SA-TIED YOUNG SCHOLARS PROGRAMME

Financial inclusion and food security nexus

Evidence from the Southern African Development Community

Tharollo Machili

Young Scholars

This paper was produced as a part of the SA-TIED Young Scholars' programme. The programme is a part of SA-TIED's capacity building initiatives, designed to support the development of skills and capabilities in the research and policymaking aspects of economic development. Every year, the programme recruits Masters' level college students from Southern Africa to become SA-TIED Young Scholars.

SA-TIED Young Scholars work with top academics and officials in their research fields to complete original research projects as a part of the programme and as a part of the research component of their Masters' degree.

About the programme

Southern Africa –Towards Inclusive Economic Development (SA-TIED)

SA-TIED is a unique collaboration between local and international research institutes and the government of South Africa. Its primary goal is to improve the interface between research and policy by producing cutting-edge research for inclusive growth and economic transformation in the southern African region. It is hoped that the SA-TIED programme will lead to greater institutional and individual capacities, improve database management and data analysis, and provide research outputs that assist in the formulation of evidence-based economic policy.

The collaboration is between the United Nations University World Institute for Development Economics Research (UNU-WIDER), the National Treasury of South Africa, the International Food Policy Research Institute (IFPRI), the Department of Monitoring, Planning, and Evaluation, the Department of Trade and Industry, South African Revenue Services, Trade and Industrial Policy Strategies, and other universities and institutes. It is funded by the National Treasury of South Africa, the Department of Trade and Industry of South Africa, the Delegation of the European Union to South Africa, IFPRI, and UNU-WIDER through the Institute's contributions from Finland, Sweden, and the United Kingdom to its research programme.

Corresponding author: tharollomachili@outlook.com

Financial inclusion and food security nexus

Evidence from the Southern African Development Community

Tharollo Machili

August 2021

Abstract: Financial inclusion is considered a vehicle to inclusive growth and thus critical in addressing the three key socioeconomic ills of modern society—particularly in Southern Africa: poverty, unemployment, and inequality. Being excluded from the financial services sector has been associated with poverty and derailed economic emancipation. This study investigates whether financial inclusion will lead to the expected reduction in poverty and improved food security. The empirical investigation makes use of data from the Southern African Development Community, considering the different levels of financial sector development and overall economic advancement of each member country to ensure that the results are comparable. A Generalised Method of Moments is used to test for the association. The study finds that access to financial inclusion has a significant impact on the overall level of food security in the region and notes the need to increase access to and usage of financial inclusion services to improve welfare.

Note: abbreviations at the end, before the reference list

1   Introduction

All countries in Africa are beginning to realize the important role that financial inclusion plays in poverty alleviation and its contribution to sustainable and inclusive economic growth and development. Emerging evidence indicates that financial sector deepening is essential to economic development. The Finmark Trust (2016) reports that inclusive economic growth has a positive impact on the livelihoods of the poor and underprivileged.

Recent developments in financial services, specifically for the bottom income segment, afford new avenues through which governments can increase the use of financial services by the vulnerable and excluded population (Demirgüç-Kunt et al. 2017). In addition, several studies emphasize that financial inclusion—mainly the use of digital financial services and mobile money services—can have a significant impact on development (Beck et al. 2014; Ouma et al. 2017). Several countries in the Southern African Development Community (SADC) region have also begun to establish national financial inclusion strategies and to lead core initiatives to enhance financial services.

Although studies fail to conclusively concur on the direction of the effect that financial inclusion has on economic development, it is worth noting that even studies that do not find any evidence of a relationship emphasize the prospect of attaining better outcomes through careful consideration of local needs (Honohon and King 2012; Wright et al. 2014).

Financial services enable individuals to prepare for unforeseen financial contingencies such as illness or retrenchment, which normally result in financial distress. Most of the poor globally lack access to financial services that can be used to manage unforeseen financial problems, such as bank accounts and digital payments. Demirgüç-Kunt et al. (2017) report an increase in the percentage of adults worldwide who have a bank account or use mobile payment services from 62 per cent in 2014 to 69 per cent in 2017. However, in developed countries, 94 per cent of adults have accounts compared with 63 per cent in developing countries.

This study seeks to quantity whether financial inclusion will indeed result in improved welfare, specifically focusing on food security. No previous study has investigated whether this hypothesis holds; previous studies have focused on the importance of financial inclusion and economic growth (Arcand et al. 2012; Chen et al. 2012; Ikhide 2015; Rousseau and Wachtel 2011). There are currently no studies on the nexus between financial inclusion and food security. In addition, there has not been a comprehensive study that measures financial inclusion and food security in a single model. Thus, this study also seeks to address a literature gap by investigating the impact of financial inclusion on food security.

