Improving Food Security in Developing Countries: An Analysis of Multilateral Development Bank Finance

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24.05.2024

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International development: Theories, discourses, and practices

BSc International Relations and Organizations - Thesis

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Word count: 7994

Public Statement: Public

Abstract

Every day, thousands of people go to bed hungry, die of malnutrition, or do not know where their next meal is going to come from. Food security is a central topic of the United Nations Sustainable Development Agenda, but despite international attention to this topic, there is no sufficient improvement. In particular, Multilateral Development Banks (MDBs) are identified as potential actors to fill financial gaps for food security projects in developing countries. However, the existing literature has failed to carefully assess which aspects of MDB finance are most effective in improving food security. Thus, this research paper aims to answer the research question "*Which aspects of MDB finance are most suited to improve food security in developing countries and why?*". Using a quantitative approach, a cross-country, longitudinal analysis is applied to assess the effect different aspects of MDB finance have on national levels of food security. The results indicate that MDBs should focus on a higher number of projects per country rather than highly financed projects, as well as prioritize financial instruments of grants and technical assistance. However, no genuine effect of MDB finance on levels of food security could be established due to no statistical significance. Thus, the findings must be treated with caution. It is, therefore, crucial to further investigate the different aspects of MDB finance and their effects on levels of food security, to be able to make meaningful recommendations to the MDBs.

Table of Contents

1. Introduction and Problem Statement

Hunger and food insecurity are prominent global issues that remain unsolved. Looking at recent statistics, between 691 and 783 million people faced hunger in 2022 (United nations [UN], n.d.). Moreover, in 2024, still over 9000 people die from hunger every day (*The world counts*, n.d.). Against common beliefs, 90% of deaths related to hunger are not the result of conflicts or famines, but the consequence of a long-lasting, chronic lack of access to adequate food (Office of the High Commissioner of Human Rights [OHCHR], 2010). Access to adequate food, however, is a central human right (OHCHR, 2010).

Since the UN Millennium Declaration, states have officially committed to fighting hunger and food insecurity (OHCHR, 2010). Moreover, food security poses a central aspect of development, which is reflected in the second goal of the Sustainable Development Agenda (Viana et al., 2022, p. 1). The "zero hunger" goal embodies ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture by the target date of 2030 (Viana et al., 2022, p.1; UN, n.d.). However, achieving this goal requires a profound change in the global food and agriculture system (UN, n.d.).

Additionally, the growing threat of climate change increases the social relevance of this topic and the urgency of improving food security (Lipper et al., 2021, p. 1525; Millan et al., 2019, p. 2). Extreme weather events and increasing temperatures may, for example, reduce crop yields and livestock productivity (Millan et al., 2019, p. 2). Climate change and food systems are further intertwined having a reciprocal effect on each other. Food systems are not only affected by climate change, but a more efficient and sustainable production of food is essential to meet the 2°C climate commitments of the Paris Agreement and to mitigate the effects of climate change (International Fund for Agricultural Development [IFAD], 2015, p. 1; Millan et al., 2019, p. 2).

Therefore, financing that addresses the transformation of food systems is crucial to overcome vulnerabilities and improve food security (Lipper et al., 2021, p. 1525). The agricultural sector of developing countries is identified as a critical area of investment to improve food security (IFAD, 2015, p. 1). Growth in this sector has led to disproportionately large impacts on food security, as most people living in extreme poverty secure their livelihoods from this sector (IFAD, 2015, p. 1; Lipper et al., 2021, pp. 1525, 1526).

However, while threats to the agricultural sector and food security in developing countries remain a concern, investment needs have not been met (IFAD, 2015, p. 3).
Lipper et al (2021, p. 1525) argue that Multilateral Development Banks (MDBs) play an essential role in addressing these shortcomings in the financing of agri-food sector transformations. MDB support in developing countries can strengthen the agricultural sector and reduce food insecurity through the leverage of public finance, as well as technical assistance (IFAD, 2015, p. 2). Additionally, MDB activity can incentivize private actors to invest in the agricultural sector in developing countries, which can contribute to attaining the necessary levels of financing (Lipper et al., 2012, p. 1525).

Despite the crucial role MDBs can take in contributing to development, as well as increasing food security, the existing literature has not yet sufficiently examined what the optimal contribution of MDB finance towards enhancing food security looks like. Specifically, there has not been quantitative research analyzing the effects different types and magnitudes of MDB finance have on food security. Most existing research on the financing activities of MDBs has only focused on individual cases, for example on one bank in one region (Steffen & Schmidt, 2019, p. 80). Furthermore, there is no comprehensive compilation of cross-regional MDBs' financing activities in the sectors of agriculture and food. To find general guidelines for MDB finance in these sectors, it is, hence, crucial to further test and understand successes and failures to effectively use financial tools to improve food security (Havemann & Negra, 2020, p. 10).

To fill this gap in the literature, global patterns of MDB finance in the agricultural sector and their effects on levels of food security will be examined. This research paper, therefore, follows the research question "*Which aspects of MDB finance are most suited to improve food security in developing countries and why?*".

To answer the research question, this paper will first provide an overview of the existing theories surrounding food security and the role MDBs can play in supporting food security and the agricultural sector. Furthermore, the theoretical framework will give an overview of the hypotheses that will be tested to answer the research question. Next, the research approach and methodology will be presented, followed by a discussion of the results. Finally, the conclusion will review the findings and discuss possible limitations, as well as

recommendations for future research. This thesis uses a quantitative research approach, a longitudinal, cross-country analysis is conducted using the statistical software SPSS. The results of this research find that MDB finance does not have a significant effect on levels of food security.

2. Theoretical Discussion and Framework

The following section will review existing theories surrounding food security, MDBs, and the role MDBs can play in improving food security. Furthermore, the theoretical framework will set out the hypotheses used to assess the research question.

2.1. Theoretical Discussion

2.1.1. The Road to Food Security

According to the 1996 World Food Summit definition, food security is achieved when all people, always, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Manikas et al., 2023, p. 1). This definition has laid the foundation to capture food security in four dimensions: availability, access, utilization, and stability (Manikas et al., 2023, p. 1). Sen (1981) and Pinstrup-Andersen (2009, p. 5) emphasize the distinction between the availability of food and the physical and economic access to it, which captures the essence of food security.

In developing countries, the agricultural sector, which entails the production of crop and livestock, as well as fisheries and forestry, is imperative for food security, thus, it requires a primary focus in the development process (Dethier & Effenberger, 2012, p. 175). Low-income countries show large interactions between agriculture and other economic sectors, as agriculture aggregates income and labor force contributing to both income growth and poverty reduction, which improves food security (Dethier & Effenberger, 2012, pp. 175, 177).

However, a general interaction between economic growth and food security is debated (Fernandes & Samputra, 2022, p. 206). While some authors find a significant relationship between indicators of economic growth, such as GDP per capita, and the risk for food

insecurity (Yilmaz & Günal, 2023, p. 1), an extensive literature review found that 20% of investigated research papers did not support the argument for an association between economic growth and food security (Fernandes & Samputra, 2022, p. 216).

It can be argued that the root problem of food insecurity and poorly developed agricultural sectors lies in the lack of technical and economic possibilities (Dethier & Effenberger, 2012, p. 183). A barrier to the adoption of new technologies is exacerbated by the non-existence of functioning credit markets (p. 187). It is, hence, important to make inputs available to farmers and to generate locally specific knowledge (p. 187). Moreover, improving education about new seeds and technologies can positively impact agriculture and food security (p. 183). Investments in the transformation of food systems are key to improving food security (Lipper et al., 2022, p. 1525). Despite current investments being insufficient, finance from the public sector, for example through MDBs, plays a critical role in distributing capital needed to provide economic and technological opportunities (Millan et al., 2019, p. 19).

2.1.2. Multilateral Development Banks

MDBs are defined as International Organizations set up between three or more states to fund otherwise infeasible socioeconomic development projects (Mendez & Houghton, 2019, p. 3). Their activities consist of combining financial heft and technical knowledge to support borrowers in reconstruction, growth, or poverty reduction (Ahluwia et al., 2016, p. IX). Furthermore, MDBs are influential in shaping policies, as lenders may have to commit to implementing reforms and undertaking public investments to receive MDB finance (Buiter & Fries, 2002, p. 3, 20).

Given the high investment risks investors face in developing countries, public finance plays an important role here (Steffen & Schmidt, 2019, p. 75). According to the social view, public finance is imperative in compensating for market imperfections, such as the lack of private investment due to high risks (Levy-Yeyati, 2004, p. 4). Moreover, the development view (Levy-Yeyati, 2004, p. 6) assumes the need for public intervention in economies with scarce capital, public distrust, and fraudulent practices that slow down economic development. MDBs are key actors in the public sector and their ability to provide large-volume finance under attractive terms can address financing gaps in developing countries (Murphy & Parry, 2020, p. IV).

In particular, in the agri-food sector, authors see valuable chances for MDBs to address existing shortcomings. The International Fund for Agricultural Development (IFAD) (2015, p. 2) explains that MDBs leverage public finance to the agricultural sector in developing countries through development projects. They have a unique capacity to combine technical expertise and capacity building with financing, hence, MDBs can address many of the shortcomings identified with current financing for food systems (Lipper et al., 2021, p. 1537; van Gaal et al., 2023, p. 7). Van Gaal et al. (2023, p. 7), therefore, argue for MDBs to mobilize more capital to support the development of agricultural sectors and to improve food security.

In contrast to the opportunities identified for MDB finance, the results of existing regional research identified shortcomings in the effects of MDB finance. For instance, the effects of food security projects in Kenya, were found to fade out once funding stops (Wabwoba & Wakhungu, 2013, p. 7). However, Wabwoba and Wakhungu argue that levels of funding, as well as the transmission of knowledge and skills to local farmers, can improve outcomes and lead to longer-lasting impacts (p. 4).

Moreover, although many authors agree on the crucial role MDBs play in financing the development of the agricultural sector and improving food security, MDBs have also been critiqued for their institutional makeup and practices.

Head (2005, p.111) presents arguments about MDBs making use of inappropriate financial policies. As MDBs operate with a laissez-faire model of free market policies, critics believe that MDBs conceive of development as a narrow process of economic restructuring to stimulate economic growth (p. 111). Some projects and policies that are supported by MDBs promote, for instance, privatization in economies that are not yet suited for such processes (p. 112).

Salamah (2016, p. 923) adds that financial development institutions serve the political goals of Western states. The author argues that current standards of economic integration of low-income countries lead to higher impoverishment, while already rich countries benefit from low-income countries (p. 923). Moreover, Chang (2002) explains that the institutions and policies recommended for development differ from policies that were in place in the now-

developed countries when they were developing. The author argues that recommending unsuitable policies is a means for Western countries to maintain the status quo (Chang, 2002). MDBs' power to shape countries through conditionalities and dependencies may, thus, be abused. The problem of Western domination is further reinforced considering the remaining imbalance of capital shares and voting rights in many MDBs (Reisen, 2015, p. 297). However, recent developments in the MDB landscape demonstrate the growing influence of emerging economies in the global financial system through the establishment of two new MDBs, the NDB by the BRICS, and the AIIB by China (Larionova & Shelepov, 2016, p. 713).

2.1.2.1. Financial Instruments

MDBs use different financial instruments to deliver finance to recipient countries. The instrument chosen and its manner of delivery have an impact on the intended beneficiaries by influencing whether the finance reaches its intended goals, and whether additional finance is crowded in (Mustapha, 2022, p. 7). It is, thus, important to look at the different financial instruments MDBs give out and to assess which instruments are most suited to increase food security. This research paper will focus on the three most commonly used financial instruments: loans, grants, and technical assistance (Engen & Prizzon, 2018, p. 19).

A) Loans

Loans are transfers in cash or in kind, for which the recipient incurs legal debt, loans can be given out at market rate or concessional, which means that terms are more generous, for example through zero or low interest rates, and extended repayment schedules (Mustapha, 2022, p. 9). MDBs commonly offer loans with concessional rates to those countries that are not able to take out loans at market rates (Engen & Prizzon, 2018, p. 8).

B) Grants

Grants consist of transfers made in cash, goods, or services, for which no repayment is required (Mustapha, 2022, p. 10). Grants are commonly given out to vulnerable countries in need of financial support (Head, 2005, p. 134).

C) Technical Assistance (TA)

TA commonly refers to a hands-on approach to capacity building in organizations and communities (Scott et al, 2022). This approach involves the provision of guidance through coaching, consulting, professional development, site visits, and referrals to informational resources. TA can support the implementation of an innovation, practice, or policy, as well as enhance overall system capacities by empowering staff and improving organizational or system processes (p. 2). MDBs can, for instance, contribute to development by providing TA in areas where governments have limited expertise (Griffith-Jones & Kollatz, 2015, p. 4).

2.1.2.2. Which Financial Instrument is Best Suited to Improve Food Security?

This section presents arguments on the different financial instruments used by MDBs to promote development. Findings could indicate which financial instrument may be appropriate for food security projects.

