The financial crisis and its effects on people's health in Sub-Saharan Africa

How health was affected in eastern and southern Africa where GDP fell compared to western and central Africa where it was not.

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Abstract:

The financial crisis hit the world during the years of 2008 and 2009. This crisis led to severe financial consequences in mostly North America, Europe but also in Sub-Saharan Africa. Sub-Saharan Africa already had healthcare difficulties, low standard of living and were sensitive to shocks. The question to answer was therefore whether Sub-Saharan Africa's people's health was affected by the economic shock that the financial crisis was. The GDP decrease was bigger in the Eastern- and Southern Africa compared to Western- and Central Africa. This paper is testing if the financial crisis had an impact on HIV, suicide mortality or infant mortality on aforementioned regions where GDP decreased during the crisis by doing an interaction model, which is similar to difference-in-difference regression. Few studies have been found investigating this area.

The results were not significant for any of the three health factors studied, which makes it difficult to say anything about how the health effects differed between the Eastern- and Southern Africa and Western- and Central Africa. Together with Sindzingres' analyses of the poverty trap could a conclusion be made, suggesting that the effects differed between countries, depending on how vulnerable they are and which uncertainties they have when being exposed to shocks.

Key words: Financial crisis, Health, Africa, GDP, Suicide, Infant mortality, HIV

Bachelor-thesis in National Economics, 15 credits
Spring Semester 2022
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1. Introduction

Year 2007 was, in many countries, what is referred to as the "worst economic disaster since the Great Depression of 1929" (Amadeo, 2022). Understanding whether and how economic downturns affect individuals' health is especially relevant in the aftermath of the Great Recession, which caused significant economic disruptions including increases in unemployment rates and large budgetary cuts (Aliber & Zoega, 2008). Prior work has found that income shocks generated by unexpected unemployment, wage cuts, or income shocks and major life events can substantially affect individuals' health (Bejenariu-Tudor & Mitrut, 2016).

The overall effects of the economic shocks and recessions on individuals' health are ex-ante difficult to disentangle. During economic recessions, households may reduce expenditures on consumption goods and could afford less hospitalizations, which could negatively affect their health; at the same time, household might lower the consumption of health-damaging goods which in turn could offset the negative effects (Ruhm & Black, 2002; Ruhm, 2003). Bozzoli and Quintana-Domeque (2013) show the procyclical effects of economic fluctuations in Argentina on children's health, noting that birth weights are sensitive to macroeconomic fluctuations (because of stress or nutritional deprivation).

In this paper we aim to understand how the recession affected individuals' health in 38 developing countries from Sub-Saharan Africa.**[1] In particular, we ask whether people from the Sub-Saharan countries, an area with developing countries according to Momene (2016), that have been more severely affected by the great economic recession experienced a health shock compared to Sub-Saharan countries that have not been affected by the recession.

Our main health outcome is infant mortality, but we also look at some other outcomes such as suicidal rate and the prevalence of HIV.

Fig 1 shows the GDP per capita growth per year. Both Europe and North America had a bigger GDP decline in 2009 than the world in total. Eastern and Southern Africa had a relatively large GDP growth decline, but Western and Central Africa seem not to have a GDP decline. A

[1]** Sub-Saharan Africa includes every country in Africa except the countries in North Africa which are: Morocco, Algeria, Tunisia, Libya, Egypt and Sudan (Murigi, 2021). In Appendix B are all the included and excluded countries documented.

decrease in GDP growth around the world can be seen in 2008 but the big downfall happened in 2009. During the recession, Africa moved from an overall budgetary surplus of GDP (gross domestic product) in 2008 of accounting for 1,8% to a deficit of -5% in 2009 (Kasekende et al., 2009). From this figure we notice that some of the Sub-Saharan countries have been more affected by the economic recession and experienced a drop in the GDP growth - countries in the East and Southern Africa - compared to the countries in the West and Central Africa where there was no change over these years.

Thus, our aim is to understand how infant mortality, suicide mortality and prevalence of HIV were affected by the GDP fall during this period in East and Southern Africa compared to in West and Central Africa. We will thus compare in an interaction model (like difference-in-difference regression) the health before and after the recession (during the period 2007-2012), for the countries more and less affected.

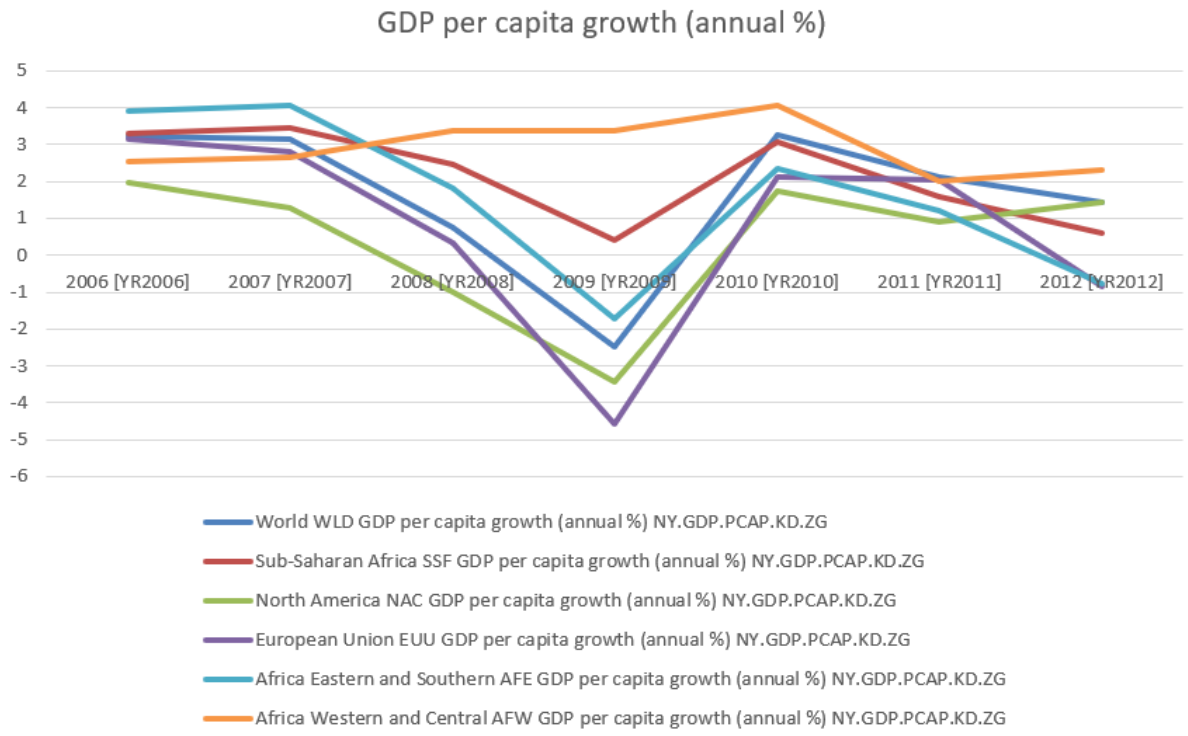

Figure 1. Based on data from The World Bank:s *World Development Indicators.* The figure shows the GDP per capita growth per year. Both Europe and North America had a bigger GDP decline in 2009 than the world in total. Eastern and Southern Africa had a relatively large GDP growth decline, but Western and Central Africa seem not to have a GDP decline. A decrease in GDP growth around the world can be seen in 2008 but the big downfall happened in 2009.