The research also has the following sub-goals: to review trends in financial inclusion and food security in the SADC region and to explore the effect of financial literacy on financial inclusion.

2   Food security trends in Africa (1999–2017)

Manyame (2002) contends that food security in the African continent dwindled over a period of 30 years from 1960 to 1990. In the same period, Africa moved from food self-sufficiency to being undernourished, hungry, and impoverished. Poverty and inequality are the main drivers of food insecurity in the SADC region, despite the fact that more food is being produced worldwide now than ever before (Manyame 2002).

In recent years there has been a rampant increase in the number of people facing severe food insecurity in many parts of the world (Figure 1a). The State of Food Security and Nutrition in the World (FAO 2019) reports that hunger as measured by Prevalence of Undernourishment (PoU) seems to have increased in the past two years, reaching 10.9 per cent in 2017. Keeping in mind persistent population growth, this suggests that the number of food-insecure people has been increasing. Globally, over 821 million people were affected by hunger in 2017 (FAO 2019).

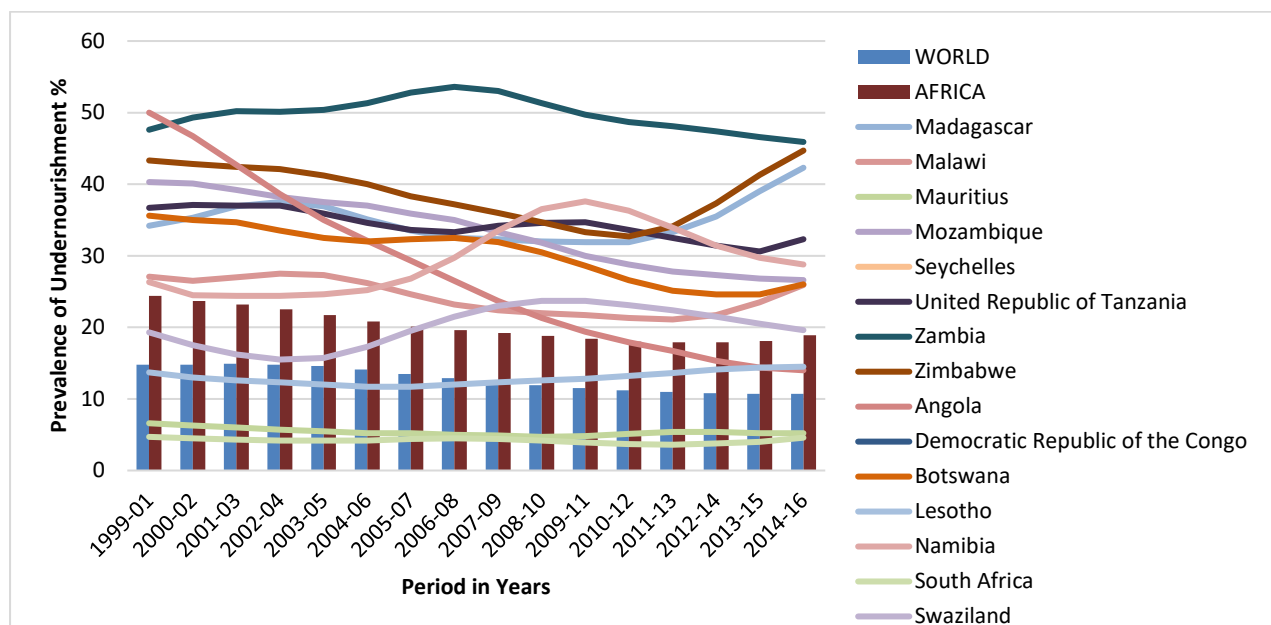Figure 1a: Prevalence of undernourishment in the world

Source: author's construction based on data from FAO (2018).