The majority of MDB finance takes on the form of loans (Mustapha, 2022, p. 14). However, critics argue that MDBs should reduce or stop giving out loans because the current global financial system is mature, thus MDB loans are no longer needed (Head, 2005, p. 112). Ackerly (1995, p. 56), furthermore, raises the point that loans always pose a liability. Mustapha (2022, pp. 13, 14) adds that in contexts of equity and climate justice, financing used to achieve climate goals, of which food security and the agricultural sector are crucial components (Viana et al. 2021, p. 1), should not impose additional burden on those with lower levels of responsibility and less capability. The practice of making loans has been criticized for exacerbating debt levels, as loans must be repaid (Mustapha, 2022, p. 13). Debtor countries tend to prioritize loan repayments over other types of government expenditure given the potential negative legal, financial, and reputational effects associated with missing a debt payment (Mustapha, 2022, p. 14). This can particularly impact the poorest and most vulnerable in a country, who tend to be most affected by austerity measures used to get debt onto a sustainable path (p. 14).

Head (2005, p. 112) argues that, additionally, MDBs justify their existence with their mandate to reduce poverty. MDBs should support those countries that truly need financial support, which is better accomplished by giving grants rather than loans, thus grants should be increased (Head, 2005, pp. 112, 113, 135).

However, MDB lending still plays a crucial role in attracting private investors, as commercial lenders have a higher incentive to participate when MDBs form the lead lender (Head, 2005, p. 134). MDBs, moreover, rely in large parts on the "reflows", repayments of loans, for their resources (Head, 2005, p. 134). Griffith and Kollatz (2015, p. 8) argue that transactional costs can be higher with more complex instruments, therefore, the majority of MDB finance should be provided through loans. Mustapha (2022, p. 17) adds that if the alternative is that a project will be postponed or canceled, loans can still be necessary instruments. He emphasizes the importance of ensuring responsible borrowing and lending practices with the proper management of risks of debt (p. 17).

Head (2005, p. 135), furthermore, identifies TA as a crucial instrument and valuable contribution to development. Van Gaal et al. (2023, p. 9) add that MDBs should use TA to build capacities to implement government food system policies. Moreover, policy-based operations can be effective in driving more sustainable land management policies and investments (van Gaal, 2023, p. 9). However, Scott et al. found that many gains associated with TA did not sustain long-term, with most effects disappearing after some time (p. 10). TA, however, did yield larger and more sustainable progress with the groups that received the greatest dose of implementation support, other critical factors were leadership engagement and the staff's commitment (pp. 9, 10).

2.2. Theoretical Framework

The above discussed theories offer various standpoints on the role different aspects of MDB finance may play in increasing food security. This section presents the hypotheses that will be tested to answer the research question.

While there are differing opinions on the role MDBs should play in development finance and the financing of sectors of agriculture and food, numerous authors highlight the unique ability of MDBs to offer public finance to projects that are under-financed by the private sector. It is highlighted that the agricultural sector needs more investment to increase food security and resilience against climate change. These arguments lead to the first hypothesis:
H1: An increase in MDB finance is associated with an increase in food security.

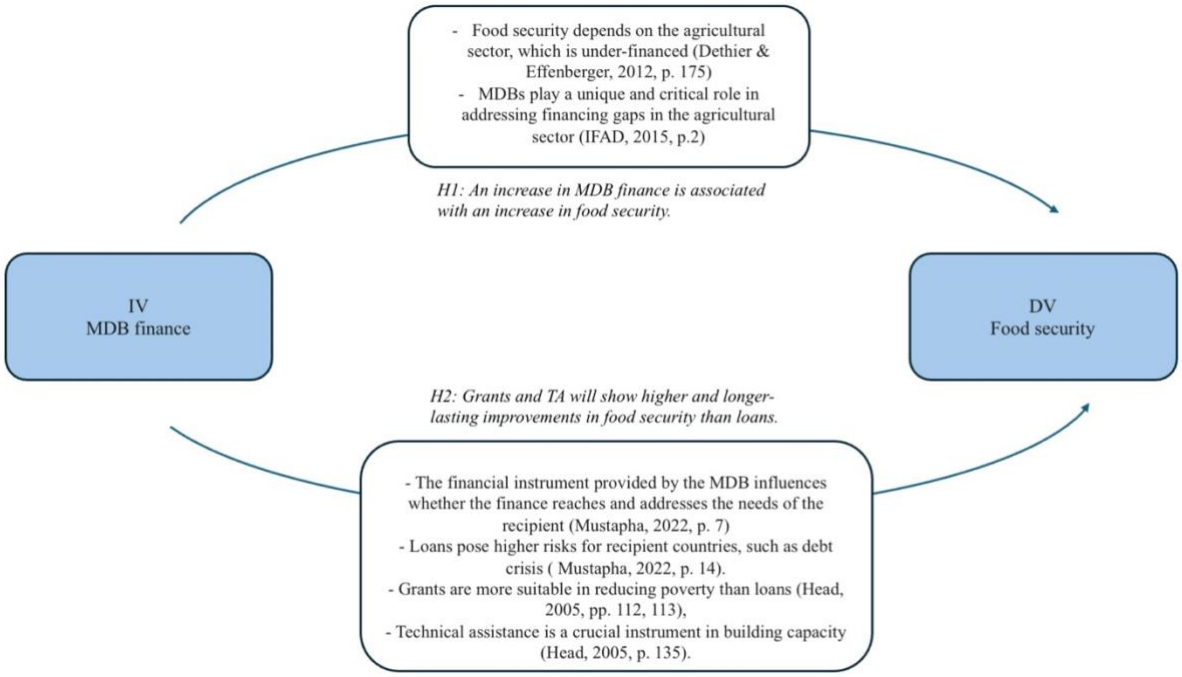
Moreover, financial instruments offered by MDBs differ greatly in their nature and conditions. As presented in the literature, in particular, the giving of loans is heavily criticized, as vulnerable countries may have difficulties paying back loans, which may affect the countries' economies and levels of food security in the long term. Moreover, it is argued that grants may be more successful in reducing poverty than loans. Furthermore, technical assistance (TA) is presented as an opportunity to convey knowledge and train decision-makers, thus, TA can be crucial in building the capacities of communities and governments in improving food security. Therefore, it is hypothesized that:

H2: Grants and TA will show higher and longer-lasting improvements in food security than loans.

The hypotheses are visualized in Figure 1.

Figure 1

Visualization theoretical framework



3. Research Design and Methodology

This section presents the research design and methodology chosen to answer the research question.

3.1. Research Approach

The research question is going to be answered using a quantitative approach. The large-N quantitative analysis is the best method for testing generalizations about complex causal relationships (Halperin & Heath, 2020, p. 252). Thus, it is well suited to analyze the effects of MDB finance on levels of food security. Quantitative analysis will help make robust generalizations about which aspects of MDB finance are most suitable to increase food security (Halperin & Heath, 2020, p. 252).

The quantitative analysis consists of a longitudinal design, as MDB projects may take a few years to be implemented and to show an impact (Nguyen & Bloom, 2006, pp. 19, 20). Therefore, levels of food security are assessed at three points in time after the year in which MDB finance was measured. This accounts for short-term, medium-term, and long-term effects. Moreover, levels of food security are compared to pre-MDB finance levels, which establishes a baseline comparison and helps avoid the risk of observing higher MDB activity in countries with lower levels of food security, because there is a higher need.

The approach of a cross-country analysis is suited to assess the general effects of MDB activities on food security and increases external validity. The results will allow for universal recommendations to MDBs regarding their most effective approaches.

To measure the strength and direction of the association between MDB activity and levels of food security, linear regressions are conducted. This, furthermore, allows for the inclusion of interaction terms, which assess the impact different types of financial instruments have on levels of food security.

3.2. Variables

3.2.1. Independent Variables (IVs)

Two IVs are included in separate regressions to operationalize MDB financing. Both variables are limited to MDB projects signed in 2013.

The first IV measures the amount of total MDB spending per country in the year 2013. To calculate the total amount of spending a country received, the individual project commitments of all projects in that country are added together. To account for different sizes in population, the spendings are, furthermore, divided by the total population. MDB spending is measured in million US$. The first IV, therefore, captures the total MDB spending per country per capita.

The second IV counts the amount of MDB projects a country received in 2013. This allows for comparisons between the effects of MDB activity on food security relative to either their magnitude of spending or their number of projects. Both of these variables are continuous.

To analyze the impact of different financial instruments on the effect of MDB finance on food security, dummy variables representing the most used (mode) type of instrument per country were created. All projects were assessed for their type of financial instrument, being either a loan, grant, technical assistance, mixed instruments, or “other” instrument. The mode type of instrument for each country was established and included as dummy variables. These dummy variables will be included in the regression as interaction terms. The IVs are multiplied with each dummy variable to establish the effect of MDB finance on food security depending on the type of financial instrument.

3.2.2. Dependent Variables (DVs)

To operationalize food security, the Global Food Security Index (GFSI) produced by the Economist Intelligence Unit (Manikas, 2023, p. 2) will be used. The GFSI is suitable, because an ideal food security indicator should capture all four dimensions of food security (Manikas, 2023, p. 2). The GFSI uses 69 indicators covering these four dimensions of availability, affordability (accessibility), quality and safety (utilization), and natural resources and resilience (stability) (p. 2). The GFSI has been produced every year between 2012 and 2022, including 113 countries and covering five regions: Asia Pacific, Europe, Latin

America, the Middle East, Africa, and North America (Economist Intelligence Unit, 2022, p. 3). Food security is measured on a scale from 0 to 100, with a value of 100 representing the maximum level of food security a country can achieve (p. 30). It is a continuous variable. Izraelov and Silber (2019, p. 1135) examined the GFSI and confirmed its appropriateness and accuracy to adequately measure food security on national levels. To account for short-, medium, and long-term effects, regressions with the DV measured in 2014, 2016, and 2019 are conducted.

3.2.3. Control Variables

The first control variable consists of levels of food security before MDB finance was measured. This means, that for the GFSI, the values of the GFSI in 2012 are added to the regression. This allows for a baseline comparison between levels of food security across countries before and after they received MDB finance. Moreover, the inclusion of food security levels pre-MDB finance provides temporal context to the analysis. Controlling for pre-existing trends or conditions of levels of food security across countries helps isolate the specific impacts of MDB finance on food security outcomes.

To consider possibly confounding variables, GDP per capita is, moreover, included in the regression as a control variable. For each regression model, the values of GDP per capita are included for the year in which the DV food security is measured. So, for each country, values for the GDP per capita for 2014, 2016, and 2019 are included. GDP per capita poses a valuable control variable, due to its possible relationship with food security. As discussed in the literature, economic growth may contribute to higher levels of food security. GDP per capita as an indicator of economic growth can, therefore, control for economic effects influencing levels of food security. Countries with a higher GDP per capita may possess more resources to address food insecurity. By controlling for GDP per capita, it is ensured that observed changes in food security can be attributed more accurately to MDB finance interventions rather than economic disparities.

3.3. Data Collection and Data Set

Data sets were created manually gathering data on MDB projects from the respective MDB websites. The selection of MDBs was guided by Engen and Prizzon's (2018, p. 9) list of MDBs. After excluding those banks, that did not provide sufficient project information, the

first data set collected project information from eight development banks (see Appendix A). A total of 197 projects were recorded, which corresponds to all projects in sectors related to agriculture or food signed by the included MDBs in the year 2013.

A second data set was created to adjust the MDB data to national levels instead of project levels. As the DV represents food security at national level, it is important to match the MDB data level. The number of MDB projects per country, as well as the total MDB spending per country were calculated and mode types of financial instruments included. Data for the GFSI is available for 52 countries out of 71 countries included in the data set, which gives a total N of 52.

Data for the population and GDP per capita were acquired from World Bank databases and values for the GFSI are provided by the Economist Intelligence Unit (see Appendix A).

The time frame encompasses the year 2013 for the MDB project data, as well as the years 2012, 2014, 2016, and 2019 to measure levels of food security. The choice of the time frame is motivated by three aspects. First, data availability is crucial. The GFSI was first conducted in 2012, thus, this was the earliest available year to measure food security with the GFSI. Second, while topics of agriculture and food disappeared from the development agenda in the 1980s and 1990s, they re-appeared in the first decade of the 21st century and re-gained relevance from then on (Dethier & Effenberger, 2012, p. 176). Third, priorities for choosing the time frame laid in the recency of the data, as well as the possibility of using a longitudinal approach, due to the nature of MDB projects. As the COVID-19 pandemic had negative effects on food security (Workie et al., 2020, pp. 5-6), it was crucial to investigate levels of food security before the outbreak of the COVID-19 pandemic in 2020 to avoid misleading results. Therefore, the year 2019 was chosen to assess long-term effects.

3.4. Assumptions

Before conducting and interpreting the regression analysis, the assumptions for linear regression were tested (see Appendix B). The tests involved checking collinearity statistics of VIF to avoid multicollinearity, investigating normal P-P plots to test for normality of the errors, the Durbin-Watson test was conducted to assess autocorrelation, a scatterplot was used to assess linearity and homoskedasticity, additionally, the data was checked for outliers and

influential cases. The assumptions were met, however, the scatterplots indicate heteroskedasticity, which could decrease the reliability of the regression (Field, 2017, section 6.7.2). Thus, results must be treated with caution.

4. Results and Discussion

The following section presents the results of the regressions conducted in pursuit of answering the two hypotheses identified in the theoretical framework. Moreover, the results are discussed and put into context. Each table presented below consists of six models, model 1 includes the DV for 2014, model 2 for 2016, and model 3 for 2019. Models 4 to 6 include the additional control variable GDP per capita, here model 4 includes the DV for 2014, as well as the control variable for 2014, model 5 includes the variables for 2016, and model 6 for 2019. The direct SPSS output can be found in Appendix B. As the results show no statistical significance, attempts were made to improve the outcomes by increasing the sample size and log-transforming the control variable GDP per capita. However, no improvements were achieved (see Appendix C).