1.1 Problem discussion

According to the United Nations (African Renewal, 2016) healthcare has been a challenge for Sub-Saharan Africa, with underfunded budgets for healthcare with goals that have been difficult to reach. Lack of access to hospitals, nurses and hospital beds, low endowment in both public and private sector healthcare systems are reasons for a lot of health-related deaths, and to low life expectancy in the continent. According to Friedman and Schady (2012), the costs for people from the financial crisis can vary and be in many ways. For example, as by lower income and consumption levels, higher unemployment, decrease in investments in education by families and worse health and nutrition outcomes. Reading about the financial crisis and the health situation in Africa makes you wonder how health in Sub-Saharan Africa got affected because of this event, when the countries already were fragile. From *Figure 1* can you see the difference in GDP growth between where the crisis hit and where it did not. The effects from infant mortality, suicide mortality and prevalence of HIV (Human Immunodeficiency Virus) can help when trying to investigate health consequences and differences. Earlier articles about health consequences from the financial crisis are limited and relatively unexplored.

1.2 Purpose and research question

The purpose of this paper is to add to current understanding about health and how the financial crisis impacted the population in Sub-Saharan Africa from a health perspective. This paper can give a wider picture of the consequences by answering the questions and test for the GDP shock that the crisis led to (The World Bank, 2022, A). The relationship between HIV, suicide and infant mortality and GDP growth is tested by investigating the effects of the financial crisis. The paper is therefore made to answer the following research questions:

- *Was infant mortality affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

- *Was suicide mortality affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

- *Was the prevalence of HIV affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

1.3 Overview of the paper

The paper starts with an explanation of the background of the health, healthcare, and Africa and then the theoretical background. The section describes the financial crisis, Africa, the poverty trap, and the importance of these. Further in section 3 presents existing literature about the financial crisis effects on Africa and on health. Section 4 gives a closer explanation of the paper's method choice, economic models and the potential problems are discussed. Section 5 includes a presentation of the papers' data sources, selection and variables that is used in models for the thesis. The results from the regression analyses are presented and explained in section 6 and are discussed and analyzed in section 7. The paper ends with a conclusion in section 8 and with suggestions to further research.

2. Background and theory

Information, background and the theory about the subject will be reported in this section together with theories.

2.1 The financial crisis 2007-2009 and Africa

The financial crisis began in the United States with a subprime mortgage crisis on the market 2007. This spilled over into the real estate and banking sectors. From the financial markets to the housing in the United States market, then it spilled over to the international markets all around the world and GDP (Gross domestic product) started to fall during 2008 (Prakash, 2020).

The question to investigate is how people's health in Africa was affected by the economic shock that the financial crisis was. Sub-Saharan African countries, like other developing countries, do not have the same resilience against risks. The vulnerability in developing countries with health issues arises when they are exposed to external, in this case economic shocks (McGillivray et al., 2010). For example, during the financial crisis, developing countries got less aid, less investments and less purchases of luxury goods such as tourism, coffee, cotton and tobacco. The lack of investments led to a decrease in jobs and earned income. The poverty rose and the gap between countries rose too during the finance crisis and those with relative wealth recovered faster (Kelleciouglu, 2008).

Africa is at the bottom of the Human Development Index which means they have a relatively low standard of living (Momene, 2016). In The World Bank's list of countries listed after GDP per capita 2006, not one single country in Africa is in the top 50. The highest ranked African country on the list is Equatorial Guinea that is ranked as number 63 and soon after that comes Seychelles as number 65. In the bottom of the list, of the 20 lowest ranked countries, is only one country not African (The World Bank, 2006, B).

When investigating developing countries, one theory Greenlaw and Shapiro (2017) discuss is the poverty trap. To understand this theory, one must look at the system in developing countries. There are programs in those countries that fight poverty by assisting the poor, but as soon as the poor people and countries earn money themselves, the level of assistance is reduced,

giving the person no net gain for working. The countries are stuck in the poverty trap. This theory could explain why countries in Africa are having a hard time getting out of this economic situation (Greenlaw & Shapiro, 2017).

World Bank's Chief Economist Albert Zeufack writes that “African economies are vulnerable to external shocks” (Dzimwasha, 2019). In the year of 2009, some African nations cut health and HIV budgets because of the financial situation. It was said that it could cause the health situation to get worse since many people in Sub-Saharan Africa are poor and in need of treatments (Shah, 2013). The financial help during the crisis has been criticized by the European Parliament since only 1,6 percent of the international monetary fund had been loaned to countries in Africa and the aid from some states sank during 2008 (European Parliament, 2009).

2.2 Health in Africa

Infant mortality is an indicator for health and Africa has a low life expectancy, and infant deaths are one of the main reasons for this (Saleh, 2022). There are around 41,6 deaths per thousand live births in 2020, but the number of infant deaths has declined virtuously in the last two decades, from around 81,05 in 2000 (Saleh, 2022). Child diseases can be easily prevented. Accounts for many infant deaths among children, common diseases are pneumonia, diarrhea, malaria. Malnutrition contributes to a weak immune system and leads to children being more vulnerable to these diseases (WHO, n.d. A).

Another factor that affects health in Africa is HIV (Human Immunodeficiency Virus)/ AIDS (acquired immunodeficiency syndrome) (WHO, n.d. B). Today 27,5 million people are living with these diseases in Africa and around 500 000 thousand died from it in 2018 (WHO, n.d. B). The large number of people that have been infected with HIV/AIDS has made it hard to treat everyone and research has been done to improve medication and treatment for the infected. It is still a widely spread disease which has influenced many African inhabitants and there is still much to do in the development of medication and treatment. Malaria and tuberculosis are other community diseases that can explain the low life expectancy. There have been improvements in preventing and curing malaria which have led to the number of people that have been infected have declined rapidly over the last century (Borjas, 2017).

Another health factor is suicide (Joszt, 2018). All around the world is suicide a big cause of premature mortality but the data on suicides is limited. The suicides are according to Mars et al. (2014) a health problem in Africa and they inquire for more studies on the subject.

2.3 Healthcare challenges in Africa

Healthcare has been a huge challenge for African nations, with underfunded budgets for healthcare and goals that have been difficult to reach. Lack of access to hospitals, nurses and hospital beds, low endowment in both public and private sector healthcare systems has been reasons why there are so many health-related deaths. Enhancement in sanitation and basic drinking water has helped deaths related to water poisoning decline. Rwanda is one of the few countries that met the goal from 2001 that they would give 15% of their budget to health care (Africa Renewal, 2016).

This motivates why healthcare is important when trying to improve health situations (Texila American University, n.d.). The biggest challenges for Africa and the healthcare systems around the continent are to have more educated doctors and better constitution of the workers and healthcare since it is inadequate. Resources also need to be allocated more efficiently between and within healthcare, corruption has been a major problem, selling medicines on the black market. Illegal drugs and drug overuse is one reason for many deaths in Africa according to Texila American University (n.d.). Moreover, there are major challenges left, above all to make healthcare accessible to all and to recruit more and more knowledgeable staff and make better healthcare insurance (Texila American University, n.d.).

According to the WHO (World Health Organization) regional director for Africa, Dr Luis Sambo, there is a risk that the financing of the health development in Africa can be affected by the financial crisis when the average GDP growth rate declines (WHO Africa, 2010). There are predictions by The World Bank (n.d.) saying that the financial crisis threatens the treatment of the HIV infected all around the globe. 70% of the people that are on HIV treatment in southern and eastern Africa were threatened to not get the treatment during the crisis. By looking at some certain countries, there are examples of the restrictions that could have consequences for the treatment of HIV; HIV budgets reduced by 25% in Tanzania, reduced health budget in Kenya and private spendings on programs for prevention is supposed to decline in South Africa (Alcorn, 2009).

3. Literature review

In this section firstly the earlier literature studies will be reported, where there will be some earlier science about the subject of the paper. Secondly, the paper will provide the financial crisis impact on the population in Africa and a summary on the literature and based on that what this paper contributes to literature. Finally, there will be a hypothesis based on the earlier literature studies.