The food security situation appears to be most pronounced in parts of sub-Saharan Africa (SSA) and other parts of the world torn by conflict and climate change (FAO, IFAD, UNICEF, WFP, and WHO 2017). Of the 821 million food-insecure people worldwide, a large proportion are reported to be in Africa, where the PoU stood at 20.4 per cent in 2017. Between 2005 and 2017, there was a pronounced increase in the PoU in West Africa (from 12.8 to 15.1 per cent) and SSA (from 22.3 and 23.2 per cent). In Oceania, the PoU improved slightly between 2005 and 2010, from 5.5 to 5.2 per cent, but then worsened to 7 per cent in 2017. In an aggregated estimate of food-insecure people the African Development Bank (AFDB 2011) reports that out of 32 countries in need of external assistance, 24 (three quarters) are in Africa. The FAO, IFAD, UNICEF, WFP, and WHO (2017) reported that 25 per cent of the people facing malnutrition in 2017 were in Africa and that 124 million people in 51 African countries were facing extreme hunger.

Figure 1b indicates the PoU in the world and the African continent against that in SADC member states. While the African continent as a whole improved slightly—from 24.4 per cent in 2001 to 18.8 per cent in 2010—the PoU has increased in 2015 and 2016 from 18.1 to 18.9 per cent. The rise in undernourishment in the SADC was most pronounced in Zimbabwe, Madagascar, Namibia, Lesotho, and Swaziland—from 40, 35.1, 25.2, 11.7, and 17.3 per cent in 2004 to 44.7, 42.3, 28.8, 14.5, and 19.6 per cent in 2016, respectively—the situation regressing sharply subsequent to the 2007/8 substantial increase in the prices of staple foods. Conversely, Angola, Mozambique, Botswana, Tanzania, and Zambia have made significant strides in reducing the PoU from 32.1, 37, 32, 34.6, and 51.3 per cent in 2003 to 14, 26.6, 26, 32.3, and 45.9 per cent, respectively, in 2016.

Figure 1b: Prevalence of undernourishment

Source: author's construction based on data from World Bank (2017).

Many SSA countries face a high degree of risk from production and price fluctuations when factoring several relevant indicators. Table 1 indicates per capita food production (FP) variability in SADC member states compared with that of the world and Africa as a whole. The indicator compares variations in per capita FP across countries and time and acts as a measure of the country's ability to feed itself. Globally, per capita FP dipped from 2 per cent in 2000 to 1.5 per cent in 2014. FP in Africa declined from 3.6 to 2 per cent in the same period. The decline in FP affected most parts of the SADC region, although Namibia, Mauritius, Botswana, Zimbabwe, and South Africa felt the greatest impact: from 35.9, 21.8, 15.3, 12.9, and 12.8 per cent in 2000 to 2.4, 3.6, 11, 4.9, and 5.7 per cent in 2014, respectively. On the other hand, Angola, Mozambique, Madagascar, and Tanzania saw an increase in production from 4.7, 3.6, 2.5, and 4.1 per cent to 17.4, 14.8, 6.6, and 6.2 per cent, respectively. The regional decline in FP may be attributed to stagnant growth and adverse weather conditions.

In Angola, the relatively high economic growth rate of 4 per cent between 2005 and 2016 (FAO 2017) drove efforts to reduce undernourishment, yet serious concerns remain, as high inflation erodes access to food and other essentials. The FAO (2018) suggests that the country's economic growth has not been inclusive, with severe poverty falling slightly between 2000 and 2008 and subsequently remaining high at about 30 per cent. Furthermore, the prevalence of stunting has risen over the decade to about 38 per cent and remains the highest in SSA.