4.1. Hypothesis 1

To test the first hypothesis *H1: An increase in MDB finance is associated with an increase in food security*, linear regressions will be conducted.

Table 1 includes MDB spending per capita as the IV, levels of food security in 2012 and GDP per capita as control variables, and levels of food security in 2014, 2016, and 2019 as the DVs. A separate regression is conducted for each DV.

Table 1

Regression results MDB spending per capita on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.413*** (1.183)	9.479*** (1.776)	27.906*** (2.254)	9.069*** (1.519)	11.894*** (2.499)	32.821*** (3.115)
GFSI 2012	.881*** (.027)	.881*** (.041)	.656*** (.052)	.819*** (.045)	.791*** (.077)	.473*** (.097)
MDB spending per capita	.014 (.052)	-.003 (.078)	-.037 (.100)	.012 (.051)	-.005 (.078)	-.056 (.096)
GDP per capita				.000 (.000)	.000 (.000)	.001 (.000)
R^2	.956	.906	.772	.959	.910	.793
Adj. R^2	.954	.902	.762	.956	.904	.780
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

Holding the effect for food security in 2012 constant, the coefficient for MDB spending per capita in model 1 indicates, that as spending increases by one unit, the level of food security increases by 0.014 units. This result is not statistically significant (p=.790). Thus, it is not possible to reject the null hypothesis of no statistically significant relationship between the variables. The coefficient for GFSI in 2012 indicates that a one-point increase in the GFSI in 2012 is associated with a 0.882-point increase in the GFSI in 2014. This is statistically significant at a 99% confidence level (t=32.457, p<0.001).

In model 2, holding the effect for food security in 2012 constant, the coefficient for MDB spending indicates, that as spending increases by one unit, the level of food security decreases

by 0.003 units. This result is not statistically significant (p=.973). The null hypothesis cannot be rejected. The coefficient for the control variable GFSI 2012 indicates that, as food security in 2012 increased by one unit, food security in 2014 increased by 0.881 units. This result is statistically significant at a 99% confidence level (t= 21.643, p<0.001).

In model 3, holding the effect for food security in 2012 constant, the coefficient for MDB spending indicates, that as spending increases by one unit, the level of food security decreases by 0.037 units. However, this result is not statistically significant (p=.712). Therefore, the null hypothesis cannot be rejected. The coefficient for the GFSI in 2012 indicates that a one-unit increase in the GFSI in 2012 is associated with a 0.656-unit increase in the GFSI in 2019. This is statistically significant at a 99% confidence level (t=12.685, p<0.001).

Models 4 to 6 include the respective control variable GDP per capita. For instance, model 4 contains the DV GFSI 2014 and correspondingly the control variable for GDP per capita in 2014. However, in all three models, the control variable does not show a significant relationship between GDP per capita and levels of food security.

As expected in H1, model 1 shows an increase in food security, as MDB spendings increase. However, in model 2 and 3 an increase in MDB spending is associated with a decrease in food security. This means that, over time, as countries received higher sums of MDB finance, their levels of food security decreased. This trend could be explained by the possible use of an inappropriate financial instrument. According to the theory, loans could, for instance, lead to an initial increase in food security, as financing was received, but in the long run, loans might lead to economic disadvantages through debt distress. This may impact food security negatively. However, as all models show no statistical significance for the effect of MDB spending on levels of food security, the results must be treated with caution. The statistical significance of a result shows that the IV has an effect on the DV (Field, 2017, section 2.9.10). If there is no statistical significance, there is no indication that an effect genuinely exists (Field, 2017, section 2.9.10). Thus, the majority of research papers interprets results with statistically not significant p-values as demonstrating no effect of the IV on the DV (Farrar et al., 2022).

The statistically significant, positive coefficients for the GFSI2012 control variable indicate that higher levels of food security in 2012 are associated with higher levels of food security in

the following years. However, as the coefficient decreases from 2014 (0.881) to 2019 (0.656) this association decreases as well. As GDP per capita and MDB spending do not have a statistically significant effect on levels of food security, there might be other factors or events that influence the GFSI score.

For all models, the values of R^2 and adjusted R^2 are high, as around 90% of the variance in the DV is explained by the IVs in the models for 2014 and 2016. This is because the control variable GFSI 2012 explains most of the variance in the DV giving the initial levels of food security. As, however, the adjusted R^2 value decreases for 2019 (adj. R^2=.772), this could indicate that as time passes, the initial levels of food security from 2012 do not predict the levels of food security as accurately anymore. Thus, levels of food security might vary due to factors not included in the regression model.

To, furthermore, account for the fact that multiple low-financed projects may have a different effect on levels of food security than one high-financed project, the second regression includes the number of MDB projects a country received as the independent variable. This allows to observe the effect of MDB finance on levels of food security isolated from the expenditure amount and helps broaden the observation of the effect of MDB finance on levels of food security. The results are displayed in Table 2.

Table 2

Regression results number of MDB projects on food security

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(Constant)	7.420*** (1.170)	9.352*** (1.745)	27.595*** (2.207)	9.118*** (1.501)	11.706*** (2.468)	32.123*** (3.082)
GFSI 2012	.878*** (.028)	.872*** (.041)	.641*** (.052)	.813*** (.046)	.785*** (.077)	.474*** (.096)
Number of MDB projects	.063 (.132)	.182 (.196)	.282 (.249)	.083 (.129)	.172 (.195)	.222 (.243)
GDP per capita				.000 (.000)	.000 (.000)	.001 (.000)
R^2	.956	.908	.777	.959	.911	.795
Adj. R^2	.954	.904	.768	.956	.905	.782
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

In table 2, all three models indicate a positive relationship between the number of MDB projects and levels of food security. For model 1, as the number of projects per country increases by one unit, the level of food security increases by 0.063 units (p=.633). In model 2, the coefficient for the number of projects per country is 0.182 (p=.359), in model 3 it is 0.282 (p=.263). This indicates that the level of food security in a country has increased over the years as the number of MDB projects per country increased in 2013. This may be due to projects taking time to be built or crops taking time to grow. In comparison to the results of Table 1, the increase in food security, instead of a decrease over time, could mean that a higher number of projects has a more positive effect on levels of food security, than particularly highly financed projects. This could be due to more regions being covered by

multiple projects, or multiple projects addressing different issues. However, as none of the results are statistically significant, discussions must be approached with caution.

The results of table 1 and 2 indicate that some types of MDB finance may be associated with improvements in levels of food security. Table 2, moreover, indicates that the magnitude of MDB spending might not be as determinant in improving levels of food security as the number of MDB projects in a country. However, *H1: An increase in MDB finance is associated with an increase in food security* cannot be answered confidently, as the results are not statistically significant.

4.2. Hypothesis 2

To test *H2: Grants and TA will show higher and longer-lasting improvements in food security than loans*, interaction terms for the different financial instruments and the IVs are included in regressions. Due to the sample size, the interaction terms are included in separate regressions, which, moreover, allows for assessing the unique contribution of each financial instrument to the relationship between MDB finance and levels of food security.

Table 3 presents the results of the regression assessing the impact loans have on the effect of MDB spending per capita on food security.

Table 3

Regression results interaction MDB spending per capita and loan on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.369***	10.971***	28.201***	9.825***	13.501***	33.216***
	(1.368)	(1.977)	(2.638)	(1.696)	(.782)	(3.311)
GFSI 2012	.889***	.876***	.665***	.805***	.782***	.477***
	(.028)	(.041)	(.055)	(.046)	(.074)	(.096)
MDB spending per capita	.070	-.101	.009	.050	-.104	.010
	(.108)	(.156)	(.209)	(.104)	(.154)	(.200)
loan	-1.161	-3.385	-2.250	-1.658	-3.422	-2.291
	(.856)	(1.239)	(1.665)	(.850)	(1.222)	(1.590)
MDB spending per capita * loan	-.043	.198	-.008	-.010	.199	-.034
	(.128)	(.185)	(.247)	(.123)	(.182)	(.236)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.959	.920	.785	.964	.924	.809
Adj. R^2	.956	.913	.767	.960	.915	.787
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

To find the effect of loans in MDB spending per capita, the main effect of MDB spending per capita has to be summed with the interaction effect. For model 1 this is 0.027 (p=.741). Thus, for MDB spending per capita using the financial instrument loans, a 1 unit increase in

MDB spending per capita leads to an increase of 0.027 units in food security. For model 2 the interaction effect is 0.097 (p=.289). In model 3 the observed value for the interaction effect is 0.001 (p=.974). Comparing these results to Table 1, MDB spending in the form of loans has a more positive effect on levels of food security than general MDB spending. This effect was the largest in 2016. These results do not confirm the idea that decreases in the levels of food security may be caused by finance being given out as loans. However, the results of the interaction terms are not statistically significant.

Table 4 includes the results for the interaction of MDB spending per capita and the financial instrument grants.

Table 4

Regression results interaction MDB spending per capita and grant on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.461***	9.641***	27.656***	9.059***	12.187***	32.642***
	(1.408)	(2.133)	(2.699)	(1.701)	(2.813)	(3.483)
GFSI 2012	.882***	.877***	.664***	.822***	.783***	.480***
	(.031)	(.047)	(.059)	(.048)	(.082)	(.102)
MDB spending per capita	-.006	.013	-.068	-.006	.013	-.085
	(.057)	(.086)	(.109)	(.056)	(.085)	(.105)
Grant	-.961	.439	-.938	-.880	.447	-1.014
	(1.234)	(1.870)	(2.369)	(1.215)	(1.852)	(2.281)
MDB spending per capita * grant	.167	-.118	.231	.153	-.135	.222
	(.161)	(.244)	(.308)	(.158)	(.242)	(.297)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.957	.907	.774	.959	.910	.795
Adj. R^2	.953	.899	.755	.955	.901	.773
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

For model 1, the effect of MDB spending in the form of grants is 0.161 (p=.304), for model 2 it is -0.105 (p=.630), and for model 3 0.163 (p=.458). In 2014 and 2019, these results show a more positive effect on levels of food security than MDB spending in the form of loans, however, in 2016 there was a decrease in food security when the financial instrument was a

grant. Overall, MDB spending in the form of a grant seem to have a more positive effect on levels of food security than general MDB spending observed in Table 1. However, these results are not statistically significant.

Table 5 presents the impact of technical assistance on the effect MDB spending per capita has on food security.

Table 5

Regression results interaction MDB spending per capita and technical assistance on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.460***	9.473***	28.076***	9.481***	11.985***	33.058***
	(1.184)	(1.763)	(2.256)	(1.529)	(2.501)	(3.109)
GFSI 2012	.873***	.873***	.639***	.796***	.779***	.454***
	(.028)	(.041)	(.053)	(.047)	(.079)	(.097)
MDB spending per capita	.033	.020	.001	.037	.022	-0.17
	(.054)	(.080)	(.103)	(.052)	(.080)	(.099)
Technical assistance	.988	.321	2.901	1.597	.747	3.122
	(1.356)	(2.019)	(2.845)	(1.349)	(2.022)	(2.732)
MDB spending per capita * technical assistance	.721	2.676	.278	.382	2.341	.040
	(1.512)	(2.252)	(2.985)	(1.476)	(2.242)	(2.865)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.958	.912	.782	.961	.915	.804
Adj. R^2	.954	.904	.763	.957	.906	.782
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

For model 1, the effect of MDB spending in the form of technical assistance on levels of food security is 0.754 (p=.636), for model 2 it is 2.696 (p=.241), and for model 3 it is 0.279 (p=.926). These results indicate that MDB spending in the form of technical assistance led to the largest positive effects on levels of food security. The value for 2016 shows the highest positive effect, while for MDB spending in the form of grants, a negative effect is observed for that year. Overall, the effects of loans and technical assistance were associated with only

increases in the levels of food security. Grants had more positive effects on levels of food security than loans in 2014 and 2019, but not in 2016. This partly corresponds with H2. However, as all results are statistically not significant, no conclusion can be drawn.

To further test the second independent variable of number of MDB projects per country, table 6 to 9 observe whether the number of projects with the most common type of financial instrument of these projects being a loan, grant, or technical assistance has an impact on the effect of levels of food security.

Table 6 presents the results for the regression assessing the effect of number of MDB projects on levels of food security when the majority of projects in a country was financed through a loan.

Table 6

Regression results interaction number of MDB projects and loan on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.699***	9.843***	27.848***	10.271***	12.393***	32.655***
	(1.174)	(1.705)	(2.196)	(1.557)	(2.480)	(3.287)
GFSI 2012	.886***	.887***	.654***	.796***	.796***	.487***
	(.028)	(.040)	(.052)	(.046)	(.076)	(.100)
Number of MDB projects	.013	.102	.270	-.003	.068	.143
	(.139)	(.201)	(.260)	(.132)	(.201)	(.261)
Loan	-1.125	-1.631	.362	-2.329	-2.325	-1.512
	(1.284)	(1.864)	(2.409)	(1.325)	(1.910)	(2.536)
Number of MDB projects * loan	-.035	-.335	-1.104	.348	-.040	-.367
	(.498)	(.723)	(.931)	(.502)	(.746)	(.983)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.959	.918	.794	.963	.921	.810
Adj. R^2	.955	.911	.776	.959	.913	.789
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

Model 1 shows that as the number of MDB projects per country, with the majority of the projects being a loan, increases by one unit, food security decreases by 0.022 units (p=.944). For model 2 there is a 0.233-unit decrease (p=.645) and for model 3 a 0.834-unit decrease (p=.242). These results differ from the results in table 2, which did not show a negative effect of an increase in the number of food projects per country on levels of food security over the years. For the number of MDB projects per country with the majority of MDB projects being loans, however, levels of food security decrease with the effect increasing over time. In this table the theory of MDB finance in form of loans having sub-optimal effects on levels of food security over time is somewhat reflected. The findings, moreover, differ from the results in table 3, where the spending amount of MDB finance in form of loans was assessed. However, these results are not statistically significant.

