no. 1, pp.139–176
- Odusola. (2018). Investing in Africa Is Sound Business and a Sustainable Corporate Strategy, *Africa Renewal*, Available Online: <https://www.un.org/africarenewal/web-features/investing-africa-sound-business-and-sustainable-corporate-strategy> [Accessed 16 May 2023]
- OECD. (1996). OECD Benchmark Definition of Foreign Direct Investment: Third Edition | READ Online, *Oecd-Ilibrary.Org*, Available Online: <https://read.oecd->

library.org/finance-and-investment/oecd-benchmark-definition-of-foreign-direct-investment_9789264064805-en [Accessed 16 May 2023]

- OECD. (2017). Pollution Havens? Energy Prices Are Not Key Drivers of Offshoring - OECD, Available Online: <https://www.oecd.org/economy/greeneco/pollution-haven-hypothesis.htm> [Accessed 4 May 2023]
- Onyenuchey, A. (2021). \$2.9b Escravos Seaport to Decongest Lagos Ports, Generate 40,000 Jobs, *The Guardian Nigeria News - Nigeria and World News*, Available Online: <https://guardian.ng/business-services/2-9b-escravos-seaport-to-decongest-lagos-ports-generate-40000-jobs/> [Accessed 25 May 2023]
- Ouattara, B. & Issa, H. (2012). The Effect of Private and Public Health Expenditure on Infant Mortality Rates: Does the Level of Development Matters?, vol. 28, pp.21–37
- Oumarou Zallé. (2019). Natural Resources and Economic Growth in Africa: The Role of Institutional Quality and Human Capital - ScienceDirect, *Resources Policy*, vol. 62, pp.616–624
- PAHO. (2018). Health Indicators: Conceptual and Operational Considerations., Washington, D.C.: Organización Panamericana de la Salud
- RenewAfrica.Biz. (2022). Hive Hydrogen to Set up a \$4.6bn Green Ammonia Plant in South Africa, Available Online: <https://renewafrica.biz/news/south-africa-news/hive-hydrogen-investors-to-set-up-4-6bn-green-ammonia-plant-in-south-africa/> [Accessed 24 May 2023]
- Reuell, P. (2016). For Life Expectancy, Money Matters, *Harvard Gazette*, Available Online: <https://news.harvard.edu/gazette/story/2016/04/for-life-expectancy-money-matters/> [Accessed 12 May 2023]
- Reuters. (2021). Naspers, Prosus Complete Share Swap, New Cross-Holding Structure, *Reuters*, 16 August, Available Online: <https://www.reuters.com/article/prosus-shareissue-naspers-idUSL8N2PM0X4> [Accessed 17 May 2023]
- Rugulies, R., Aust, B., Burr, H. & Bültmann, U. (2008). Job Insecurity, Chances on the Labour Market and Decline in Self-Rated Health in a Representative Sample of the Danish Workforce, *Journal of Epidemiology and Community Health*, vol. 62, no. 3, pp.245–250
- Salahuddin, M., Vink, N., Ralph, N. & Gow, J. (2020). Effects of Economic Growth, Foreign Direct Investment and Internet Use on Child Health Outcomes: Empirical Evidence from South Africa, *Development Studies Research*, vol. 7, no. 1, pp.1–17
- Tang, H., Chen, W. & Dollar, D. (2015). How Similar Is Chinese Investment in Africa to the West's?, *Brookings*, Available Online: <https://www.brookings.edu/blog/order-from-chaos/2015/08/18/how-similar-is-chinese-investment-in-africa-to-the-wests/> [Accessed 16 May 2023]
- Textor, C. (2022). China: Outward FDI Flows to Africa 2021 | Statista, Available Online: <https://www.statista.com/statistics/277985/cash-flow-of-chinese-direct-investments-in-africa/> [Accessed 24 April 2023]
- The State Council Information Office of & the People's Republic of China. (2021). China and Africa in the New Era, Available Online: http://zw.china-embassy.gov.cn/eng/zgj/202112/t20211216_10470558.htm [Accessed 11 May 2023]