3.1 Africa's vulnerability to shocks

Allen and Giovannetti (2011) have investigated how fragile countries are when being exposed to shocks. The writers mention different reasons for vulnerabilities, for example conflicts as a reason for vulnerability in countries exposed to a lot of conflicts, increased prices as a reason for vulnerability in countries that are food and oil importers and the volatile prices as another reason for vulnerability in some countries. Some of the countries in Africa depend on export baskets with few products, directed to few markets that make them dependent on others. Investments made in the countries are concentrated in a few sectors. Another factor to the vulnerability among African countries is the limited safety-nets. Allen and Giovannetti (2011), also mentioned unemployment as a concern because of the positive relationship between unemployment and illegal activities among young males. Investigations have predicted that unemployment was about to rise during the crisis and that armed conflicts are mentioned as a possible outcome. They furthermore mention how the protection of these fragile countries is important since the consequences in those countries seem to be more severe compared to other countries even though they don't suffer more from macroeconomic shocks such as the financial crisis.

Sindzingre (2012) has investigated how the impact of the financial crisis on low-income African countries can be explained by the poverty trap. The paper argued that the concept of the theory is a relevant concept when trying to understand the effects of the crisis. The countries show differences and the casualties and responses to this external shock are specific to every country and are affected by uncertainties. These uncertainties could be for example growth dynamics, demand from other countries and stems from international commodity prices. The low equilibria do not only come from one factor, more elements matter and the author write that causality does not mean determinism. Since a lot of the determinants to growth are

endogenous to economic growth, the endogeneity is one feature of the poverty trap in developing countries (Sindzingre, 2012).

3.2 Financial consequences for Africa from the financial crisis

During the crisis there were predictions that the economic situation would have a significant impact on Africa because of changes in drivers of African growth factors according to Kasekende et al. (2009). The factors that drive growth could be for example prices and demand for primary commodities, capital flows and direct foreign investments. It was said that if the crisis was to last then this could threaten the gains that the continent has achieved when fighting poverty. Countries like Kenya, Mauritius and Nigeria had a huge loss on the financial market. Tunisia on the other hand seems not to be that affected, making the outcome not unitary in the continent. When comparing regions exports and imports, North Africa seems more affected than Sub-Saharan Africa. Sub-Saharan Africa seems to be more affected by the current account balance than North Africa (Kasekende et al., 2009).

Otker-Robe and Podpiera (2013) suggested that the crisis could have significant social costs in the short- to long run. Economic activity got weaker, consumption decreased and a lower demand for investments led to a fall in the economic growth. This lower wealth by reduced asset values, less capital inflows and less foreign aid was predicted to lead to a decrease in economic activity. This could also raise unemployment and reduce wages. In the long term can this limit the food intake and lead to more violence, pulling children out of school. This could, according to the predictions, have consequences in the long run (Otker-Robe & Podpiera, 2013).

There are several reasons why people in Africa became unemployed during the financial crisis according to The impacts of the Global Recession of 2008-2009 (2016). One important reason for the increased unemployment in for example Zimbabwe was the decrease in tourism and export-oriented industries. Countries such as Ethiopia, Burundi and Mali that are dependent on agriculture saw a reduction in export revenues. The decrease led to many agriculture workers failing to export and produce the wanted levels because of the risen prices for agricultural machinery and seeds and were left unemployed. Another reason is the dropped remittances such as foreign aid, migrant workers' remittances and charities sent to Africa which affect the households income security. A lot of people depended on aid but when the financial crisis hit,

many developed countries were forced to withdraw their aid (The Impacts of the Global Recession of 2008-2009, 2016).

Unemployment has, according to Wilson and Walker (1993) an adverse effect on health. The families of unemployed men have increased mortality and men tend to have worse psychological well-being and are more likely to use hospital services and prescribed medicines. Women are less affected, but the families have a big risk of being impacted in terms of physical illness and stress.

Odinakachi (2011) claimed that the financial crisis had a significant impact on the region because of the volatility that exists in the region. The continent had relatively substantial economic growth when the crisis hit and is said to need to recover to ensure economic growth in the long-term. However, the conclusion is that once the global economy is restored then the region will also rebound, because of how dependent they are on others (Odinakachi, 2011).

The impacts of the global financial crisis on Africa were investigated by Bandara (2010). The impacts which seem to differ between countries, depend on how much financial and economic integration the countries have with the rest of the world. Botswana, Seychelles and South Africa experienced a negative economic growth in 2009 while countries such as Ethiopia, Uganda and Tanzania (all countries in the eastern Africa) seemed to be resilient during the crisis. Ethiopia, Uganda and Tanzania still experienced growth but indicated a slowdown in the growth.

Berman and Martin (2012) analyzed the effect of banking crises in the past and focused on African exporters. They found suggestive evidence that an important determinant of the countries vulnerability to crisis for African countries is the dependence on trade finance in the trade partner countries.

3.3 Financial crisis effect on the population health

There is literature that investigates the economic consequences in Africa from the financial crisis 2007-2009, but not many articles have been investigating the health consequences in the continent.

3.3.1 The relationship between GDP growth and health

Sede and Ohemeng (2015) examine the socio-economic determinants of life expectancy, which is an indicator for health, in Nigeria. They found that variables such as education, income per capita and government expenditure on health that you think is effective when determining life expectancy in developing countries were not significant in Nigeria. The study suggests that if quality is given to health expenditures and unemployment then life expectancy in Nigeria could be improved.

3.3.2 Financial crisis effects on infant mortality

In a paper by Friedman and Schady (2012), the costs for humans from the crisis are discussed. The costs can vary and be in many ways, for example as by lower income and consumption levels, higher unemployment, decrease in investments in education by families and worse health and nutrition outcomes. The consequences on the well-being of children are particularly worrying, since what they are going through can have an impact throughout their life. For example, if the children drop out of school because of the crisis. (Friedman & Schady, 2012).

The financial crisis did also have an impact on infant mortality in the continent (Friedman & Schady, 2012) and an excess of infant deaths in 2009 was estimated in Sub-Saharan countries according to Rajmil et al. (2014). According to Kiross et al. (2020) are health care expenditures important when trying to reduce infant mortality in Sub-Saharan African countries. They argue that the underdeveloped healthcare infrastructure needs to be improved to reduce infant mortality. According to Cornia et al. (2011) and their investigation, the decreased GDP from the financial crisis had a lower effect on child mortality than expected. This lower effect comes from the fact that some countries only experienced a mild recession. The rise in prices among the domestic food was also offset in many parts of the region and that the public expenditures and aid to the health sector had a rise.

3.3.4 Financial crisis effects on the prevalence of HIV

There are no articles to be found about the financial crisis effects on the prevalence of HIV in Africa, however Burke et al. (2014) researched how different economic conditions have shaped the AIDS epidemic in Africa. The conclusion of the literature is that the economic changes are an important factor to the outcomes in the epidemic of HIV and that it affects the sexual behaviour which affects the HIV pandemic. There was no evidence that mechanisms such as school drop-out, migration or early marriage were contributing factors to this outcome. The

suggestion of the results was that social returns for investments were important in countries with a high number of HIV cases (Burke et al., 2014). This suggests that the effects on HIV should vary depending on how many HIV cases the countries have.

3.3.5 Financial crisis effects on suicide

When it comes to the effects on suicide in Africa is the papers limited. There have been some papers investigating the suicide consequences from the financial crisis but in other continents such as in Europe, Asia and America. Hawton and Haw (2013) have written about economic recession and suicide and states that the economic conditions can influence suicide rates. The economic depression in the late 1920s to 1930s has been associated with high suicide rates and also the Asian economic recession of 1997-98, suggests the financial recession can have bad effects for the health of the population. The exceeded numbers in suicides during the crisis in the late 2000s were correlated with the increased unemployment. The study mentioned by Hawton and Haw (2013) provided evidence that the economic downturn had effect on suicide, but they questioned how long the effect would last. One Swedish research according to Hawton and Haw (2013) found that young people got frightened of how future earnings would come and that the biggest effects from the crisis and unemployment on suicide were among the young people. Young people also seem to be the ones with highest unemployment in different countries around Europe. They mentioned, along with unemployment from the crisis, effects on families and alcohol consumption as important factors to the increased suicides (Hawton & Haw, 2013).