Table 7 presents the results on the effect an interaction between the financial instrument grant and the number of MDB projects per country has on levels of food security.

Table 7

Regression results interaction number of MDB projects and grant on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.512***	9.582***	27.597***	9.206***	12.014***	32.244***
	(1.417)	(2.113)	(2.624)	(1.706)	(2.792)	(3.402)
GFSI 2012	.877***	.868***	.647***	.811***	.779***	.477***
	(.032)	(.047)	(.059)	(.049)	(.082)	(.100)
Number of MDB projects	.055	.178	.182	.078	.170	.123
	(.140)	(.209)	(.260)	(.138)	(.208)	(.253)
Grant	-.409	-.480	-3.175	-.346	-.531	-3.319
	(1.565)	(2.334)	(2.899)	(1.534)	(2.316)	(2.804)
Number of MDB projects * grant	.120	.082	1.281	.094	.073	.1.293
	(.505)	(.753)	(.935)	(.495)	(.747)	(.904)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.956	.908	.786	.959	.911	.804
Adj. R^2	.953	.900	.767	.954	.902	.782
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

For model 1, as the number of MDB projects in a country with most of the projects being grants increases by one unit, levels of food security increase by 0.175 units (p=.813). For model 2 this value is 0.260 (p=.914), for model 3 it is 1.464 (p=.177). This shows that as the number of MDB projects in a country increases, with most of these projects using the financial instrument of a grant, levels of food security increase. This effect increases over time. The increase in the positive association could be due to the delay of effects on levels of food security after projects were signed, as projects need time to be implemented. The increase in levels of food security is larger than when MDB spending in the form of grants was measured. However, these results are not statistically significant.

Finally, table 8 presents the results on the interaction between the number of MDB projects per country and the financial instrument technical assistance.

Table 8

Regression results interaction number of MDB projects and technical assistance on food security

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Constant)	7.132***	9.611***	27.302***	9.132***	12.118***	32.298***
	(1.336)	(2.017)	(2.530)	(1.565)	(2.612)	(3.136)
GFSI 2012	.876***	.868***	.638***	.791***	.768***	.431***
	(.028)	(.042)	(.053)	(.047)	(.079)	(.097)
Number of MDB projects	.167	.069	.371	.266	.132	.540
	(.287)	(.434)	(.544)	(.280)	(.431)	(.521)
Technical assistance	2.143	1.389	3.922	3.025	2.181	6.024
	(1.551)	(3.342)	(3.244)	(1.541)	(2.373)	(3.192)
Number of MDB projects * technical assistance	-.285	.025	-.373	-.396	-.108	-.781
	(.336)	(.507)	(.646)	(.328)	(.509)	(.634)
GDP per capita				.000	.000	.001
				(.000)	(.000)	(.000)
R^2	.958	.909	.784	.962	.913	.810
Adj. R^2	.954	.901	.766	.958	.904	.789
N	52	52	52	52	52	52

Note: OLS regression coefficients with standard errors in brackets.
****p<0.001, **p<0.01, *p<0.05*

For model 1, as the number of MDB projects per country, with the majority of the projects being financed as technical assistance, increases by one unit, levels of food security decrease by 0.118 units (p= .446). In model two there is a 0.094-unit increase (p=.961), and in model 3 again a decrease of 0.002 units (p=.566). These results do not reflect H2, as countries that received MDB projects in mostly the form of technical assistance experienced first slight decreases in levels of food security, then an increase, and then again, a decrease. The positive effect in 2016 could be explained by delayed positive impact of policies, while the following decrease in 2019 could be due to policy discontinuity after political turnover. The results in this table, furthermore, differ from the results of table 5 showing that while as MDB spending in form of technical assistance increases, the number of MDB projects in a country majorly being technical assistance, results in fluctuations in levels of food security. However, these results are not statistically significant.

In attempts to answer *H2: Grants and TA will show higher and longer-lasting improvements in food security than loans* it can be said that with the IV number of MDB projects per country, the effects for loans were indeed worse than those for grants. However, the results for technical assistance did not correspond with the hypothesis. For the IV MDB spending, it is observed that technical assistance does have the largest positive effects on food security, while loans have the smallest positive effects and grants show larger positive effects than loans in 2014 and 2019, but a negative effect in 2016. Therefore, perhaps it could be concluded that if a country received multiple MDB projects, the majority of the projects being grants has the best effects on levels of food security. Moreover, as MDB spending increases, technical assistance has the largest positive effects on food security, thus, high financed projects might be most successful in form of technical assistance. As loans showed weak or negative effects on levels of food security for both independent variables, it could be interpreted that loans are not the ideal financial instrument to improve levels of food security. However, the discussed results are not statistically significant.

4.3. Summary of Findings

As the results show, an increase in MDB spending is not necessarily associated with an increase in levels of food security, in particular considering medium- and long-term effects. Considering the theoretical discussion and the deriving H1, this is quite surprising. However,

as the number of MDB projects in a country increases, levels of food security increase with the effect strengthening over time. These results indicate that MDBs should, perhaps, not focus on high amounts of spending, but on providing well-fitted projects that address multiple regions or issues.

The results were not clear regarding which financial instrument leads to the most desirable effects on levels of food security. While for an increase in MDB spending per capita, technical assistance shows the largest improvements in food security, this effect decreases in 2019 demonstrating the short-lived nature of the effects of technical assistance on levels of food security. This is in line with Scott et al.'s (2022) findings and highlights the importance of well-designed technical assistance to achieve longer-lasting effects. In contrast, as the number of MDB projects increases, projects in the form of grants do show long-lasting positive effects on levels of food security, confirming H2. Moreover, as MDB spending in the form of loans increases, there are only small effects on levels of food security, while as the number of MDB projects in the form of loans increases, there are only negative effects on levels of food security. This corresponds with the criticism raised towards loans. Hence, the results indicate that for smaller projects, grants may be the most appropriate financial instrument, while for larger projects technical assistance could be appropriate. However, there needs to be further research into the aspects of MDB finance and why some MDB projects lead to more positive effects than others. Moreover, none of the results were statistically significant, therefore, the hypotheses cannot be answered confidently, and no confident interpretation or recommendation can be formulated, as no genuine effect of MDB finance on levels of food security can be established.

Additionally, across all tables and models the coefficients for the baseline comparison of food security, the GFSI of 2012, indicates that higher levels of food security in 2012 are associated with higher levels of food security in the following years. The control variable GDP per capita, that was included as a possible confounding variable, moreover, did not show any relationship to levels of food security. Furthermore, while the values for R^2 and adjusted R^2 are high in all models, as GFSI 2012 explains most of the variation in the DVs, this effect decreases over time. This indicates that additional factors, such as environmental aspects, aid flows, or government spending on agricultural sectors, that are not included in the models, may influence levels of food security.

5. Conclusion

In attempts to answer the research question "*Which aspects of MDB finance are most suited to improve food security in developing countries and why?*" it can be stated that the results indicate differences in the effect on levels of food security among different MDB projects. It becomes clear that further investigation into the attributes of MDB finance is necessary to determine which recommendations can be made to MDBs. Due to the missing statistical significance, which means that no genuinely existing effect is measured, the possibility to draw conclusions is limited. However, looking at the coefficients, it could be interpreted that MDB finance in the form of multiple projects per country, may be associated with an increase in levels of food security. Moreover, the financial instruments grant and technical assistance may be better suited in achieving long-lasting positive effects on levels of food security than loans.

This research took upon a highly relevant topic, as food security is a crucial component of every human's life and particularly important in the development of countries. Moreover, the unique research approach investigating the effect different aspects of MDB finance may have on levels of food security is a valuable contribution to the research surrounding MDBs and the improvement of food security in general. However, this research also entails weaknesses. An impactful aspect is the time constraint, which limited the thoroughness of the investigation. The results may, for instance have been stronger if more aspects of MDB finance were included in the model. A possible addition would be the different types of loans, as loans come with varying conditions, or terms. Moreover, it could be that the impact of MDB finance could be more effectively measured on regional levels, instead of national levels. The close examination of levels of food security in regions where MDB projects were implemented could give more meaningful insights and allow for precise observations regarding the financial instruments of projects instead of using the mode value. A larger sample size, which couldn't be obtained due to the lack of available data from smaller MDBs, may also be crucial to improve the results. Perhaps including MDB finance of multiple years may be an option to improve the findings. Finally, the identification of possible confounding variables that could explain the variation in levels of food security over time should be extended.

While future research may benefit from taking this research design as a general guideline, the topic may be better investigated through the inclusion of more aspects of MDB finance, as well as more cases and a larger time period.

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Appendix A
Data Sources and Data Set

This appendix provides details on the data included in the data sets used to conduct the linear regressions. Moreover, screenshots of the data sets are provided.

1. Project Data

The project data was acquired from the eight, below listed, MDBs. All projects included in the data set were signed by the MDBs between the 1st of January 2010 and the 31st of December 2013. The project data on the websites could be filtered by sector, the most appropriate sector to observe finance towards food security was chosen for each MDB.

A) African Development Bank (AfDB)

For the AfDB projects from the sector "Agriculture and Rural Development" were included.

African Development Bank Group. (n.d.). Data Portal.
https://projectsportal.afdb.org/dataportal/
https://projectsportal.afdb.org/dataportal/

B) Asian Development Bank (ADB)

For the ADB, projects from the sector "Agriculture, natural resources and rural development" were included.

Asian Development Bank. (n.d.). What we do: Projects & tenders.
https://www.adb.org/projects?terms=

C) European Bank for Reconstruction and Development (EBRD)

For the EBRD, projects from the sector "Agribusiness" were included.

European Bank for Reconstruction and Development. (n.d.). Project summary documents.
https://www.ebrd.com/work-with-us/project-finance/project-summary-documents.html?keywordSearch=&as_sfid=AAAAAAX9LdWF561bsYqwu9mMBFCcGuw0EZAvgxuaWwNEqZ7kcnVu777HiPLdv9DlAz7BJcKfFo3MJhE45f0jpnbVau55m7l5ERc9C4lapWPMT8JIxsWOm7ywkueCu8KC_yZLr4MZhPYyodxLjDRD5Y

-VLfZcOf0wEIl6yrEZyUyROaR8-A%3D%3D&as_fid=d8d764aa69c7744667dbff18dd2eee18fbc1fdea

D) European Investment Bank (EIB)

For the EIB, projects from the sector "Agriculture, Fisheries, Forestry" were included.

European Investment Bank. (n.d.). All projects. https://www.eib.org/en/projects/all/index.htm?q=&sortColumn=statusDate&sortDir=desc&pageNumber=0&itemPerPage=25&pageable=true&language=EN&defaultLanguage=EN&=&or=true&yearFrom=&yearTo=&orStatus=true&orRegions=true&orCountries=true&orSectors=true

E) Inter-American Development Bank (IDB)

For the IDB, projects from the sector "Agriculture and Rural Development" were included.

Inter-American Development Bank. (n.d.). What's our impact. https://www.iadb.org/en/project-search

F) International Fund for Agricultural Development (IFAD)

For the IFAD, projects from all sectors were included, as the bank's key mission is to improve food security (IFAD, n.d.)

International Fund for Agricultural Development. (n.d.). Projects and programmes. https://www.ifad.org/en/web/operations/projects-and-programmes

G) World Bank

For the World Bank, projects from the theme level "Nutrition and Food Security" were included.

World Bank Group. (n.d.). Projects. https://projects.worldbank.org/en/projects-operations/projects-list?os=0

H) OPEC Fund for International Development (OFID)

For the OFID, projects from the focus area "Agriculture" were included.

OPEC Fund for International Development. (n.d.). Operations.
https://opecfund.org/operations/search-operations

1.1.National MDB data

To adjust the MDB data to national levels, the MDB spending per capita variable was computed using data from the World Bank providing each country's population.

World Bank Group. (n.d.). Population, total [Data Set].
https://data.worldbank.org/indicator/SP.POP.TOTL

2. Food security data

Data for the levels of food security in the respective countries and years was acquired from the Economist Intelligence Unit's GFSI.

Economist Intelligence Unit. (2012). Global food security index 2012.

Economist Intelligence Unit. (2014). Global food security index 2014.

Economist Intelligence Unit. (2016). Global food security index 2016.

Economist Intelligence Unit. (2019). Global food security index 2019.

Economist Intelligence Unit. (2022). Global food security index 2022.