Promoting subsistence and commercial production and productivity in agriculture is essential for meeting the growing need for food and nutritional requirements. Growth in regional agriculture is also essential for effectively mitigating poverty and stimulating inclusive growth (Christiaensen et al. 2011). The FAO (2017) maintains that agriculture has strong ties with the other economic sectors and is the main driver of overall growth in many SADC countries. Encouraging agricultural production will address the availability of adequate quantities of food on a continuous basis.
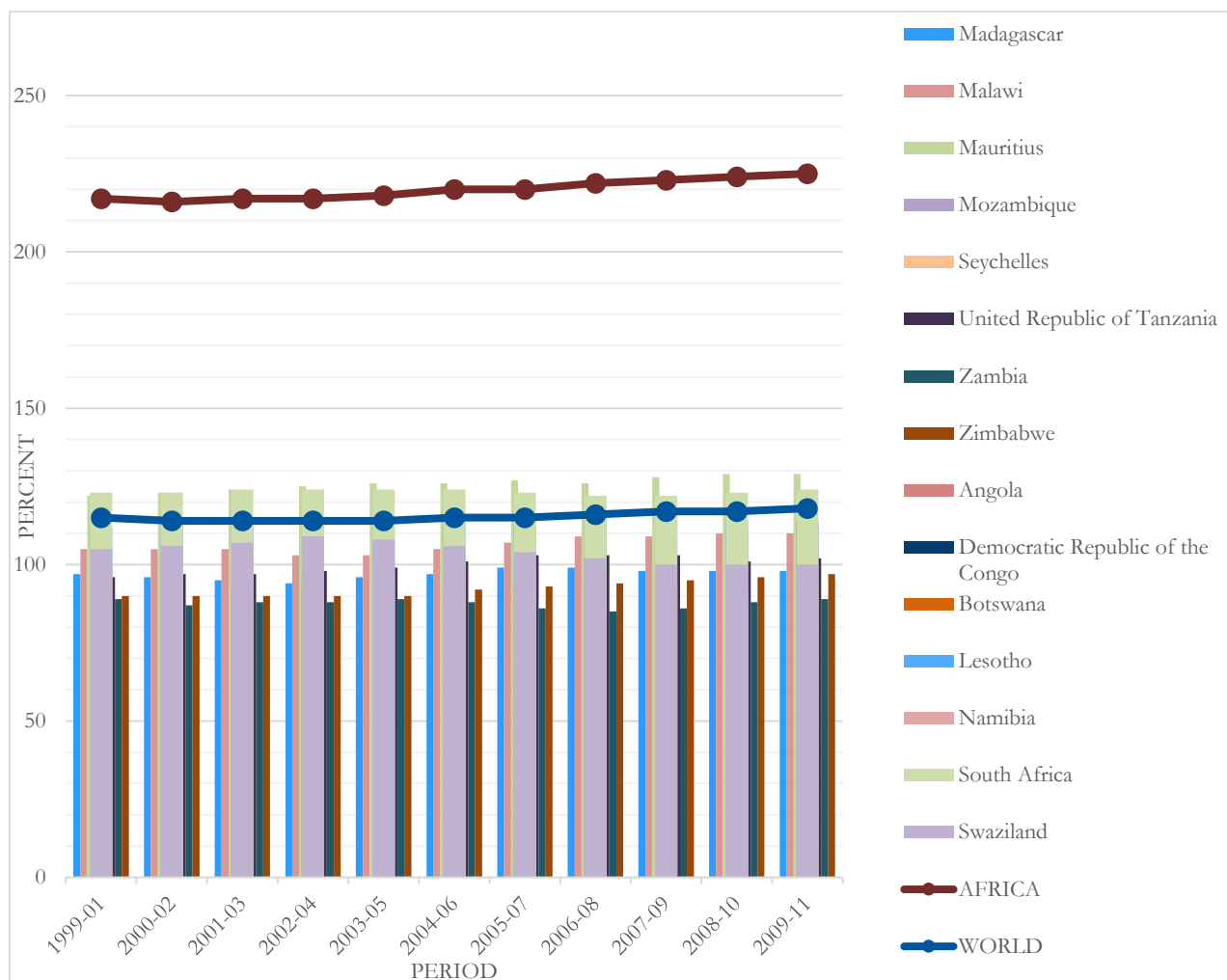
Table 1: Per capita food production variability, 2000–14