Claveria (2022) investigated the relationship between economic uncertainty and suicide for several countries around the world. According to the author was the suicide rates in Africa not that high except for the South region in Africa, including South Africa, Lesotho and Botswana (Claveria, 2022). These countries are in the region that was mostly affected by the financial crisis 2009.

3.4 Summary of earlier literature

Bandara (2010) argued that the impacts from the financial crisis in Africa seem to differ between countries and that this depends on how much financial and economic integration the countries have with the rest of the world. Estimations from Rahilm et al. (2014) suggested an increase in infant mortality from the financial crisis. Friedman and Schady (2012) argued that

the financial crisis had an impact on infant mortality, but Cornia et al. (2011) saw a smaller increase in child mortality than estimated. Limited number of studies have been made about HIV effects from the financial crisis, however Hawton and Haw (2013) suggested that social investments were important in countries with a high number of HIV cases. Investigations have been done about Europe, Asia and America on suicide consequences from the financial crisis but not that many in Africa. However, Claveria (2022) claimed that countries in Africa were not that affect from higher suicide rates except countries in Southern Africa, which are countries in the region affected by the GDP fall. The author also claimed that economic uncertainties were significant when investigating suicide effects. Sindzingre (2012) investigated how the impact of the financial crisis on the low-income countries could be explained by the poverty trap. The three theoretical features in the poverty traps are threshold effects, low equilibria and cumulative causation. Poverty trap is debated just like other commodity-based traps, arguing that the fluctuations can be analyzed by other economic concepts. Poverty trap was, however, relevant but the countries had differences and the responses to this external shock differed between countries and are affected by uncertainties. They mentioned uncertainties, it could be for example growth dynamics, demand from other countries and stems from international commodity prices. A lot of the determinants to growth are endogenous to economic growth. This endogeneity is one feature of the poverty trap in low-income countries (Sindzingre, 2012).

3.5 This paper's contribution to literature

The conclusion of the earlier literature is that there can be a need for more investigations on how the differences between eastern and southern compared to the western and central Africa were affected by the financial crisis. This paper has a health perspective that makes this study having a contributory approach. Literature about how peoples health was affected in Africa from the financial crisis seem limited and when it comes to consequences from HIV and suicide are the research literature almost absent. This paper is made to fill up some of this gap and to get a wider picture of how people in African countries' health reacted to the shock that the financial crisis was when it hit Sub-Saharan Africa. It was also made to see how the outcomes differ, if they differ, in the parts in Africa that were more hit compared to the places that were not. By investigating infant mortality, suicide mortality and HIV effects will a fundamental research of the crisis and its health effects be done.

3.6 Hypothesis

From the earlier research theory and summary of the subject is the conclusion that the financial crisis could have had an impact on health in the Sub-Saharan African countries. Different sources suggest different things, such as it would differ depending on which uncertainties different countries had. The crisis could have had an impact on health in Africa though since they had rising unemployment, less trade and decreased aid. The decreased aid from some states could lead to a rising unemployment (European Parliament, 2009). This rising unemployment were correlated with the numbers in suicides during the crisis according to Hawton and Haw (2013). By taking the GDP differences from the eastern and southern Africa, compared to the western and central Africa, can a comparison be made on health's effect on the regions being influenced by the GDP shock that the financial crisis was, and the regions that were not. Sindzingre (2012) argued that the poverty trap is a relevant concept when trying to understand the effects of the crisis but that the countries show differences. The casualties and responses to this external shock are specific to every country and are affected by uncertainties. The results may vary from each country since the result could depend on which uncertainties each country has. From other studies can an expectation be done though, suggesting that health would get worse in places where GDP fell. Based on the presented background and theory, the following hypothesis are formulated:

I. Infant mortality was affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

II. Suicide mortality was affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

III. Prevalence of HIV was affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

4. Method

The method for the investigation and some method critique will be presented in this chapter.

4.1 Method of the investigation

The data in this method is consistent with panel data or *longitudinal data*. Panel data contains observations across different cross-section across different time (Woolridge, 2019). There is a cross-sectional dimension, with indicator *i* which refer to the countries, and a time series dimension indicated by *t*, which refer to the time where the observations took place. The data that is used include panel data for *N* (38) different countries during the period *t* 2007-2012, one year before the GDP fell and four years after the crisis hit.

Additionally, the countries where there was no data to be found were excluded since there was data missing. The models that are chosen include fixed effects. These are variables that are time-invariant and are the same for all cross-sectional units at a given time or a given year that allows us to conclude casual relationships (Woolridge, 2019). There is a need to include control variables, and the chosen ones are, unemployment, access to basic drinking water, access to basic sanitation, current health expenditures, incidence of tuberculosis, mortality rate attributed to poisoning and population growth.

Panel data is very beneficial (Hsiao, 2007). The advantages with panel data is that it contains more degrees of freedom (information supply) which allows us to have more accurate estimates. The opportunity that panel data gives us is that by having multiple observations for a given individual reduces the measurement errors and allows us to control for omitted bias. Panel data also acknowledges us for having individual heterogeneity and robustness (Hsiao, 2007). The panel data makes it practicable for us to study the dependent variable between 2007-2012. This makes it possible to see how the dependent variable changes during these years before and after the financial crisis (Stock & Watson, 2015).

4.1.1 Interaction model

To investigate the relationship between the GDP growth changes and health during the financial crisis we implement an interaction model which resembles a difference in difference regression will be conducted as follow:

$$Yit = \beta 0 + \beta 1After + \beta 2Treated\_countries_{it}\ (Treated\_countries \times after) + \beta 3xi_{it} + Y\ Fixed\ Effects_i + \varepsilon_t \quad (1)$$

The dependent variable Yit is infant mortality, suicide mortality and HIV in a specific time *t* and a specific country *i*. $After$ describes the year after the financial crisis and takes the value one for the year after 2010, 2011 and 2012 and zero for the years 2007, 2008 and 2009. *Treated_countries* indicate the countries who have been most affected by the financial crisis and had a GDP decrease, which is the Eastern and Southern Africa, they take the value 1. Western and Central Africa which was not affected by the financial crisis takes the value 0. *Treated_countries*After* is the interaction term and this is the variable who captures the effect on the dependent variable for the treated group after the financial crisis, who is indicated as *it_after* later in our result.

$Y\ Fixed\ Effects_i$ include all the time invariant a year-specific and a country-specific term. The last variable ε_t include all the unobserved characteristics and is our error term. There is a suspicion that different countries in Africa have different effects on the dependent variable (Bandara, 2010). Further is a thought that different years have different impacts on the dependent variable. Furthermore, the dependent variables have been checked for a Hausman test (see Appendix A) to see if random effects (RE) or fixed effects (FE) are suitable for this particular study. The result shows that null hypotheses were rejected and the conclusion from this is that FE is the most suitable method since RE is used if the Hausman test (Appendix A) does not reject (Wooldridge, 2019). The use of fixed effects regression can help to remove omitted variable bias since it looks at the effect of the GDP per capita growth within the countries and years. The fixed effects that are used in the regression are *countries* and *years.* They are variables assumed to be able to remove time invariant variables for infant mortality, infant suicide and prevalence of HIV (Kellogg Northwestern, n.d.).