3. Control variable

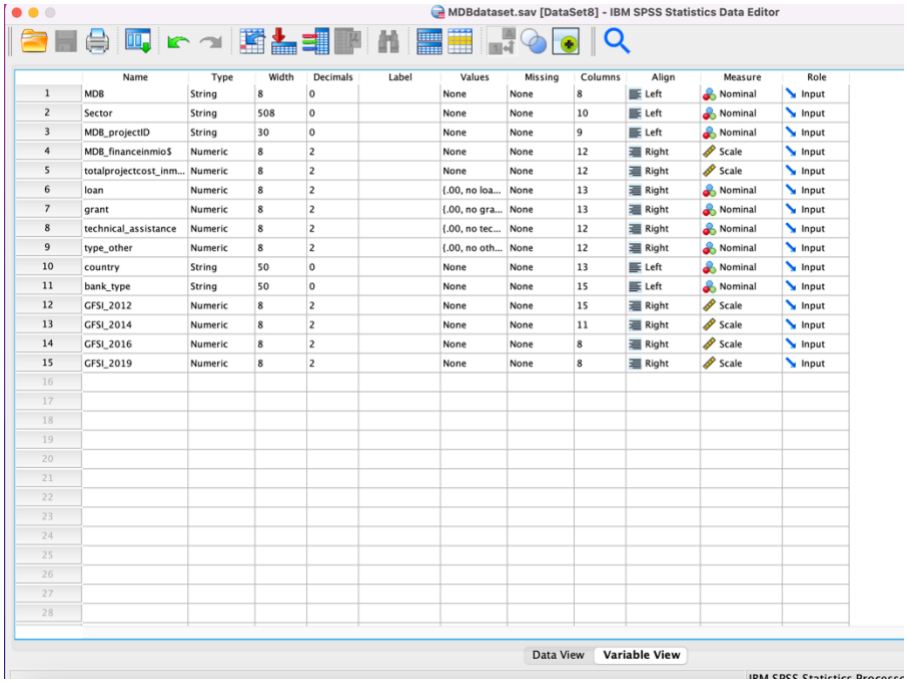
For the control variable GDP per capita, data provided by the World Bank was included into the data set.

World Bank Group. (n.d.). GDP per capita (current US$) [Data Set].
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

4. Screenshots Data Sets

Figure A1

Screenshot Data Set 1 Variable View



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2	Sector	String	508	0		None	None	10	Left	Nominal	Input
3	MDB_projectID	String	30	0		None	None	9	Left	Nominal	Input
4	MDB_financeinmio$	Numeric	8	2		None	None	12	Right	Scale	Input
5	totalprojectcost_inm...	Numeric	8	2		None	None	12	Right	Scale	Input
6	loan	Numeric	8	2		{.00, no loa...	None	13	Right	Nominal	Input
7	grant	Numeric	8	2		{.00, no gra...	None	13	Right	Nominal	Input
8	technical_assistance	Numeric	8	2		{.00, no tec...	None	12	Right	Nominal	Input
9	type_other	Numeric	8	2		{.00, no oth...	None	12	Right	Nominal	Input
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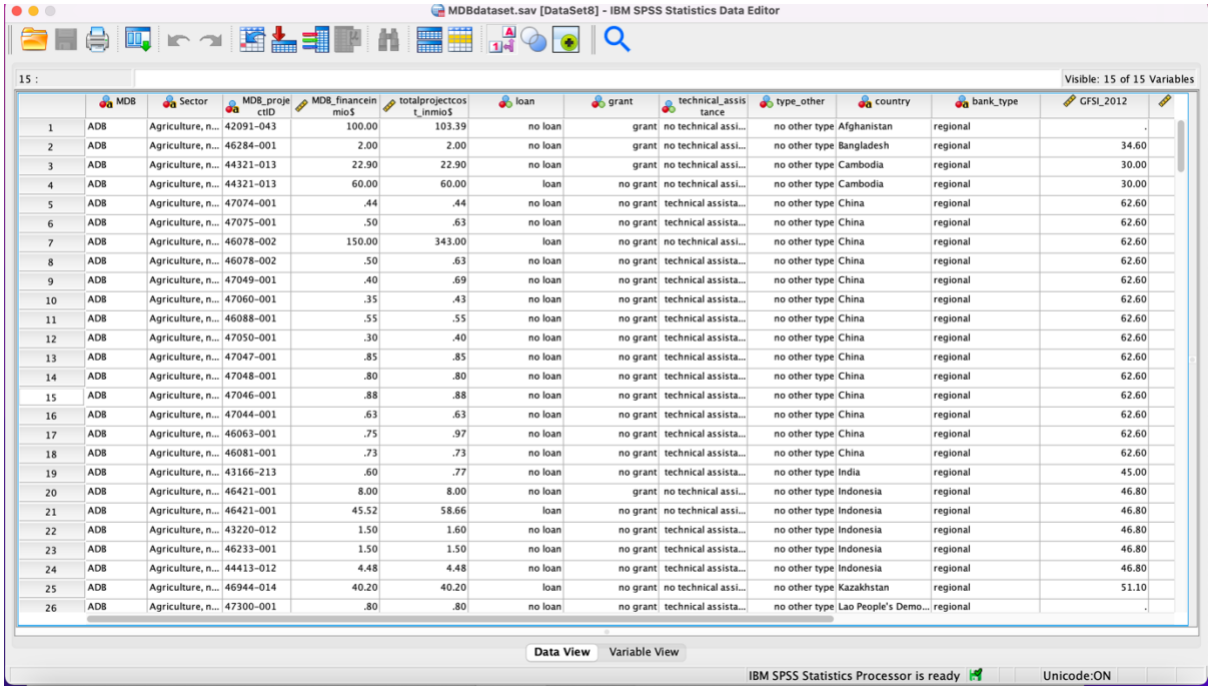
11	bank_type	String	50	0		None	None	15	Left	Nominal	Input
12	GFSI_2012	Numeric	8	2		None	None	15	Right	Scale	Input
13	GFSI_2014	Numeric	8	2		None	None	11	Right	Scale	Input
14	GFSI_2016	Numeric	8	2		None	None	8	Right	Scale	Input
15	GFSI_2019	Numeric	8	2		None	None	8	Right	Scale	Input

Figure A2

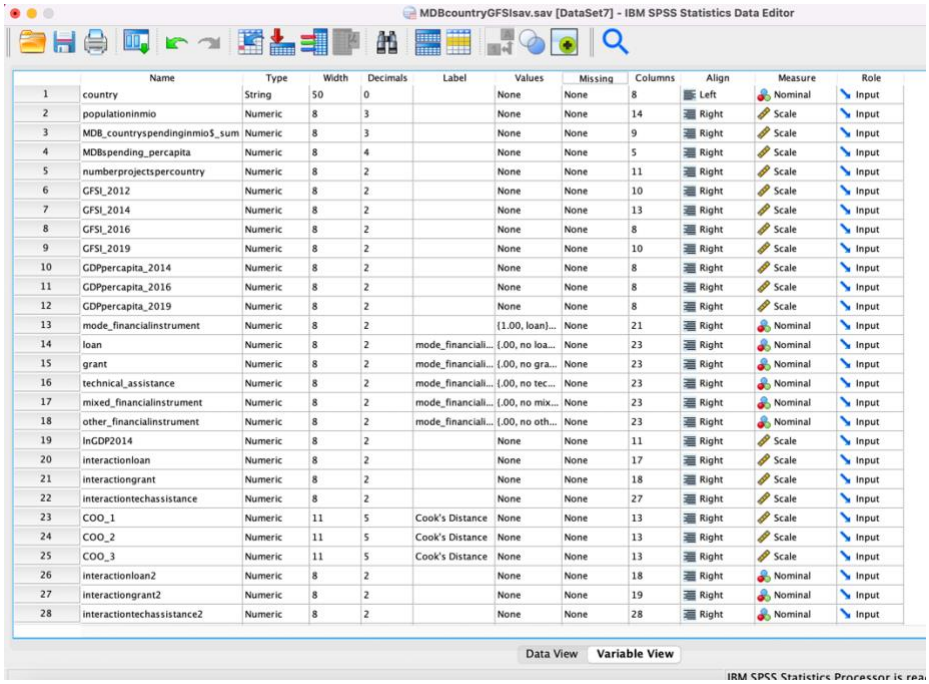
Screenshot Data Set 1 Data View



	MDB	Sector	MDB_projectID	MDB_financeinmio$	totalprojectcost_inmio$	loan	grant	technical_assistance	type_other	country	bank_type	GFSI_2012
1	ADB	Agriculture, n...	42091-043	100.00	103.39	no loan	grant	no technical assi...	no other type	Afghanistan	regional	.
2	ADB	Agriculture, n...	46284-001	2.00	2.00	no loan	grant	no technical assi...	no other type	Bangladesh	regional	34.60
3	ADB	Agriculture, n...	44321-013	22.90	22.90	no loan	grant	no technical assi...	no other type	Cambodia	regional	30.00
4	ADB	Agriculture, n...	44321-013	60.00	60.00	loan	no grant	no technical assi...	no other type	Cambodia	regional	30.00
5	ADB	Agriculture, n...	47074-001	.44	.44	no loan	no grant	technical assista...	no other type	China	regional	62.60
6	ADB	Agriculture, n...	47075-001	.50	.63	no loan	no grant	technical assista...	no other type	China	regional	62.60
7	ADB	Agriculture, n...	46078-002	150.00	343.00	loan	no grant	no technical assi...	no other type	China	regional	62.60
8	ADB	Agriculture, n...	46078-002	.50	.63	no loan	no grant	technical assista...	no other type	China	regional	62.60
9	ADB	Agriculture, n...	47049-001	.40	.69	no loan	no grant	technical assista...	no other type	China	regional	62.60
10	ADB	Agriculture, n...	47060-001	.35	.43	no loan	no grant	technical assista...	no other type	China	regional	62.60
11	ADB	Agriculture, n...	46088-001	.55	.55	no loan	no grant	technical assista...	no other type	China	regional	62.60
12	ADB	Agriculture, n...	47050-001	.30	.40	no loan	no grant	technical assista...	no other type	China	regional	62.60
13	ADB	Agriculture, n...	47047-001	.85	.85	no loan	no grant	technical assista...	no other type	China	regional	62.60
14	ADB	Agriculture, n...	47048-001	.80	.80	no loan	no grant	technical assista...	no other type	China	regional	62.60
15	ADB	Agriculture, n...	47046-001	.88	.88	no loan	no grant	technical assista...	no other type	China	regional	62.60
16	ADB	Agriculture, n...	47044-001	.63	.63	no loan	no grant	technical assista...	no other type	China	regional	62.60
17	ADB	Agriculture, n...	46063-001	.75	.97	no loan	no grant	technical assista...	no other type	China	regional	62.60
18	ADB	Agriculture, n...	46081-001	.73	.73	no loan	no grant	technical assista...	no other type	China	regional	62.60
19	ADB	Agriculture, n...	43166-213	.60	.77	no loan	no grant	technical assista...	no other type	India	regional	45.00
20	ADB	Agriculture, n...	46421-001	8.00	8.00	no loan	grant	no technical assi...	no other type	Indonesia	regional	46.80
21	ADB	Agriculture, n...	46421-001	45.52	58.66	loan	no grant	no technical assi...	no other type	Indonesia	regional	46.80
22	ADB	Agriculture, n...	43220-012	1.50	1.60	no loan	no grant	technical assista...	no other type	Indonesia	regional	46.80
23	ADB	Agriculture, n...	46233-001	1.50	1.50	no loan	no grant	technical assista...	no other type	Indonesia	regional	46.80
24	ADB	Agriculture, n...	44413-012	4.48	4.48	no loan	no grant	technical assista...	no other type	Indonesia	regional	46.80
25	ADB	Agriculture, n...	46944-014	40.20	40.20	loan	no grant	no technical assi...	no other type	Kazakhstan	regional	51.10
26	ADB	Agriculture, n...	47300-001	.80	.80	no loan	no grant	technical assista...	no other type	Lao People's Demo...	regional	.