Region/ Subregion Country	Per capita food production variability (constant 2004–06 int$'000 per capita)														
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
WORLD	2.0	1.2	2.1	3.3	3.6	2.7	2.1	2.1	1.7	2.4	2.3	2.2	1.7	2.4	1.5
AFRICA	3.6	2.8	2.3	2.3	2.6	2.5	2.9	2.7	2.6	2.8	2.8	3.1	2.8	2.2	2.0
Angola	4.7	4.4	3.9	4.7	4.7	2.5	1.6	3.5	2.9	2.4	10.3	12.1	11.8	17.7	17.4
Botswana	15.3	10.7	7.9	7.1	7.2	5.3	4.7	4.8	3.9	3.8	4.3	7.4	12.5	10.4	11.0
Comoros	1.9	1.9	1.9	0.9	0.8	0.6	2.1	2.8	4.0	4.3	4.2	1.4	1.9	3.1	2.6
DRC	2.1	2.2	2.1	0.7	1.1	1.5	2.2	2.2	1.7	1.3	0.5	0.4	0.7	1.0	2.3
Lesotho	5.8	3.6	5.1	5.4	5.6	5.7	5.7	1.9	2.0	1.8	2.2	4.1	4.7	5.0	4.7
Madagascar	2.5	4.1	5.3	6.0	5.8	3.6	7.1	9.2	8.4	6.2	1.9	1.8	1.9	1.7	6.6
Malawi	8.2	12.8	16.3	19.0	20.7	22.9	25.4	12.4	15.4	15.7	18.2	7.1	4.8	6.9	7.7
Mauritius	21.8	21.7	25.5	24.1	24.1	12.1	11.1	7.0	9.6	9.1	6.8	6.9	7.1	3.5	3.6
Mozambique	3.6	5.0	6.3	6.5	4.8	1.2	4.5	4.6	4.1	3.2	1.8	12.3	16.0	15.4	14.8
Namibia	35.9	34.7	25.9	5.2	4.1	10.6	19.1	19.9	15.6	13.2	14.6	13.8	11.4	1.9	2.4
Seychelles	2.9	3.0	2.2	6.4	8.1	9.4	8.6	3.7	3.0	2.4	2.5	2.2	3.3	4.2	4.8
South Africa	12.8	10.5	10.7	11.1	8.7	7.9	4.7	6.4	6.1	12.3	13.1	13.1	11.7	9.4	5.7
Swaziland	5.9	5.7	6.3	9.6	10.7	11.8	13.3	5.6	6.7	8.3	9.6	5.3	2.1	2.1	2.1
Tanzania	4.1	4.2	4.0	9.7	10.2	10.7	9.5	8.6	6.1	6.8	9.1	8.9	5.5	4.4	6.2
Zambia	5.0	3.7	2.9	3.1	3.1	2.8	2.8	2.8	3.8	3.8	6.9	11.7	12.9	11.0	7.9
Zimbabwe	12.9	5.8	6.1	11.1	11.5	11.7	10.5	8.1	6.1	7.8	5.8	5.6	4.7	5.2	4.9

Source: author's construction based on data from World Bank (2017).

Figure 2 presents the average dietary energy supply adequacy (ADESA) of SADC member states in comparison with world and African averages. The ADESA provides an index of a country's or region's adequacy of food supply in terms of calories. The higher the index, the greater the food sufficiency. Angola, Mozambique, and Tanzania made significant progress between 2000 and 2016 (from 89, 96, and 97 per cent, respectively to 120, 109, and 107 per cent, respectively, while Zimbabwe, Madagascar, and Namibia regressed in the same period (from 90, 96, and 100 per cent to 89, 90, and 96 per cent, respectively) and South Africa and Malawi remained constant. Angola's spike in ADESA can be attributed to an increase in FP, as can be observed in Table 1.

Figure 2: Average dietary energy supply adequacy, 1999–2011

Source: author's construction based on data from World Bank (2017).

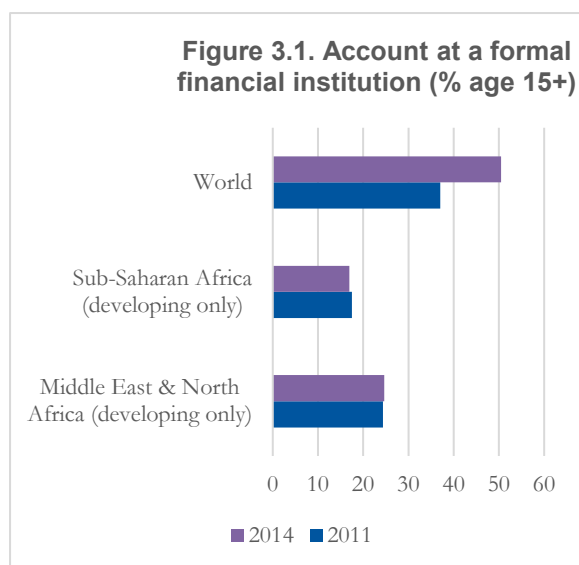## 3   Trends in financial inclusion

The Global Findex database, instituted by the World Bank Development Research Group, provides a comprehensive data set on how adults save, borrow, make payments, and manage risk in 148 countries. The initiative resulted in the development of the first detailed demand-side financial inclusion indicators based on usage of financial product. Demirguc-Kunt and Klapper (2012) maintain that the Global Findex database fills a significant gap in determining the relationship between household access to finance and developmental outcomes through provision of cross-country, time series data on individuals' use of financial services. The data enhance cross-country comparability, demographic covariates, and the tracking of the performance on the key indicators of financial inclusion: bank account, saving, borrowing, payment, and insurance.