4.1.3 Treatment group and control group

Different countries in Africa have been affected differently, and therefore has one control group and one treatment group been created. The countries in Sub-Saharan Africa are almost all developing countries (UNCTAD, n.d.) which motivates that the countries should be similar when exposed to a shock. By using an interaction model can a control group (western and central Africa where GDP stayed stable) and a treatment group (eastern and southern Africa where GDP decreased) be compared before and after the crisis. It means the difference in time

in the average difference of health changes in the two parts of Africa, where GDP growth sank and where it was not (Wooldridge, 2019). The motivation for the differences can be seen in *Figure 1*). The treatment group includes the countries that have been most affected by the financial crisis the years 2008 and 2009 and therefore takes the value 1. The control group are the countries that have not been affected or affected very little at all in the years 2008 and 2009 and therefore the value is 0. This sectioning is based on the graph seen in *Figure 1*. This is to see if there is any health difference before and after the financial crisis between countries in Sub-Saharan Africa.

The regression model will be based on four different models for each dependent variable. To see how the control variables affect the measured variables, the control variables will be added one by one. Model 1 is an outcome for an indicator after the crisis, with the years 2007-2012 with country and year FE. In model 2 is the independent variable GDP and all the controls added and FE for year and country. In model 3 a new variable was added; *treated_countries* and only keep year FE. In model 4 the interaction term (*it_after*) was added and kept the year fixed effects.

4.2 Method critique

4.2.1 Endogeneity problem

It is difficult to find causality when investigating the health outcomes differences. There is a risk with getting omitted variable bias, which can wrongly assume causality, and therefore is it fixed effects in the regression. Fixed effect means to hold one or more variables fixed, and an estimation of the effects from the observed variables. Even though the regression is controlling for fixed effects there could still be other things correlated with the dependent and independent variables and create omitted variable bias (Wooldridge, 2019). The result from the thesis should therefore be seen with awareness of this to not make wrong assumptions. Panel data is used to reduce the risk of endogeneity problems.

4.2.2 Test for multicollinearity

When two or more independent variables are highly correlated it is called *multicollinearity*. This issue makes it difficult to derive the change from a specific independent variable to eventual effects on the dependent variable and this can make it difficult to find a significant statistical effect. This is because of the effects multicollinearity has on the estimated standard

errors in a regression analysis. Multicollinearity can also be when two independent variables say the same thing, that it explains the same variety in the dependent variable (Wooldridge, 2019). Consequently, little sample variation in xj, or a strong linear relationship between xj and the other explanatory variables that is, multicollinearity can cause the heteroskedasticity-robust standard errors to be large (Wooldridge, 2019).

5. Data

In this section all information about the data and how it was collected will be presented. Our different variables will be presented together with data critique.

5.1 Data and sample

All data in the dataset for this paper is from the databank The World Bank. All dependent, independent and control variables are collected from there. The databases which have been used from the databank are the World Development Indicators (n.d.) and Health Nutrition and Population Statistics (n.d.). Data concerning development for countries in Africa has been taken from World Development Indicators (n.d.), GDP is the independent variable and is taken from there. World Development Indicators (n.d.) are the main and primary source the World Bank uses when collecting world indicators and it is available at global, national and regional level and internationally acknowledged (World Development Indicators, n.d.). Other indicators that you may think affect health and mortality, such as HIV, suicide mortality, access to basic drinking water, and unemployment are received from the database Health Nutrition and Population Statistics (n.d.). The data has been collected and then transferred to Excel where it was sorted. The data were then translated to panel data in Stata which then made the ground for building the regression model in the study. This also allows us to include fixed effects for measuring the causal effect of the regression. Fixed effects are used to ensure that the independent variables are not correlated.

5.1.1 Describing the sample

The data in this study has been collected from 38 countries in Africa. Due to insufficient data six countries were removed, and the countries which are in the north of Africa were removed since they are not a part of Sub-Saharan Africa. The countries in Africa not included in the study are: South Sudan, Seychelles, Djibouti, Eritrea, Somalia, Zimbabwe, the Democratic Republic of Congo, Madagascar, Sudan, Morocco, Algeria, Tunisia, Libya, Egypt, Cote d'Ivoire and Mauritius**.** The effect of the financial crisis between 2007 (one year before the crisis) to 2012 (3 years after the crisis). A table including the countries in Africa for this study can be found in Appendix B. Based on the data available and the time frame of the work, only countries in Sub-Saharan Africa are chosen to be compared, see *Figure 1* for motivation. A further study could have been done comparing developed countries and developing countries

to get a broader result, almost all countries in Sub-Saharan Africa are developing countries UNCTAD (n.d.). Furthermore, in Africa there are these large differences between countries, which can be interesting as one can get an idea of how a more developed country, as well as a less developed country in Africa has been affected.

5.1.2 Dependent variables

This paper has three dependent variables to evaluate the connection between the financial crisis and health. The choices have been made because we wanted to test for a shock and based on *Figure 1*, our motivation was that it would be interesting to check health effects where GDP fell compared to where it did not. It should be noted that there are variables that are not investigated in this thesis, for example life expectancy, that are also of interest but because of lack of time and data have been excluded. Even though there have been some excluded variables, the paper is made to have a comprehensive image over the consequences on health from the financial crisis. An explanation of every dependent variable comes below.

Mortality rate, infant (per 1,000 live births)

One of the three dependent variables is *infant mortality*, which is counted as the number of infant deaths by the children under one year old during one year per 1 000 births in the same year. The infant mortality rate is common as an indicator of health in a country (The World Factbook, n.d.). This variable seems interesting to study since a high GDP means low number of infant deaths (Kolbl, 2015).

Suicide mortality rate (per 100,000 population)

A second indicator for health is the *suicide mortality rate.* This indicator shows the number of suicide deaths per year per 100,000 population. Suicide is the fourth most common reason to death among people ages 15-19 (WHO, n.d., C).

Prevalence of HIV, total (% of population ages 15-49)

Lastly the variable *prevalence of HIV* measures the amount of population that have HIV by the population in the ages 15 to 49. According to WHO (n.d., B) is examples of conditions that put individuals to a great risk of contracting HIV unsafe blood transfusions and medical procedures and having unprotected sex. The variable is relevant since getting the increase in HIV prevention, treatment and care can help people live a healthy life.

5.1.3 Independent variable

The independent variable in this paper is *GDP per capita growth.* This is counted by taking the countries GDP and dividing them with the total population and comparing the growth from the year before (The World Bank, n.d., A). It is a variable that we think can show the economic effects of the financial crisis. GDP per capita growth is measured and not GDP per capita to measure what the change of the growth is rather than just the changes which gives a wider view in the financial crisis impacts on the countries. Also have estimates suggesting that the differences between GDP showed a small decrease. The GDP growth decrease was clear to see, and therefore also easily motivated.

5.1.4 Control variables

It is important to have control variables that are held constant during the regression. This since there is a risk that these variables influence the outcome when they are not supposed to. An example of a control variable could be to hold GDP growth constant when investigating if a program is effective (Bhandari, 2021). Since it has been difficult to find studies on exactly this subject, have the choice been to partly choose the control variables based on similar studies but also based on the data that has been available. The choice of control variables is also based on what preferences that seem to be relevant and interesting for this study and that are relevant when comparing the health between treated and untreated countries before and after the impact of the recession. The control variables used in this study are briefly presented below.

Unemployment, total (% of labor force)

The first variable that the thesis controls for is the amount of the population that are *unemployed*, which is the rate of people in the labor force that could be employed but are not (Anderson, 2022). This seems relevant to test for since according to Shah (2013) got people unemployed during the financial crisis.

People using at least basic drinking water services (% of population) & People using at least basic sanitation services (% of population) = Access to water and sanitation

What a big part of the population that has access to *basic sanitation and water* is controlled in this thesis. This means both basic sanitation and water and more complex systems (The World Bank 2022, C).

Current health expenditure (CHE) (% of GDP)

The regression is controlled for the country's *current health expenditures*. This tells how much countries spend on health, to fight conditions and diseases (WHO, n.d, D). Health care expenditures are for example important when trying to reduce infant mortality in Sub-Saharan African countries (Kiross et al., 2020).