Figure A3

Screenshot Data Set 2 Variable View



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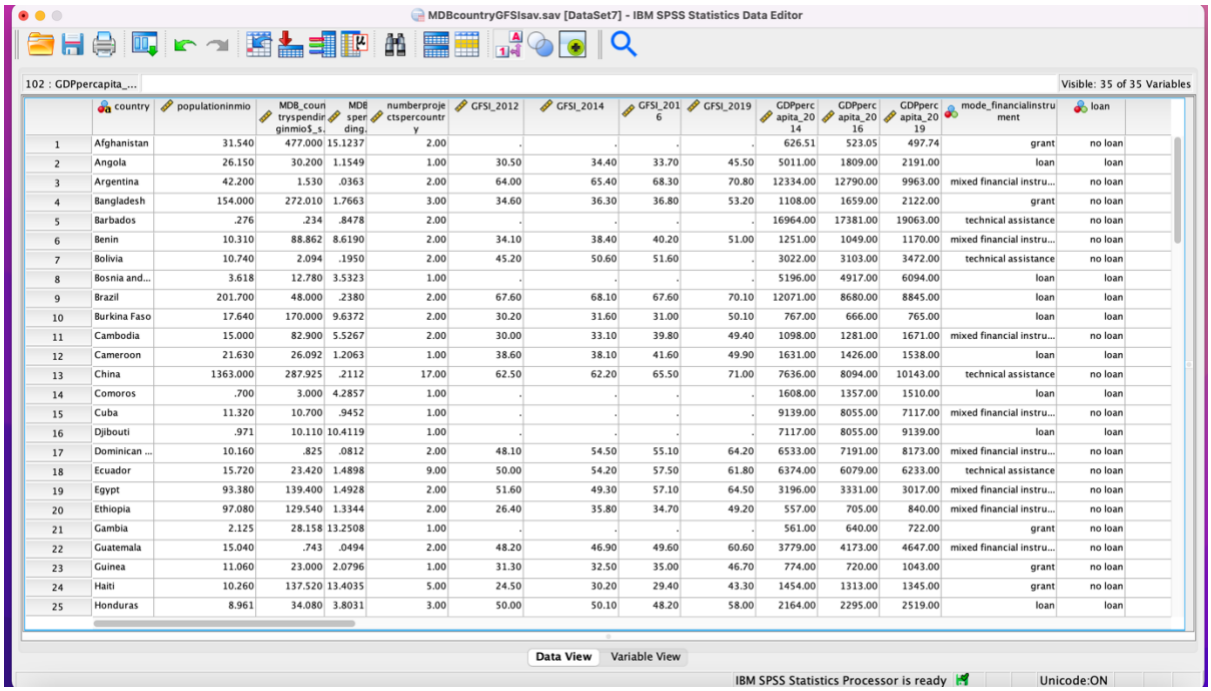
3	MDB_countryspendinginmio$_sum	Numeric	8	3		None	None	9	Right	Scale	Input
4	MDBspending_percapita	Numeric	8	4		None	None	5	Right	Scale	Input
5	numberprojectspercountry	Numeric	8	2		None	None	11	Right	Scale	Input
6	GFSI_2012	Numeric	8	2		None	None	10	Right	Scale	Input
7	GFSI_2014	Numeric	8	2		None	None	13	Right	Scale	Input
8	GFSI_2016	Numeric	8	2		None	None	8	Right	Scale	Input
9	GFSI_2019	Numeric	8	2		None	None	10	Right	Scale	Input
10	GDPpercapita_2014	Numeric	8	2		None	None	8	Right	Scale	Input
11	GDPpercapita_2016	Numeric	8	2		None	None	8	Right	Scale	Input
12	GDPpercapita_2019	Numeric	8	2		None	None	8	Right	Scale	Input
13	mode_financialinstrument	Numeric	8	2		{1.00, loan}...	None	21	Right	Nominal	Input
14	loan	Numeric	8	2	mode_financiali...	{.00, no loa...	None	23	Right	Nominal	Input
15	grant	Numeric	8	2	mode_financiali...	{.00, no gra...	None	23	Right	Nominal	Input
16	technical_assistance	Numeric	8	2	mode_financiali...	{.00, no tec...	None	23	Right	Nominal	Input
17	mixed_financialinstrument	Numeric	8	2	mode_financiali...	{.00, no mix...	None	23	Right	Nominal	Input
18	other_financialinstrument	Numeric	8	2	mode_financiali...	{.00, no oth...	None	23	Right	Nominal	Input
19	lnGDP2014	Numeric	8	2		None	None	11	Right	Scale	Input
20	interactionloan	Numeric	8	2		None	None	17	Right	Scale	Input
21	interactiongrant	Numeric	8	2		None	None	18	Right	Scale	Input
22	interactiontechassistance	Numeric	8	2		None	None	27	Right	Scale	Input
23	COO_1	Numeric	11	5	Cook's Distance	None	None	13	Right	Scale	Input
24	COO_2	Numeric	11	5	Cook's Distance	None	None	13	Right	Scale	Input
25	COO_3	Numeric	11	5	Cook's Distance	None	None	13	Right	Scale	Input
26	interactionloan2	Numeric	8	2		None	None	18	Right	Nominal	Input
27	interactiongrant2	Numeric	8	2		None	None	19	Right	Nominal	Input
28	interactiontechassistance2	Numeric	8	2		None	None	28	Right	Nominal	Input

Figure A4

Screenshot Data Set 2 Data View



	country	populationinmio	MDB_countryspendinginmio$_s...	MDBspending_percapita	numberprojectspercountry	GFSI_2012	GFSI_2014	GFSI_2016	GFSI_2019	GDPpercapita_2014	GDPpercapita_2016	GDPpercapita_2019	mode_financialinstrument	loan
1	Afghanistan	31.540	477.000	15.1237	2.00	.	.	.	.	626.51	523.05	497.74	grant	no loan
2	Angola	26.150	30.200	1.1549	1.00	30.50	34.40	33.70	45.50	5011.00	1809.00	2191.00	loan	loan
3	Argentina	42.200	1.530	.0363	2.00	64.00	65.40	68.30	70.80	12334.00	12790.00	9963.00	mixed financial instru...	no loan
4	Bangladesh	154.000	272.010	1.7663	3.00	34.60	36.30	36.80	53.20	1108.00	1659.00	2122.00	grant	no loan
5	Barbados	.276	.234	.8478	2.00	.	.	.	.	16964.00	17381.00	19063.00	technical assistance	no loan
6	Benin	10.310	88.862	8.6190	2.00	34.10	38.40	40.20	51.00	1251.00	1049.00	1170.00	mixed financial instru...	no loan
7	Bolivia	10.740	2.094	.1950	2.00	45.20	50.60	51.60	.	3022.00	3103.00	3472.00	technical assistance	no loan
8	Bosnia and...	3.618	12.780	3.5323	1.00	.	.	.	.	5196.00	4917.00	6094.00	loan	loan
9	Brazil	201.700	48.000	.2380	2.00	67.60	68.10	67.60	70.10	12071.00	8680.00	8845.00	loan	loan
10	Burkina Faso	17.640	170.000	9.6372	2.00	30.20	31.60	31.00	50.10	767.00	666.00	765.00	loan	loan
11	Cambodia	15.000	82.900	5.5267	2.00	30.00	33.10	39.80	49.40	1098.00	1281.00	1671.00	mixed financial instru...	no loan
12	Cameroon	21.630	26.092	1.2063	1.00	38.60	38.10	41.60	49.90	1631.00	1426.00	1538.00	loan	loan
13	China	1363.000	287.925	.2112	17.00	62.50	62.20	65.50	71.00	7636.00	8094.00	10143.00	technical assistance	no loan
14	Comoros	.700	3.000	4.2857	1.00	.	.	.	.	1608.00	1357.00	1510.00	loan	loan
15	Cuba	11.320	10.700	.9452	1.00	.	.	.	.	9139.00	8055.00	7117.00	mixed financial instru...	no loan
16	Djibouti	.971	10.110	10.4119	1.00	.	.	.	.	7117.00	8055.00	9139.00	loan	loan
17	Dominican ...	10.160	.825	.0812	2.00	48.10	54.50	55.10	64.20	6533.00	7191.00	8173.00	mixed financial instru...	no loan
18	Ecuador	15.720	23.420	1.4898	9.00	50.00	54.20	57.50	61.80	6374.00	6079.00	6233.00	technical assistance	no loan
19	Egypt	93.380	139.400	1.4928	2.00	51.60	49.30	57.10	64.50	3196.00	3331.00	3017.00	mixed financial instru...	no loan
20	Ethiopia	97.080	129.540	1.3344	2.00	26.40	35.80	34.70	49.20	557.00	705.00	840.00	mixed financial instru...	no loan
21	Gambia	2.125	28.158	13.2508	1.00	.	.	.	.	561.00	640.00	722.00	grant	no loan
22	Guatemala	15.040	.743	.0494	2.00	48.20	46.90	49.60	60.60	3779.00	4173.00	4647.00	mixed financial instru...	no loan
23	Guinea	11.060	23.000	2.0796	1.00	31.30	32.50	35.00	46.70	774.00	720.00	1043.00	grant	no loan
24	Haiti	10.260	137.520	13.4035	5.00	24.50	30.20	29.40	43.30	1454.00	1313.00	1345.00	grant	no loan
25	Honduras	8.961	34.080	3.8031	3.00	50.00	50.10	48.20	58.00	2164.00	2295.00	2519.00	loan	loan

Appendix B
Linear Regression Assumptions and SPSS Output

This appendix provides an exemplary overview of the linear regression assumptions and statistical output of the SPSS software. The thesis includes a total of 24 regressions, as each regression was run three times, once for each DV. Including all the SPSS output of all regressions would exceed the word file size limit to convert it to a pdf file, moreover, the output encompasses around 100 pages. Therefore, an exemplary selection is provided showing the assumptions and output for both IVs, as well as each IV with one interaction term.

1. Regression 1: IV MDB spending per capita, DV GFSI 2019, control variables GFSI 2012, GDP per capita 2019

1.1.Syntax

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT GFSI_2019
  /METHOD=ENTER GFSI_2012 MDBspendings_percapita
  /METHOD=ENTER GFSI_2012 MDBspendings_percapita GDPpercapita_2019
  /PARTIALPLOT ALL
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS DURBIN NORMPROB(ZRESID)
  /CASEWISE PLOT(ZRESID) OUTLIERS(3)
  /SAVE PRED ADJPRED COOK RESID ZRESID SRESID DRESID.
```

1.2.Output

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin–Watson
1	.878[a]	.772	.762	4.51307	
2	.890[b]	.793	.780	4.34297	2.098

a. Predictors: (Constant), MDBspendings_percapita, GFSI_2012

b. Predictors: (Constant), MDBspendings_percapita, GFSI_2012, GDPpercapita_2019

c. Dependent Variable: GFSI_2019

Autocorrelation: Durbin-Watson around 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3301.554	2	1650.777	81.049	<.001[b]
	Residual	977.653	48	20.368		
	Total	4279.207	50			
2	Regression	3392.723	3	1130.908	59.959	<.001[c]
	Residual	886.484	47	18.861		
	Total	4279.207	50			

a. Dependent Variable: GFSI_2019

b. Predictors: (Constant), MDBspendings_percapita, GFSI_2012

c. Predictors: (Constant), MDBspendings_percapita, GFSI_2012, GDPpercapita_2019

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	27.906	2.254		12.383	<.001		
	GFSI_2012	.656	.052	.879	12.727	<.001	.997	1.003
	MDBspendings_percapita	-.037	.100	-.026	-.371	.712	.997	1.003
2	(Constant)	32.821	3.115		10.537	<.001		
	GFSI_2012	.473	.097	.635	4.893	<.001	.262	3.817
	MDBspendings_percapita	-.056	.096	-.039	-.584	.562	.988	1.012
	GDPpercapita_2019	.001	.000	.286	2.199	.033	.260	3.839

a. Dependent Variable: GFSI_2019

Multicollinearity: VIF below 5

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	GFSI_2012	MDBspendings_percapita	GDPpercapita_2019
1	1	2.440	1.000	.01	.01	.07	
	2	.519	2.169	.02	.02	.93	
	3	.041	7.715	.97	.97	.00	
2	1	3.134	1.000	.00	.00	.03	.01
	2	.578	2.328	.00	.00	.88	.03
	3	.275	3.375	.05	.00	.07	.24
	4	.013	15.593	.94	.99	.01	.72

a. Dependent Variable: GFSI_2019

Casewise Diagnostics[a]

Case Number	Std. Residual	GFSI_2019	Predicted Value	Residual
70	-3.050	35.60	48.8450	-13.24501

a. Dependent Variable: GFSI_2019

One potential outlier

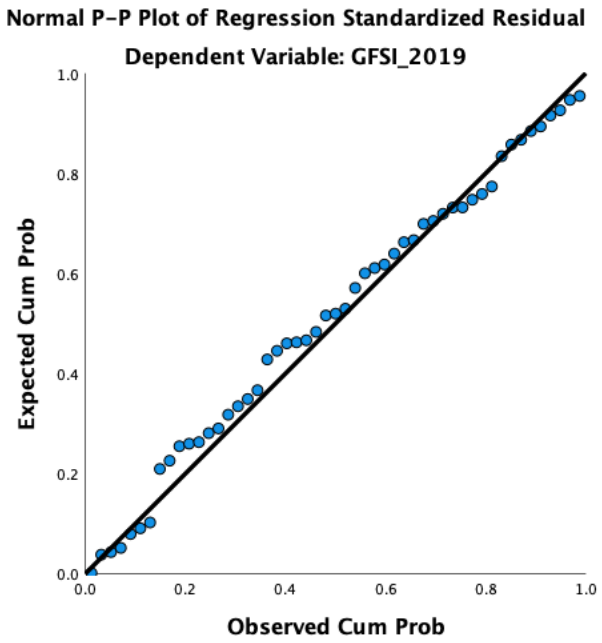
Residuals Statistics[a]

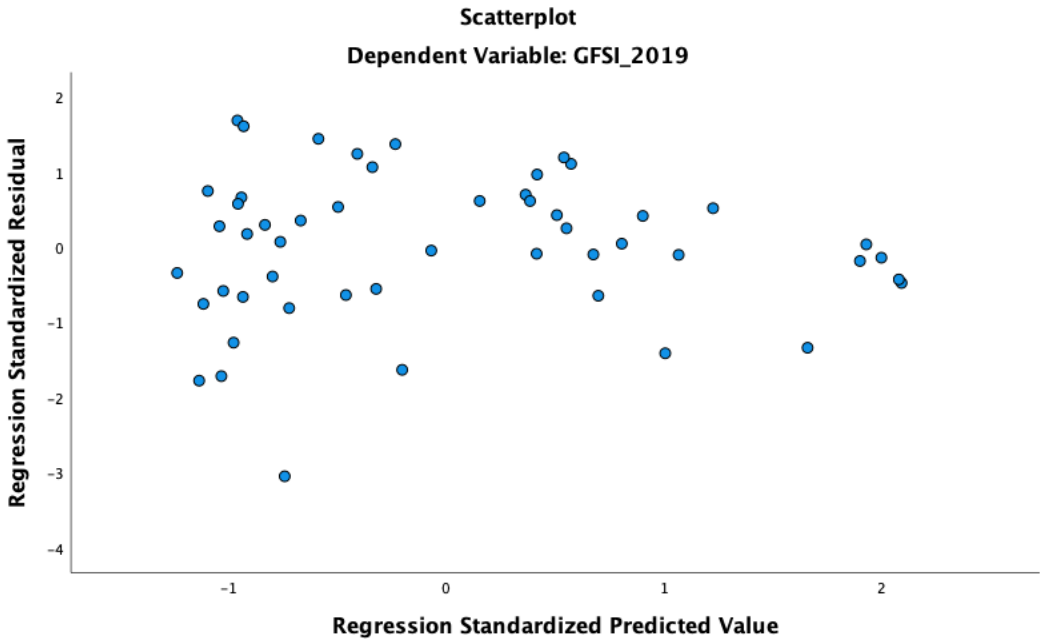
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	44.7813	72.1598	54.9529	8.23738	51
Std. Predicted Value	-1.235	2.089	.000	1.000	51
Standard Error of Predicted Value	.760	2.959	1.137	.437	51
Adjusted Predicted Value	44.9780	73.0498	55.0203	8.34016	51
Residual	-13.24501	7.34195	.00000	4.21066	51
Std. Residual	-3.050	1.691	.000	.970	51
Stud. Residual	-3.103	1.775	-.007	1.003	51
Deleted Residual	-13.71488	8.08969	-.06739	4.52026	51
Stud. Deleted Residual	-3.443	1.817	-.014	1.033	51
Mahal. Distance	.550	22.228	2.941	3.860	51
Cook's Distance	.000	.168	.019	.031	51
Centered Leverage Value	.011	.445	.059	.077	51

a. Dependent Variable: GFSI_2019

Influential cases: Cook's Distance no case greater than 1

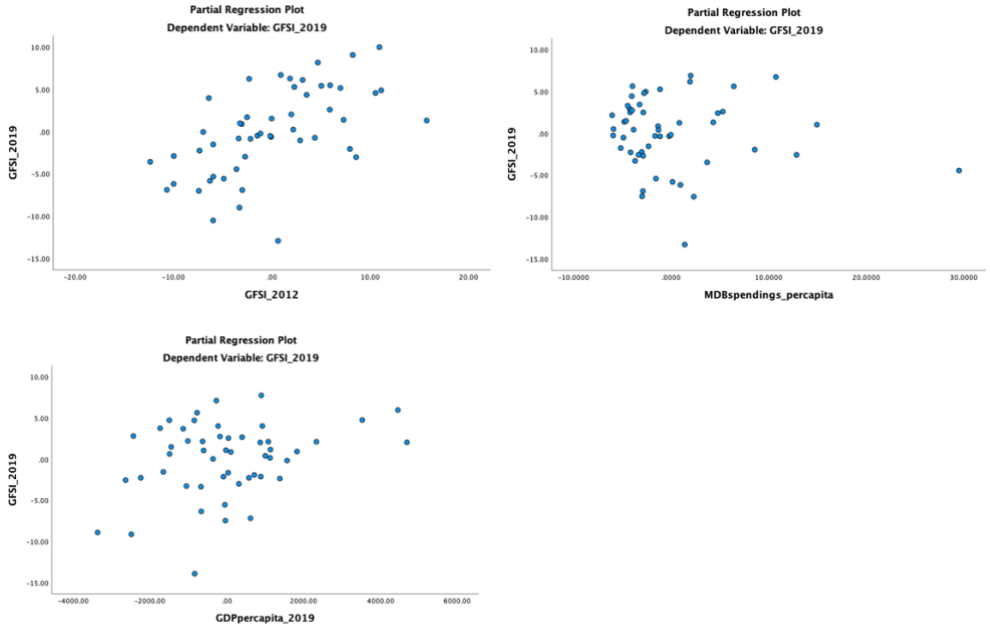
Normality of errors:





Heteroskedasticity: slight funnel shape

Non-linearity: there could be a bit of a curve shape -> check partial plots: no curvilinear relationship



2. Regression 2, IV: number of MDB projects, DV: GFSI 2014, control variables: GFSI2012, GDP per capita 2014

2.1.Syntax

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT GFSI_2014
  /METHOD=ENTER GFSI_2012 numberprojectspercountry
  /METHOD=ENTER GFSI_2012 numberprojectspercountry GDPpercapita_2014
  /PARTIALPLOT ALL
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS DURBIN NORMPROB(ZRESID).
```