- Thomas, D. & Frankenberg, E. (2002). Health, Nutrition and Prosperity: A Microeconomic Perspective., *Bulletin of the World Health Organization*, vol. 80, no. 2, pp.106–113
- Ullah, S., Akhtar, P. & Zaefarian, G. (2018). Dealing with Endogeneity Bias: The Generalized Method of Moments (GMM) for Panel Data, *Industrial Marketing Management*, vol. 71, pp.69–78
- UNACTAD. (2014). World Investment Report 2014: Investing in the SDGs - an Action Plan, [e-book] UN, Available Online: <https://www.un-ilibrary.org/content/books/9789210566964> [Accessed 4 May 2023]
- UNCTAD. (2022). Investment Flows to Africa Reached a Record \$83 Billion in 2021 | UNCTAD, Available Online: <https://unctad.org/news/investment-flows-africa-reached-record-83-billion-2021> [Accessed 24 April 2023]
- UNITED NATIONS. (1999). FOREIGN DIRECT INVESTMENT IN AFRICA: Performance and Potential
- United Nations. (2022). Human Development Index, *Human Development Reports*, United Nations, Available Online: <https://hdr.undp.org/data-center/human-development-index> [Accessed 16 May 2023]
- United Nations Conference on Trade and Development. (2017). World Investment Report 2017: Investment and the Digital Economy, [e-book] UN, Available Online: <https://www.un-ilibrary.org/content/books/9789210607032> [Accessed 26 April 2023]
- UNWPP. (2023). Home Page | Data Portal, Available Online: <https://population.un.org/dataportal/home> [Accessed 8 May 2023]
- Wang, S., Wang, H. & Sun, Q. (2020). The Impact of Foreign Direct Investment on Environmental Pollution in China: Corruption Matters, *International Journal of Environmental Research and Public Health*, vol. 17, no. 18, p.6477
- Whalley, J. & Xin, X. (2010). China's FDI and Non-FDI Economies and the Sustainability of Future High Chinese Growth, *China Economic Review*, vol. 21, no. 1, pp.123–135
- White, H., Hanmer, L. & Lensink, R. (2003). Infant and Child Mortality in Developing Countries: Analysing the Data for Robust Determinants, *The Journal of Development Studies*, vol. 40, pp.101–118
- WHO. (2000). The World Health Report 2000: Health Systems : Improving Performance, World Health Organization
- World Bank. (2023). World Development Indicators | DataBank, Available Online: <https://databank.worldbank.org/source/world-development-indicators> [Accessed 8 May 2023]
- World Economic Forum. (2021). Why Foreign Direct Investment Is Key to Africa's Sustainable Recovery, *World Economic Forum*, Available Online: <https://www.weforum.org/agenda/2021/08/foreign-direct-investment-key-africa-sustainable-recovery/> [Accessed 17 May 2023]
- Yimer, A. (2023). The Effects of FDI on Economic Growth in Africa, *The Journal of International Trade & Economic Development*, vol. 32, no. 1, pp.2–36
- Zajacova, A. & Lawrence, E. M. (2018). The Relationship between Education and Health: Reducing Disparities through a Contextual Approach, *Annual review of public health*, vol. 39, pp.273–289

Appendix A

VARIABLES	(1) Doctors (RE)	(2) Hospital Beds (FE)	(3) Hospitals (RE)	(4) Health Centers (RE)	(5) Nursing Personnel (RE)
FDIflows	0.000261 (0.000205)	-0.000134 (0.000185)	-0.000197 (0.000577)	-0.00127 (0.00103)	-0.000154 (0.000737)
GDPpc	0.00130*** (0.000354)	-0.00135*** (0.000404)	-0.000278 (0.000239)	-0.000252 (0.000164)	-0.000590 (0.00136)
Health expenditure	0.361*** (0.137)	0.354* (0.197)	-0.0227 (0.0338)	-0.0159 (0.0902)	0.321 (0.322)
Government effectiveness	1.096 (1.129)	0.519 (5.457)	1.621 (1.354)	0.394 (1.849)	-0.900 (4.067)
Corruption	-0.791 (1.286)	3.447 (5.535)	-0.234 (0.376)	0.245 (0.652)	-2.688 (4.018)
Trade	-3.005** (1.378)	-6.749** (3.141)	0.0271 (0.395)	0.359 (0.639)	-13.93*** (4.985)
Constant	-0.215 (0.827)	19.69*** (1.957)	3.092 (2.123)	5.876** (2.551)	15.37*** (4.147)
Observations	287	70	69	68	356
R-squared	0.700	0.197	0.009	0.0043	0.464
Number of countries	42	40	35	34	44

Source: author's calculations. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As previously mentioned, the unavailability of observations ruled out the possibility of using the GMM model, leading to the utilization of fixed and random effects models.