Incidence of tuberculosis (per 100 000 population)

The *incidence of tuberculosis* means the cases of tuberculosis arising during a certain period at a rate of 100,000 people. That period is often a year. This data gives an indication of how much of a burden the disease is. This data is according to WHO (the World Health Organization) less rapid than if compared to the prevalence of mortality (WHO, n.d., E).

Mortality rate attributed to poisoning (per 100 000 population)

Additionally, the regression has one control variable that measures the *amount of people dying from unintentional poisoning* each year. This is an indication for how much pollution and chemicals there are in one country, but also how effective the health systems are in the countries. This is one cause-of-death statics just as the suicide rate, and they both tell us a lot about the actions of the public health in the countries and what they should focus on WHO, n.d., F).

Population growth (annual %)

The last control variable is the annual *population growth*. Population growth is the change in the population size per year and it is counted by taking the ratio between the increase of the population and the total population the given year. It is the differences between births and deaths and immigrants and emigrants according to the Global Health Observatory. (WHO, n.d., G). Population growth could for example cause healthcare difficulties. It could make it difficult to provide healthcare to everyone needed if the population grows faster than healthcare develops and grows (Fletcher, 2017).

5.1.5 Dummy variables

Another type of variables used in the regression done for this paper are dummy variables which are used to describe qualitative factors. Our *After* variable takes the value 1 for all the years after the financial crisis 2010-2012 and 0 for the years before the financial crisis 2007-2009.

We also have *treated_countries* which takes the value 1 for all the countries where GDP fell, and 0 for the rest.

5.2 Data critique

For those countries where data has been missing, all countries from the entire dataset have been removed and for those countries where only one year was missing, which makes the data balance. The dataset is balanced as it is easier to use the data in this way. To use balanced data means that *i* is used for each unit and measure this unit i for each period *T* and every *T* corresponds to one unit in the dataset (Baum, 2006). Even though it is easier to work with balanced data, the disadvantage of excluding variables from the dataset is that bias can occur, since some data are missing, because it is hard to establish that the results would be different if all countries were available. Lists on Rwanda and Burundi shows that they could both belong to central Africa but also to eastern Africa. By comparing different sources was the conclusion that they belong to eastern Africa. The aim was to collect data from a trustable source to give the most trustable results as possible. The data collected is from The World Bank, which is a trustable source, but there can never be hundred percent correct data, which is needed to remember when reading this research.

6. Results

In this section the studies' empirical results will be explained. The section includes an explanation for the result of the regression analysis.

6.1 Hypothesis I

I. Infant mortality was affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

The regression is used to see if there is a link between GDP per capita and infant mortality. The null hypothesis is formulated as follows. Infant mortality is not affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

Mortalityrate	Model 1	Model 2	Model 3	Model 4
2007	-0.212***	-0.220***	-0.154	-0.153
	(0.005)	(0.002)	(0.653)	(0.655)
2008	-0.399***	-0.415***	-0.280	-0.280
	(0.000)	(0.000)	(0.405)	(0.407)
2009	-0.663***	-0.664 ***	-0.555*	-0.553*
	(0.000)	(0.000)	(0.097)	(0.098)
2010	0.356***	0.401 ***	0.189	0.188
	(0.000)	(0.000)	(0.534)	(0.535)
2011	0.165 **	0 .191 ***	0.060	0.060
	(0.020)	(0.006)	(0.840)	(0.840)
2012	0	0	0	0
	(omitted)	(omitted)	(omitted)	(omitted)
After	-1.184***	-1.251 ***	-0.780**	-0.878***
	(0.000)	(0.000)	(0.019)	(0.011)
Gdppercapita		0.007	-0.016	-0.015
		(0.168)	(0.583)	(0.588)
Basicdrink		-0.026*	-0.045 ***	-0.045***
		(0.042)	(0.000)	(0.000)
Pop.o.65		0.335*	-0.474***	-0.484***
		(0.029)	(0.000)	(0.000)
Unemploy		-0.018	-0.075 **	-0.075**
		(0.471)	(0.026)	(0.024)
Popgrowth		-0.128	-0.158	-0.171
		(0.221)	(0.113)	(0.108)
Santation		0.033*	-0.011 *	-0.011
		(0.066)	(0.092)	(0.101)
Poisning		0.001	0.009	0.009
		(0.706)	(0.130)	(0.106)
Turbeculos		-0.000	0.002***	0.002 ***
		(0.219)	(0.000)	(0.000)
Healthexpen		0.001	0.097 *	0.095*
		(0.976)	(0.082)	(0.091)
Treat_countr			-2.375***	-2.500***
			(0.000)	(0.000)
It_after				0.265
				(0.472)
Cons	8.775***	8.814	11.854***	11.963***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	280	280	280	280
R^2	0.984	0.985	0.571	0.572
F-test	0.000	0.000	0.000	0.000

Table 1. Infant mortality.

The p-value is in each parenthesis and explains the p-value for each individual variable in the regression. *: significant at a 10 percent level. **: significant at a 5 percent level. ***: significant at a 1 percent level. The parentheses explain the p-value for each individual variable. See Appendix B for a complete list of all countries. Note 2012 is omitted because of collinearity. Also note when we add the variable *Treated_countries* R^2 decreases. This means that the variable predicts the model less.

The f-test is significant, which means that there is an explanatory power that is significant even though the independent variable is not significant. R^2 explains 0.984 of the x-variables variation and decreases as more variables are added.

In model 1 the after variable is significant at a 1% level. In model 2 when adding GDP, it is not significant at any level. In model 3 *treated_countries* are significant at a 1% level, but in model 5 when adding for *it_after* we can see that either of GDP of *it_after* is significant. We can say anything about the model.

There is, as seen, no significant difference in infant mortality, we can conclude that the financial crisis did not affect some countries more when looking at GDP. The null hypothesis can therefore not be rejected.

6.2 Hypothesis II

II. Suicide mortality is affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

The regression is used to see if there is a link between GDP per capita and Suicide in Africa. The null hypothesis is formulated as follow: Suicide is not affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

Suicide	Model 1	Model 2	Model 3	Model 4
2007	0.132	-0.125	0.638	0.645
	(0.858)	(0.827)	(0.597)	(0.587)
2008	0.289	0.036	1.309	1.315
	(0.639)	(0.940)	(0.302)	(0.297)
2009	0.340	-0.086	1.424	1.440
	(0.578)	(0.845)	(0.259)	(0.251)
2010	0.004	-0.266	-0.905	-0.909
	(0.994)	(0.562)	(0.595)	(0.592)
2011	-0.120	-0.290	-0.621	-0.621
	(0.852)	(0.562)	(0.723)	(0.721)
2012	0	0	0	0
	(omitted)	(omitted)	(omitted)	(omitted)
After	0.215	0.290	2.457	1.449
	(0.791)	(0.647)	(0.160)	(0.341)
Gdppercapita		0.047	-0.061	-0.060
		(0.186)	(0.529)	(0.547)
Basic drink		-0.394***	-0.205***	-0.205***
		(0.011)	(0.000)	(0.000)
Pop.o.65		0 .944	0.551	0.451
		(0.446)	(0.422)	(0.484)
Unemploy		-0.608***	0.635***	0.626***
		(0.011)	(0.000)	(0.000)
Popgrowth		3.113***	-3.608***	-3.740 ***
		(0.010)	(0.000)	(0.000)
Santation		0 .556***	0.033	0.035
		(0.014)	(0.274)	(0.245)
Poisning		0.024	0.199 ***	0.207***
		(0.193)	(0.000)	(0.000)
Turbeculos		0.012***	0.011***	0.011***
		(0.008)	(0.000)	(0.000)
Healthexpen		1.024***	-0.008	-0.031
		(0.016)	(0.964)	(0.871)
Treat_countr			0.129	-1.150
			(0.8839)	(0.316)
It_after				2.734
				(0.157)
Cons	7.058***	-13.680***	19.610***	20.729***
	(0.000)	(0.095)	(0.000)	(0.000)
Observations	280	280	280	280
R^2	0.962	0.975	0.716	0.720
F-test	0.000	0.000	0.000	0.000

Table 2. Suicide Mortality

The p-value is in each parenthesis and explains the p-value for each individual variable in the regression. *: significant at a 10 percent level. **: significant at a 5 percent level. ***: significant at a 1 percent level. The parentheses explain the p-value for each individual variable. See Appendix B for a complete list of all countries. R^2 describes the variation in suicede and

explains 0.936%. The F-test is significant at a 1% level and has the power to explain the regression even though the independent variable is not significant. Note 2012 is omitted because of collinearity. Also note when we add the variable *Treated_countries* R^2 decreases. This means that the variable predicts the model less.