2.2.Output

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin–Watson
1	.978[a]	.956	.954	2.36504	
2	.979[b]	.959	.956	2.31664	2.266

a. Predictors: (Constant), numberprojectspercountry, GFSI_2012

b. Predictors: (Constant), numberprojectspercountry, GFSI_2012, GDPpercapita_2014

c. Dependent Variable: GFSI_2014

Autocorrelation: Durbin-Watson around 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5989.350	2	2994.675	535.392	<.001[b]
	Residual	274.078	49	5.593		
	Total	6263.428	51			
2	Regression	6005.821	3	2001.940	373.022	<.001[c]
	Residual	257.607	48	5.367		
	Total	6263.428	51			

a. Dependent Variable: GFSI_2014

b. Predictors: (Constant), numberprojectspercountry, GFSI_2012

c. Predictors: (Constant), numberprojectspercountry, GFSI_2012, GDPpercapita_2014

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	7.420	1.170		6.341	<.001		
	GFSI_2012	.878	.028	.974	31.666	<.001	.943	1.060
	numberprojectspercountry	.063	.132	.015	.481	.633	.943	1.060
2	(Constant)	9.118	1.501		6.075	<.001		
	GFSI_2012	.813	.046	.901	17.553	<.001	.325	3.078
	numberprojectspercountry	.083	.129	.020	.645	.522	.936	1.068
	GDPpercapita_2014	.000	.000	.088	1.752	.086	.337	2.964

a. Dependent Variable: GFSI_2014

Multicollinearity: VIF below 5

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	GFSI_2012	numberprojectspercountry	GDPpercapita_2014
1	1	2.627	1.000	.01	.01	.05	
	2	.333	2.810	.04	.03	.94	
	3	.040	8.108	.95	.96	.01	
2	1	3.299	1.000	.00	.00	.03	.01
	2	.424	2.790	.00	.00	.59	.16
	3	.262	3.551	.07	.01	.36	.20
	4	.016	14.367	.92	.99	.02	.63

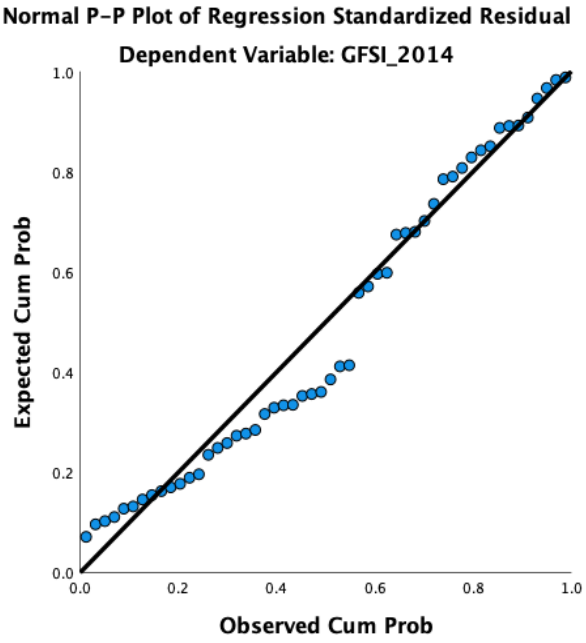
a. Dependent Variable: GFSI_2014

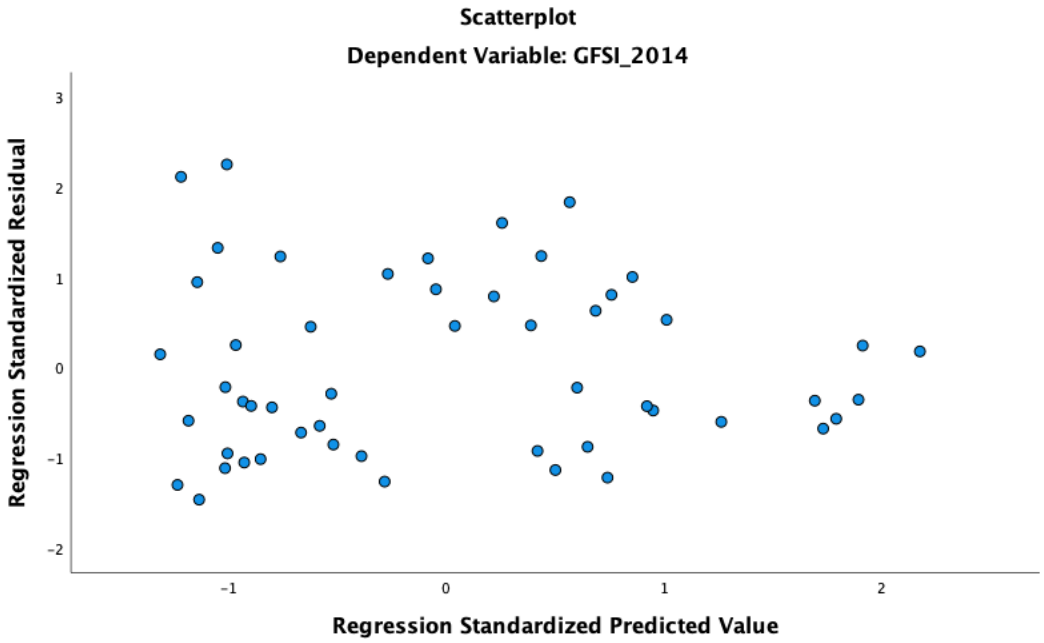
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	29.8616	67.6870	44.1058	10.85178	52
Residual	-3.39936	5.22197	.00000	2.24747	52
Std. Predicted Value	-1.313	2.173	.000	1.000	52
Std. Residual	-1.467	2.254	.000	.970	52

a. Dependent Variable: GFSI_2014

Normality of errors:





Heteroskedasticity: slight funnel shape

3. Regression 3: Interaction term MDB spending per capita and loan, DV: GFSI 2016, control variables: GFSI2012, GDP per capita 2016

3.1.Syntax

```
REGRESSION
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  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT GFSI_2016
  /METHOD=ENTER GFSI_2012 MDBspendings_percapita loan interactionloan
  /METHOD=ENTER GFSI_2012 MDBspendings_percapita loan interactionloan GDPpercapita_2016
  /PARTIALPLOT ALL
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS DURBIN NORMPROB(ZRESID).
```

3.2.Output

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin–Watson
1	.959[a]	.920	.913	3.35854	
2	.961[b]	.924	.915	3.31358	2.077

a. Predictors: (Constant), interactionloan, GFSI_2012, mode_financialinstrument=loan, MDBspendings_percapita

b. Predictors: (Constant), interactionloan, GFSI_2012, mode_financialinstrument=loan, MDBspendings_percapita, GDPpercapita_2016

c. Dependent Variable: GFSI_2016

Autocorrelation: Durbin-Watson around 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6074.548	4	1518.637	134.633	<.001[b]
	Residual	530.151	47	11.280		
	Total	6604.699	51			
2	Regression	6099.629	5	1219.926	111.106	<.001[c]
	Residual	505.070	46	10.980		
	Total	6604.699	51			

a. Dependent Variable: GFSI_2016

b. Predictors: (Constant), interactionloan, GFSI_2012, mode_financialinstrument=loan, MDBspendings_percapita

c. Predictors: (Constant), interactionloan, GFSI_2012, mode_financialinstrument=loan, MDBspendings_percapita, GDPpercapita_2016

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	10.971	1.977		5.549	<.001		
	GFSI_2012	.876	.041	.946	21.351	<.001	.870	1.149
	MDBspendings_percapita	-.101	.156	-.057	-.650	.519	.224	4.459
	mode_financialinstrument=loan	-3.385	1.239	-.146	-2.733	.009	.597	1.675
	interactionloan	.198	.185	.108	1.072	.289	.168	5.959
2	(Constant)	13.501	2.570		5.252	<.001		
	GFSI_2012	.782	.074	.845	10.573	<.001	.260	3.841
	MDBspendings_percapita	-.104	.154	-.058	-.677	.502	.224	4.459
	mode_financialinstrument=loan	-3.422	1.222	-.148	-2.799	.007	.597	1.675
	interactionloan	.199	.182	.109	1.093	.280	.168	5.959
	GDPpercapita_2016	.000	.000	.119	1.511	.138	.270	3.698

a. Dependent Variable: GFSI_2016

Multicollinearity: value above five for interactionloan, could be due to inclusion of the main effects

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	GFSI_2012	MDBspendings_percapita	mode_financialinstrument=loan	interactionloan	GDPpercapita_2016
1	1	3.462	1.000	.00	.00	.01	.02	.01	
	2	.941	1.918	.01	.02	.03	.00	.06	
	3	.470	2.714	.00	.00	.06	.57	.00	
	4	.098	5.938	.01	.13	.54	.25	.53	
	5	.028	11.072	.97	.84	.36	.15	.41	
2	1	4.047	1.000	.00	.00	.01	.01	.00	.01
	2	1.066	1.948	.00	.00	.03	.01	.05	.02
	3	.484	2.892	.00	.00	.05	.58	.00	.01
	4	.323	3.540	.03	.00	.04	.00	.03	.22
	5	.068	7.700	.02	.02	.79	.36	.81	.12
	6	.012	18.338	.94	.98	.08	.04	.10	.63