It is important to acknowledge the potential bias in the results due to the presence of endogeneity. The findings reveal that the relationship between individual variables and Chinese FDI consistently lacks significance. Surprisingly, healthcare expenditure exhibits significance and demonstrates a positive correlation with two out of the five indicators, specifically doctors and hospital beds. These results differ from those obtained from the combined health system indicator, where the relationship appears to be insignificant.

Nevertheless, it is crucial to exercise caution when interpreting these outcomes, as they may be influenced by the limited availability of data and the presence of endogeneity.

Appendix B

VARIABLES	(1) Life expectancy (FE)	(2) Life expectancy (FE)	(3) IMR (RE)	(4) IMR (RE)
Health system	0.529* (0.265)	0.621* (0.319)	-0.661 (0.629)	-0.439 (0.923)
FDIflows	0.000307 (0.000682)	0.000211 (0.000599)	-0.00128 (0.00235)	-0.000785 (0.00193)
GDPpc	0.00169*** (0.000498)	0.00179*** (0.000544)	-0.00428*** (0.00108)	-0.00424*** (0.00143)
Government effectiveness	-1.783 (1.875)	-2.546 (2.187)	6.836 (4.491)	13.87** (6.155)
Corruption	-0.399 (1.354)	-1.141 (1.198)	-4.178 (4.086)	0.109 (4.023)
Health expenditure	0.0830 (0.269)	0.0537 (0.272)	-0.157 (0.773)	-0.156 (0.957)
Immunization	0.134*** (0.0375)	0.146*** (0.0414)	-0.565*** (0.101)	-0.516*** (0.125)
Urban	-0.293 (0.384)	-0.167 (0.400)	1.670 (1.146)	1.416 (1.307)
Education		0.0342 (0.0371)		-0.257** (0.112)
Constant	45.03*** (4.182)	39.39*** (5.050)	105.5*** (12.63)	133.8*** (16.36)
Observations	409	374	409	374
R-squared	0.392	0.367	0.543	0.401
Number of countries	44	41	44	41

Source: author's computation. Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix C

VARIABLES	(1) Life expectancy	(2) Life expectancy	(3) IMR	(4) IMR
Health system	1.177*** (0.106)	1.040*** (0.162)	-0.673 (0.421)	-2.848*** (0.903)
FDIflows	-0.000543*** (4.34e-05)	-0.000280** (0.000126)	0.000479*** (6.80e-05)	0.000847*** (0.000184)
GDPpc	0.000954*** (5.05e-05)	0.000730*** (0.000193)	-0.00207*** (0.000286)	-0.00161*** (0.000223)
Government effectiveness	-0.0753 (0.444)	-1.293 (1.787)	-8.994*** (1.751)	-4.631 (3.057)
Corruption	-6.821*** (0.554)	-5.167*** (1.424)	15.12*** (2.864)	4.447** (1.975)
Health expenditure	-0.375*** (0.0685)	-0.385** (0.153)	1.479*** (0.263)	2.189*** (0.198)
Immunization	0.182*** (0.0114)	0.196*** (0.0371)	-0.923*** (0.0523)	-0.827*** (0.0337)
Urban	-1.263*** (0.119)	-1.677*** (0.356)	1.626*** (0.367)	0.843* (0.450)
Education		-0.0826 (0.0741)		-0.136*** (0.0450)
Constant	46.60*** (1.277)	56.46*** (7.324)	118.8*** (2.511)	120.1*** (6.736)
Arellano-Bond Test AR(1)	0.577	0.606	0.959	0.415
Arellano-Bond Test AR(2)	0.270	0.228	0.939	0.531
Sargan-Hansen	1.000	0.412	0.702	1.000
Observations	394	362	394	362
Number of countries	41	38	41	38

Source: author's computation. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1