In model 1 the variables after are not significant. Further in Model 2 when we add our independent variable, we can see it is not significant. When we look at model 3 when we add *treated_countries*, it is not significant. Followed by model 4 were either after or GDP is significant. We cannot say anything about the model.

In consideration to this we can conclude that the financial crisis did not affect some countries more when looking at GDP for suicide. The null hypothesis is therefore not rejected.

6.3 Hypothesis III

III. Prevalence of HIV was affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

The regression is used to see if there is a link between GDP per capita and Prevalence of HIV. The null hypothesis is formulated as follows. prevalence of HIV is not affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it was not.

Prevalence of Hiv	Model 1	Model 2	Model 3	Model 4
2007	-0.042	-0.085	0.141	0.145
	(0.653)	(0.226)	(0.824)	(0.816)
2008	-0.073	-0.144**	0.271	0.275
	(0.369)	(0.031)	(0.667)	(0.660)
2009	-0.077	0.206***	0.382	0.391
	(0.301)	(0.001)	(0.521)	(0.505)
2010	0.040	0.069	0.364	-0.366
	(0.578)	(0.266)	(0.588)	(0.582)
2011	0.035	0.031	-0.133	-0.133
	(0.716)	(0.655)	(0.847)	(0.844)
2012	0	0	0	0
	(omitted)	(omitted)	(omitted)	(omitted)
After	-0.13	-0.252***	0.668	0.071
	(0.194)	(0.013)	(0.334)	(0.911)
Gdppercapita		-0.008*	0.020	0.021
		(0.085)	(0.730)	(0.731)
Basicdrink		0.008	-0.037*	-0.037*
		(0.434)	(0.077)	(0.075)
Pop.o.65		0.473***	-0.828***	-0.887***
		(0.007)	(0.014)	(0.009)
Unemploy		-0.062***	0.289***	0.284 ***
		(0.013)	(0.000)	(0.000)
Popgrowth		0.263**	-0.949***	-1.027***
		(0.015)	(0.000)	(0.000)
Santation		0.039***	0.040***	0.041***
		(0.002)	(0.002)	(0.001)
Poisning		0.016***	0.719***	0.076***
		(0.000)	(0.000)	(0.000)
Turbeculos		0.006	0.009***	0.009***
		(0.496)	(0.000)	(0.000)
Healthexpen		0.074***	-0.196***	-0.209***
		(0.006)	(0.013)	(0.007)
Treat_countr			3.470***	2.713***
			(0.000)	(0.000)
It_after				1.618*
				(0.061)
Cons	1.901***	-2.229***	5.037***	5.699***
	(0.000)	(0.004)	(0.004)	(0.001)
Observations	280	280	280	280
R^2	0.998	0.998	0.830	0.833
F-test	0.000	0.000	0.000	0.000

Table 3. Prevalence of HIV

The p-value is in each parenthesis and explains the p-value for each individual variable in the regression. *: significant at a 10 percent level. **: significant at a 5 percent level. ***:

significant at a 1 percent level. The parentheses explain the p-value for each individual variable. See Appendix B for a complete list of all countries. Note 2012 is omitted because of collinearity. Also note when we add the variable *Treated_countries* R^2 decreases. This means that the variable predicts the model less.

The F-test indicates that there is an explanatory power that is significant within the regression. Even though it cannot be said anything about the result, the overall model is significant. R2 explains 0.998 of the x-variables variation and decreases as more variables are added.

In model 1 the variable *after* is not significant. In model 2 add our independent variable GDP is added and the controls variables and GDP was then significant at a 10% level, which means that one % increase in GDP leads to -0,08 decrease in prevalence of HIV. In model 3 *treated_countries* are significant at a 1%level. When *it_after* was added in model 3 after and then it was significant at a 10% level, but GDP was not significant so we can't say anything about the model.

This indicates that those countries who were most affected by the financial crisis, where the GDP went down, were more affected after the year of the financial crisis. Therefore, the null hypothesis is rejected and the conclusion is that the financial crisis did impact prevalence of HIV on a 10% significance level.

7. Discussion

Discussions about the results from the regression in this paper compared to the earlier studies will be presented in this chapter.

I. Did infant mortality get affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it did not?

The result was not significant. We find no evidence to conclude that there was more rise in infant mortality where GDP fell compared to where it did not even though estimates predicted an excess of infant deaths in 2009 in Sub-Saharan countries according to Rajmil et al. (2014). An investigation made by Cornia, et al. (2011), could explain the result. The authors suggested that the decreased GDP from the financial crisis had a lower effect on child mortality than expected. They explain this lower effect and that it comes from the fact that some countries only experienced a mild recession. Other reasons were that the rise in prices among the domestic food was also offset in many parts of the region and that the public expenditures and aid to the health sector had a rise. The financial crisis did have an impact on infant mortality in the continent according to Friedman and Schady (2012), which is the opposite of what this study suggests. Even though the results may be unclear, health care expenditures are important when trying to reduce infant mortality in Sub-Saharan African countries. They argue that the underdeveloped healthcare infrastructure needs to be improved to reduce infant mortality (Kiross et al., 2020). This could explain the result. The healthcare was bad so it could not get worse, or that would not show. Another option is that the result would not show until years after, making the result not significant.

III. Did the prevalence of HIV get affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it did not?

The result was not significant. We find no evidence to conclude that there was more rise in HIV where GDP fell compared to where it did not. The results from this paper do not confirm the hypothesis in the paper saying that prevalence of HIV should rise as an effect from the GDP decrease of the financial crisis. The hypothesis was based on thoughts that HIV would rise since decreased GDP led to less aid and healthcare. This could lead to less investment in HIV-healthcare, which could lead to an impact on the prevalence of HIV. The literature about HIV is limited, but according to Burke et al. (2014) are economic changes important factors to the epidemic of HIV. This cannot be confirmed by this paper.

II. Did suicide mortality get affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where it did not?

The result was not significant. We find no evidence to conclude that there was more rise in suicide mortality where GDP fell compared to where it did not. Suicide concequences have been investigated in Europe, the US etc. but not in Africa from our knowledge and suicides are according to Mars et al. (2014) a health problem in Africa and they inquire for more studies on the subject. Hawton and Haw (2013) argued that numbers in suicide exceeded during the crisis, which the result from this study cannot confirm, which could be because of different countries selected, different method used, other data chosen or for other reasons. An interesting investigation by Claveria (2022) was that there were high suicide rates in the southern region in Africa, a part of the region affected by the GDP decrease the most. That the result did not show the same result as Claveria could be explained that this paper has not investigated the effects at a country level.

Not one of the three null hypotheses can be rejected, which means that the results were not significant for any of the three health factors investigated in this study. Even though the financial crisis had a significant impact on the region (Odinakachi, 2011) could this result be explained by the fact that different countries have different vulnerability to shocks according to Allen and Giovannetti (2011). According to Bejenariu-Tudor & Mitrut (2016) can income shocks substantially affect individuals' health, but Kasekende et al. (2009) said the outcome of the financial crisis was not unitary in the continent.