Figures 3.1 and 3.2 show the percentage of adults with bank accounts in the world and within SADC countries. Globally, account ownership has increased sharply since 2011. The proportion of adults with an account at a formal financial institution rose from 37 per cent in 2011 to 50.1 per cent in 2014. In developing countries of SSA and MENA, however, formal account penetration was at 16.9 and 24.6 per cent in 2014, respectively, with no quantifiable progress since 2011. Account penetration in the SADC is still low compared with other regions. As Figure 3 indicates,
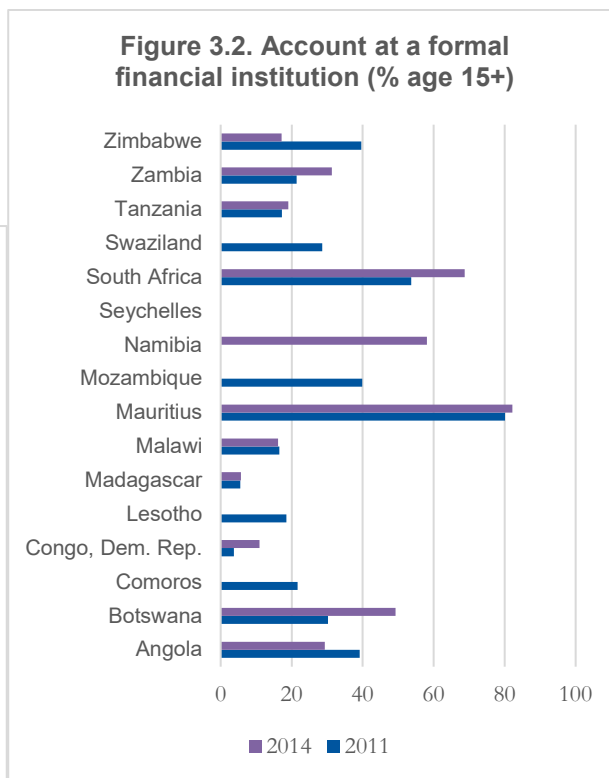
most SADC countries are still lagging behind on formal financial inclusion, while in some countries (Comoros, Lesotho, Namibia, Mozambique, and Seychelles) no data are available or available data are incomplete.

Figure 3: Percentage of adults (15+) with accounts at formal financial institutions in the world vs region and country, 2011 and 2014

Panel A: 2011

Panel B: 2014

Figure 3.1. Account at a formal financial institution (% age 15+)

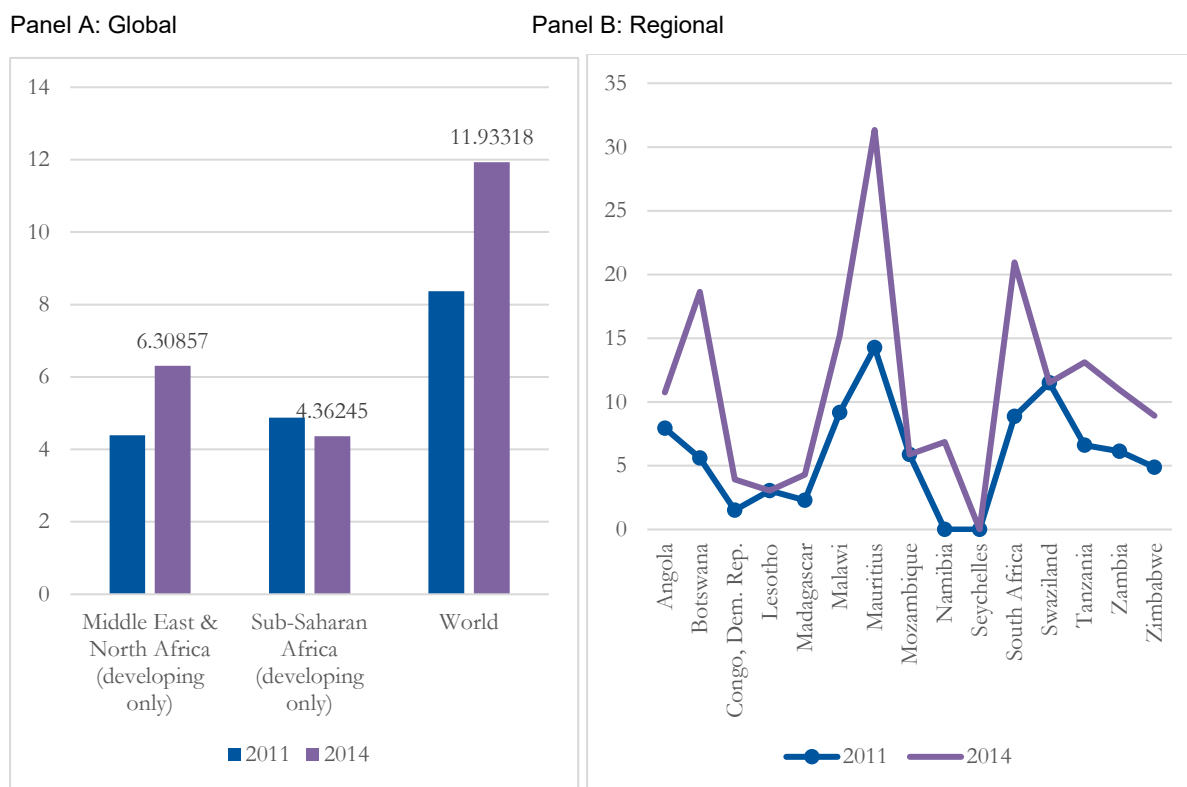**Figure 3.2. Account at a formal financial institution (% age 15+)**