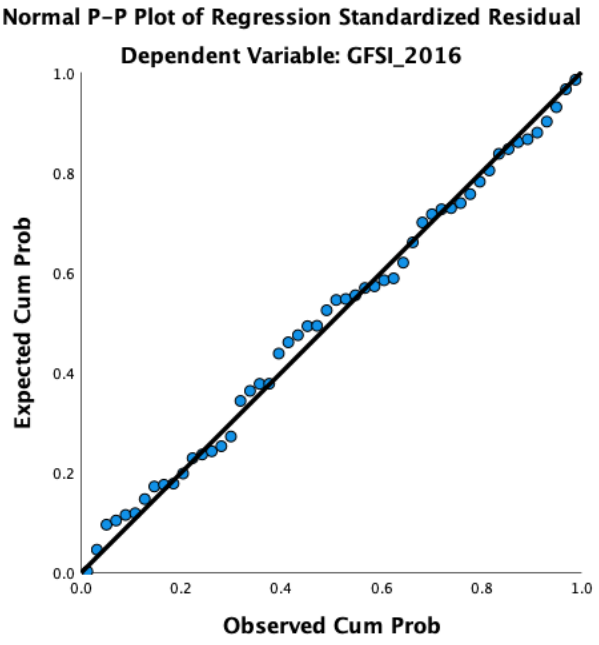
a. Dependent Variable: GFSI_2016

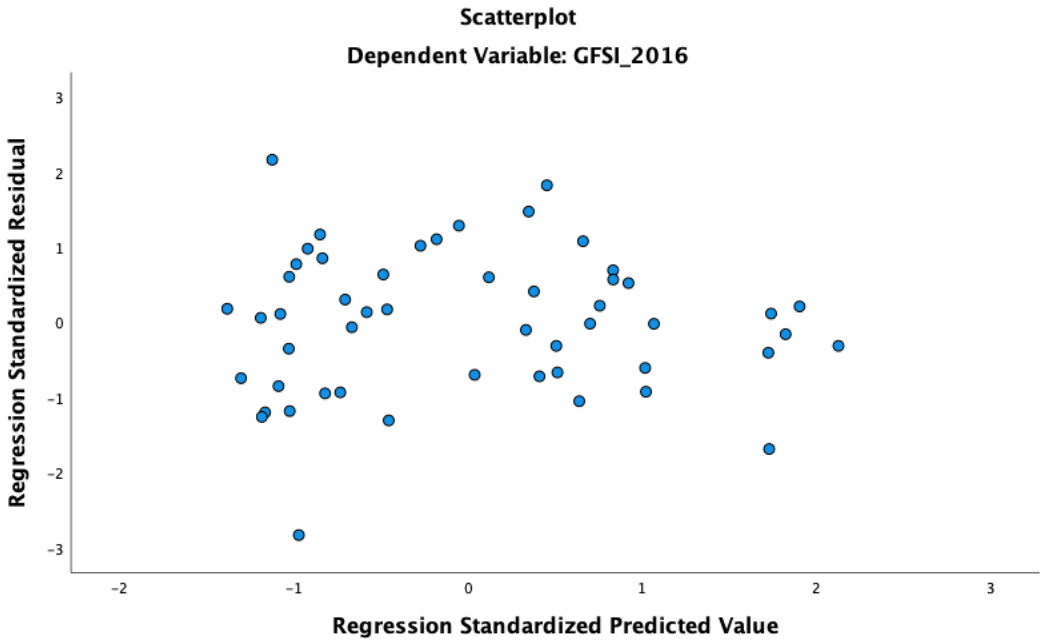
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	30.9971	69.3345	46.1038	10.93620	52
Residual	-9.38711	7.18079	.00000	3.14696	52
Std. Predicted Value	-1.381	2.124	.000	1.000	52
Std. Residual	-2.833	2.167	.000	.950	52

a. Dependent Variable: GFSI_2016

Normality of errors:





Heteroskedasticity: slight funnel shape

4. Regression 4: Interaction Number of MDB projects and grants, DV: GFSI 2014, control variables: GFSI 2012, GDP per capita 2014

4.1.Syntax

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT GFSI_2016
  /METHOD=ENTER GFSI_2012 numberprojectspercountry grant interactiongrant2
  /METHOD=ENTER GFSI_2012 numberprojectspercountry grant interactiongrant2
GDPpercapita_2016
  /PARTIALPLOT ALL
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS DURBIN NORMPROB(ZRESID).
```

4.2.Output

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.953[a]	.908	.900	3.59891	
2	.955[b]	.911	.902	3.57087	2.038

a. Predictors: (Constant), interactiongrant2, numberprojectspercountry, GFSI_2012, mode_financialinstrument=grant

b. Predictors: (Constant), interactiongrant2, numberprojectspercountry, GFSI_2012, mode_financialinstrument=grant, GDPpercapita_2016

c. Dependent Variable: GFSI_2016

Autocorrelation: Durbin-Watson around 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5995.947	4	1498.987	115.732	<.001[b]
	Residual	608.752	47	12.952		
	Total	6604.699	51			
2	Regression	6018.150	5	1203.630	94.394	<.001[c]
	Residual	586.550	46	12.751		
	Total	6604.699	51			

a. Dependent Variable: GFSI_2016

b. Predictors: (Constant), interactiongrant2, numberprojectspercountry, GFSI_2012, mode_financialinstrument=grant

c. Predictors: (Constant), interactiongrant2, numberprojectspercountry, GFSI_2012, mode_financialinstrument=grant, GDPpercapita_2016

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	9.582	2.113		4.534	<.001		
	GFSI_2012	.868	.047	.938	18.294	<.001	.746	1.340
	numberprojectspercountry	.178	.209	.041	.854	.398	.866	1.155
	mode_financialinstrument=grant	-.480	2.334	-.017	-.206	.838	.274	3.647
	interactiongrant2	.082	.753	.009	.109	.914	.282	3.544
2	(Constant)	12.014	2.792		4.304	<.001		
	GFSI_2012	.779	.082	.842	9.476	<.001	.245	4.087
	numberprojectspercountry	.170	.208	.039	.821	.416	.865	1.156
	mode_financialinstrument=grant	-.531	2.316	-.019	-.229	.820	.274	3.648
	interactiongrant2	.073	.747	.008	.097	.923	.282	3.544
	GDPpercapita_2016	.000	.000	.112	1.320	.194	.270	3.706

a. Dependent Variable: GFSI_2016

Multicollinearity: VIF below 5

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions					
				(Constant)	GFSI_2012	numberprojectspercountry	mode_financialinstrument=grant	interactiongrant2	GDPpercapita_2016
1	1	3.202	1.000	.00	.00	.03	.01	.01	
	2	1.297	1.571	.00	.01	.03	.06	.07	
	3	.349	3.027	.02	.02	.77	.02	.02	
	4	.122	5.124	.00	.01	.17	.81	.90	
	5	.029	10.441	.97	.96	.01	.10	.00	
2	1	3.714	1.000	.00	.00	.02	.01	.01	.01
	2	1.555	1.545	.00	.00	.00	.05	.06	.01
	3	.370	3.170	.00	.00	.83	.03	.00	.03
	4	.233	3.992	.04	.00	.00	.00	.12	.29
	5	.117	5.635	.01	.00	.14	.88	.81	.03
	6	.012	17.876	.94	.99	.00	.03	.00	.64

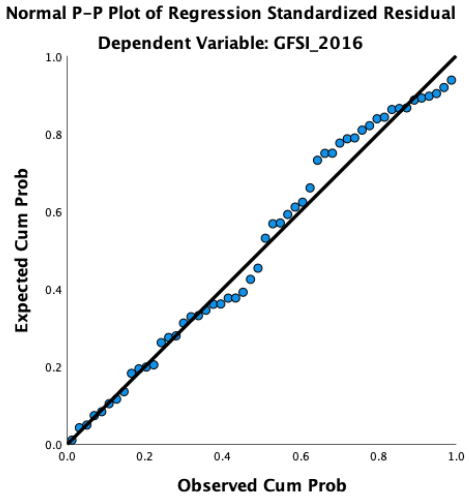
a. Dependent Variable: GFSI_2016

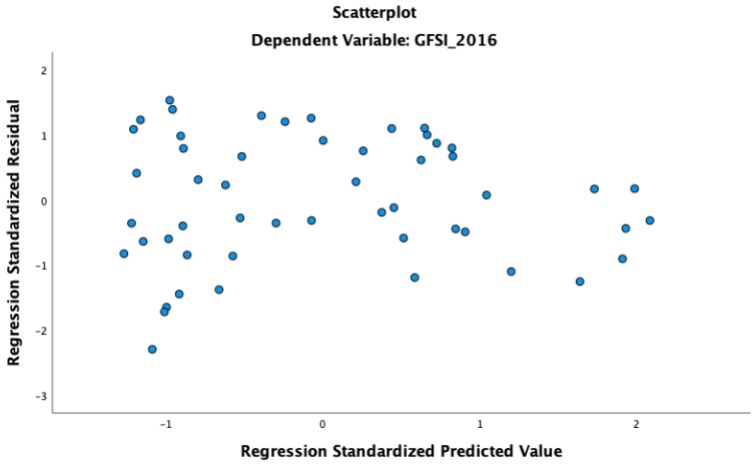
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	32.3484	68.7251	46.1038	10.86292	52
Residual	-8.20770	5.48527	.00000	3.39131	52
Std. Predicted Value	-1.266	2.082	.000	1.000	52
Std. Residual	-2.299	1.536	.000	.950	52

a. Dependent Variable: GFSI_2016

Normality of errors:





Heteroskedasticity: slight funnel shape

Appendix C
Details on the attempts made to improve the statistical results

This appendix provides information on the attempts made to improve the statistical results. The research is limited by the results not being statistically significant, moreover, no relationship between the control variable GDP per capita and levels of food security could be established.

1. Statistical significance

As there is a connection between the sample size and the p-value, a larger sample size may lead to improvements in statistical significance (Field, 2017, section 2.9.10). The data set used to conduct the linear regressions consists of a relatively small sample size with 52 cases. However, the number of available cases shrank due to unavailability of data in the GFSI. Only considering MDB finance, 71 cases were included in the data set. Thus, it was attempted to include another DV that would allow for a larger sample size. The DV undernourishment was coded for 2012, 2014, 2016, and 2019. This indicator captures food security by measuring the share of individuals of a country's population in percent, that have a daily food intake that is insufficient to provide the amount of dietary energy required to maintain a normal, active and healthy life (FAO, 2023). However, this indicator only takes into account the sufficiency of energy intake and does not consider the quality or diversity of food that is consumed (Ritchie, 2022). While this indicator is available for more cases than the GFSI, the theoretical justification of using it is not as strong. Moreover, the results (see example below) are not statistically significance either. Therefore, the thesis stuck to using the GFSI as the DV.

Figure C1

SPSS output DV undernourishment, Model Summary

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.953[a]	.908	.905	2.99710	
2	.953[b]	.909	.904	3.01395	1.907

a. Predictors: (Constant), MDBspending_percapita, undernourishment2012

b. Predictors: (Constant), MDBspending_percapita, undernourishment2012, GDPpercapita_2014

c. Dependent Variable: undernourishment2014

Figure C2

SPSS output DV undernourishment, Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-.061	.708		-.085	.932		
	undernourishment2012	1.022	.042	.950	24.606	<.001	.979	1.022
	MDBspending_percapita	-.021	.046	-.018	-.453	.652	.979	1.022
2	(Constant)	.266	.931		.286	.776		
	undernourishment2012	1.009	.048	.939	21.220	<.001	.754	1.326
	MDBspending_percapita	-.014	.048	-.012	-.299	.766	.916	1.091
	GDPpercapita_2014	-5.078E-5	.000	-.025	-.545	.587	.706	1.416

a. Dependent Variable: undernourishment2014

2. GDP per capita

Improvements in observing an effect of GDP per capita on the DVs could have been achieved through a log-transformation of the variable. However, as shown in the example below, this was not the case.

Figure C3

SPSS output log-transformed GDP per capita, Model Summary

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.978[a]	.956	.954	2.36888	
2	.979[b]	.959	.956	2.31751	2.350

a. Predictors: (Constant), MDBspending_percapita, GFSI_2012

b. Predictors: (Constant), MDBspending_percapita, GFSI_2012, lnGDP2014

c. Dependent Variable: GFSI_2014

Figure C4

SPSS output log-transformed GDP per capita, Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	7.413	1.183		6.267	<.001		
	GFSI_2012	.881	.027	.977	32.607	<.001	.997	1.003
	MDBspending_percapita	.014	.052	.008	.268	.790	.997	1.003
2	(Constant)	1.297	3.611		.359	.721		
	GFSI_2012	.797	.054	.884	14.738	<.001	.238	4.194
	MDBspending_percapita	.007	.051	.004	.133	.895	.991	1.009
	lnGDP2014	1.256	.702	.107	1.788	.080	.237	4.212

a. Dependent Variable: GFSI_2014