Another paper that could explain this result is made by Sindzingre (2012) who investigated the poverty trap and how it could explain the effects from the financial crisis. The poverty trap could explain how the consequences from the results differ between different countries depending on which uncertainties they have. When comparing Sindzingre's analysis with the results in this study, countries depending on others could explain how poor countries got less affected than others. Maybe poor countries are less affected since they do not benefit from getting richer, making them not able to have a lot to "lose" when the economy goes down. This may explain how being stuck in the poverty trap reduces the risk of being influenced by economic shocks. Otker-Robe and Podpiera (2013) on the other hand suggested an increase in social costs from the crisis, unemployment among one of them. Unemployment leads to worse health and more mortality according to Wilson and Walker (1993), even though men tend to

be more affected. Another explanation for the lack of results could be the fact that there are both positive and negative effects cancel out, or just simply that the baseline health is low, making these sorts of shocks have no effect on health outcomes in these countries.

Bandara (2010) has another argument to why the impacts differed between countries, that it depends on how much economic integration the countries have with the rest of the world. This suggests that countries with more integration with other countries should be more influenced by the crisis, making the result differ around the easter and southern part of Africa. Berman and Martin (2012) also said that the vulnerability in the African countries depend on the trade finance by the countries of the trading countries. According to Sede and Ohemeng (2015) are healthcare expenditures and unemployment significant to the health factor life expectancy in Nigeria. This could maybe motivate that the financial crisis could influence health, since unemployment according to Otker-Robe and Podpiera (2013) was estimated to rise as a consequence from the crisis.

The vulnerability in developing countries with health issues arises when they are exposed to external shocks according to McGillivray et al., (2010). This could mean that some countries with health issues before got more vulnerable when the financial crisis hit, making the result between the countries differ since a lot of the countries probably have different quality in health care. This is confirmed by Kellecioglu (2008) saying that poverty rises and the gap between countries arises during the finance crisis and those with relative wealth recover faster.

8.Conclusion and further research

Firstly, a short recap will be presented of the purpose, research questions, method and data be presented. Secondly will conclusions from the regression compared to earlier studies be presented and then comes some suggestions for future research including improvements.

8.1 Conclusion

The purpose of this paper was to investigate the relationship between the GDP changes and infant mortality, suicide mortality and prevalence of HIV in Sub-Saharan Africa. The aim was also to investigate how it differed between eastern and southern Africa where GDP fell and western and central Africa where it did not. The intention was to answer the following questions:

- *Was infant mortality affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

- *Was suicide mortality affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

- *Was the prevalence of HIV affected more in the Eastern and Southern Africa where GDP decreased than in Western and Central Africa where GDP stayed stable?*

This was investigated through an interaction model regression. From Sindzingres' analysis about the poverty trap and statements from others' work, could three hypotheses be presented. All of them indicated that health got affected more in the eastern and southern Africa where GDP decreased than in western and central Africa where it did not, but it was not clear assumptions since different articles from before had different answers. This was investigated by studying the differences in the three indicators for health; suicide mortality, infant mortality and prevalence of HIV, and the data was collected from The World Bank.

The results were not significant and that means that it cannot be assumed that the GDP had an impact on the health where it GDP decreased compared to where it was not. The null hypothesis was not rejected. This result was not surprising since the conclusions from different sources

and earlier studies differ and are not totally unitary as well. By the analysis made by Sindzingre (2012) about the poverty trap can an explanation be made about the results. It explains how the predictions are unclear and depend on a lot from how each country is and not how it was hit by the GDP during the financial crisis 2009. Because of the differences in vulnerability between the countries in Africa the results are not unitary, and it may, from our conclusion, be the reason for the unclear result. Bandara (2010) also argued that the impacts from the financial crisis in Africa seem to differ between countries and that this depends on how much financial and economic integration the countries have with the rest of the world.

Suicide mortality, infant mortality and prevalence of HIV were not significant, saying that there was no change in those health factors by the treated countries compared to the untreated countries before and after the impact of the recession. According to Cornia, et al. (2011) had the financial crisis had a lower effect on child mortality than expected. This since some countries only experienced a mild recession. The domestic food prices rise was also offset in many parts of the region and the public expenditures and aid to the health sector had a rise. This could explain the result from the study.

It is important to remember that the results could have been different if another method was made or if other variables were chosen. The model is a simplification of reality, and it is therefore important to illustrate that there is a risk for sources of error in the study. It is probably more factors than the variables tested in the model that could have an impact on the health variables chosen, and there are probably more variables that could be used as health variables too that could show another result. The thesis has time dummies and region-dummies, but it could be time or country specific differences that the model cannot control for. Because of the time limitation, could not more tests be done to investigate the results further to see if the results were the same if there was a change in the model. The results may have been different if countries that were most affected by the GDP decrease were handpicked and not divided into two geographical groups in Africa but into two groups, for example; GDP decrease and GDP stable.

The conclusion is that the economic shock did not have any significant impact on the health factors measured in this study when comparing the health between treated and untreated countries before and after the impact of the recession. This can be explained by the poverty trap theory and Sindzingre (2012), arguing that different countries respond differently to shocks

since they have different uncertainties. Bandara (2010) also agreed on this, saying that the results depend on how integrated the countries are with the world or that the result would not show until years after, making the result not significant since the time frame was too short. One last theory we got is that there are both positive and negative effects that cancel out, making eventual effects on the treated countries not significant.

8.2 Further research

This paper is from our knowledge the first one investigating the connection between GDP and health factors between west/central Africa and east/southern Africa and even though the result was not significant, does this paper help to explain differences and understand that there are probably differences between countries. The limited timeframe made the time for searching on earlier research limited and therefore it is unclear if there are earlier research in this subject area. These limited findings also made it difficult to make a fully well-thought-out work since there have been obstacles in the way when writing and investigating. Each country could be investigated individually to get a clearer result.

This paper can hopefully contribute to future research, and a subject for future research could be to investigate the GDP impacts on health in Africa after the corona-pandemic, in countries where corona had much impact compared to where it had not. The data for that research will probably be available soon, which it was not during this project. In this thesis is the focus health, a later future subject to investigate could be focusing on aid and how it was impacted in different places depending on where the GDP fell. Another future research could be focusing on Europe vs. Africa, to investigate differences between developed countries and developing countries. Another more relevant subject could be the rising food prices and how different countries got affected by them. One last future research could be to investigate the health effects on a national level.

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Appendix

Appendix A

Hausman test

Model	P-value
H_0: Difference in coefficients not systematic	0.0042

Note: The result means that there is a 0.0042 probability that the variation in the models is because of randomness. The results show that random effects are not suitable for this study and that fixed effects are recommended to be used since the null hypothesis is rejected.

Appendix B

List on countries

Western Africa	Central Africa	Eastern Africa	Southern Africa	Countries in Africa not being studied*
No GDP fall Control group	No GDP fall Control group	GDP fall Treatment group	GDP fall Treatment group	Not studied
Burkina Faso Benin Cape Verde Gambia Ghana Guinea Guinea-Bissau Liberia Mauritania Mali Niger Nigeria Sierra Leone Senegal Togo	Angola Cameroon The Central African Republic Chad Republic of Congo Equatorial Guinea Gabon Sao Tome and Principe	Burundi Comoros Ethiopia Kenya Malawi Mozambique Rwanda Tanzania Uganda Zambia	Botswana Eswatini Lesotho Namibia South Africa	Algeria Cote d'Ivoire The Democratic Republic of Congo Djibouti Egypt Eritrea Libya Madagascar Mauritius Morocco Seychelles Somalia South Sudan Sudan Tunisia Zimbabwe

Note: *Countries in Sub-Saharan Africa that have lack of data and countries part of northern Africa, which is not a part of Sub-Saharan Africa.