Source: author's construction based on data from World Bank Findex database (2017).

Figures 4.1 and 4.2 show the percentage of adults who borrowed from a financial institution globally, in developing countries in SSA and MENA, and in SADC countries in 2001 and 2014.[1] Worldwide, 11.9 per cent of adults borrowed from formal financial institutions in 2014 compared with 8.4 per cent in 2011. In SSA developing countries, in contrast, the percentage of the population borrowing from the formal sector declined from 4.9 per cent in 2011 to 4.3 per cent in 2014. In the SADC, the highest percentages of adults borrowing from formal financial services were in developed countries—Mauritius, South Africa, and Botswana. In addition, the majority of adults in developing countries seem to have access to credit card facilities.

---

[1] According to Demirgüç-Kunt et al. (2017), the percentage of adults reporting to have borrowed from a financial institution remained constant between 2014 and 2017 at 23 per cent.

Figure 4. Percentage of adults reporting to have borrowed in the last year from a formal financial institution, 2011 and 2014

Panel A: Global   Panel B: Regional

Source: author's construction based on data from World Bank Findex database (2017)

4   Literature review

4.1   Theories of financial inclusion and their critics

Efficient Market Hypothesis

Fama's (1970) Efficient Market Hypothesis posits a market where security prices fully account for all available information. The theory deals with various kinds of information available in the market, focusing on the dissemination of knowledge and how this is translated into security prices, with reference to the pace of transmission.

There are three main forms of market with regard to the nature of information available: weak, semi-strong, and strong. The weak form is where all data on past prices are accounted for in existing prices. The semi-strong form is where all publicly obtainable data are incorporated in current pricing. The strong form is where the market at any point in time completely reflects all information, whether public or private. Consequently, the likelihood of investors acquiring excess returns is almost negated. In an efficient market the security value is an independent and impartial estimate of the intrinsic value (Fama 1970). The theory has strong implications for security analysis.

Capital Market Imperfection Theory

Capital Market Imperfection Theory is a critique of the Efficient Market Hypothesis. The main argument raised by proponents of the theory are that capital market imperfections are the cause of increases in the cost of financing during a recession. Bernanke and Gertler (1989) argue that

firms may experience short-term financing challenges in a recession and that these can be manifested either through lower cashflows or through a dip in asset values. The main informational challenge facing firms is uncertainty with regard to how the money they lend is being invested.

The main argument made for the imperfect market relates to the asymmetric information inherent in capital markets. The imperfect information on the part of both the lender and the borrower, combined with risk aversion, typically results in inefficient allocation. Keynes (1936) argues that in imperfect markets borrowers in most instances do not incur the full costs related to the adverse results of their investment ventures. Adverse selection arises because of imperfect information, as the borrower's ability to pay is unknown to the lender. Moral hazard is due to asymmetric information with regard to the individual actions that could increase the probability default. When borrowers are insured against adverse outcomes, they are more likely to take advantage of asymmetric information when they undertake risky ventures. The challenges inherent in imperfect markets cause lenders to charge high interest on loanable funds.

4.2 Theories of food security and their critics

The theory of food security was first proposed in 1798, by Robert Malthus in *An Essay on the Principle of Population*. Malthus argued that the human population was increasing faster than the world's food supplies and that those supplies were insufficient to feed the increased population. Malthus was of the view that social handouts in the form of food aid and shelter to the poor were the main contributing factor to the growth of the world's poor. His emphasis was on the importance of restricting human reproduction patterns to reduce population growth. His main argument was that when a unit of productive land has been occupied, the annual growth in food production will be conditional on the increase in productivity of land already in use.

The theory remains relevant in modern society, although it has some fundamental shortcomings, as outlined by Malthus's critics. The main critique raised against Malthus is that he overlooked the prospect of declining fertility rates due to higher family income and underestimated the probability of yield improvement in agriculture. Nevertheless, his central theme of global overpopulation being due to limited means is still evident today. The decline in family sizes and fertility rates in developed countries notwithstanding, emerging economies such as those in Africa, Asia, Latin America, and China have recorded high levels of population growth in recent years.

Several arguments have recently been proposed in relation to the possibility of food distribution falling significantly behind the world population. Abdalla (2007) maintains that there is little empirical evidence to support statements on the relationship between population growth and food distribution. In most parts of the world, except for some regions of Africa, the upsurge in food distribution has been equivalent to, or outpaced, population growth—although this does not show whether hunger is being gradually eradicated, mainly because hunger is dependent on entitlement relations and not necessarily on food availability. Furthermore, Abdalla (2007) argues that many of the worst famines have happened without a substantial decline in food availability per person.

Sen (1977) termed poverty a shortage of sustenance entitlement, citing that the poor in most cases do not have access to land, financing, revenue, or a household support structure, which was the main cause of famine and hunger. Sen criticized the prevailing notion of the time that the principal cause of famine was a decline in productivity. Sen (1981) further proposed that hunger was due to a lack of means of livelihood and not necessarily a shortage of food. Sen (1981) asserted that the prerogative relations acknowledged in a secluded proprietorship market economy were mostly trade-based privileges, whereby individuals have a right to own what they receive through transacting something they possess with a willing party or, jointly, with a number of interested parties.

Production-based entitlement stipulates that an individual is eligible to own anything they are able to attain through own production or through the use of capital borrowed from willing parties satisfying the set conditions of transaction. Individual labour entitlement asserts that a person is privileged to control their labour power and therefore that transaction-based and production-based privileges are correlated with an individual's labour power. Lastly, inheritance and handover entitlement entail that an individual has a right to possess that which they are assigned by its proprietor, which could arise at any time specified by the owner.

4.3 Theoretical literature on the link between financial inclusion and food security

In his theory of demand Keynes (1936) acknowledges that financial intermediaries have an important role as a source of profitable savings. In contrast, Greenwood and Jovanovic (1990) reach a conclusion that financial development has no impact on population in a homogeneous way. Rather, they argue that income inequality is intensified by financial development initiatives that benefit only the rich, who demand financial services. Although the rich gain much from financial development, the less privileged marginally experience declining income inequality.

The indirect effect of financial inclusion on welfare manifests itself through the finance–growth nexus of financial development theory. The indirect effect can be tracked back to the work of Joseph Schumpeter in 1934. Romer (1986) asserted that, according to endogenous growth principles, an increase in savings and capital mobilization by financial intermediaries results in technological and economic growth. Established financial markets result in better saving, capital exploitation, technological advances, and economic growth.

4.4 Empirical literature

Buera et al. (2012) assert that an extension in credit ceiling by about one and half times the annual wage has a positive spinoff effect on welfare of roughly 10 per cent of consumption. The study sheds light on the impact that welfare has on the privileged and the less privileged. In particular, the study found that welfare benefits arising from financial inclusion are greater among the less privileged, growing by approximately 8 per cent of their staple consumption in the general equilibrium framework (Buera et al. 2012). Kaboski and Townsend (2012) support the findings above that financial intermediation and consumption are strongly linked.

There is a significant relationship between household expenditure and savings. Dupas and Robinson (2013) established a firm association between them, finding that households that use savings products had 13 per cent higher private expenditure than those that did not. Most studies that are focused on the savings and household welfare nexus suggest that outcomes of these studies are more positive and reliable than those of research focusing on the impact of credit usage. A study in Malawi on the relation between commitment savings and consumption expenditure concluded a positive link between the two (Brune et al. 2016).

The presence of a negative relationship between financial intermediation and welfare was reported by Angelucci et al. (2013), Benerjee et al. (2015), and Crepon et al. (2014). In a randomized trial study on the role of micro credit Benerjee et al. (2015) found no link between micro credit and average monthly consumption expenditure per capita 15–18 months later. Rather, household expenditure on big ticket items like durables rose considerably, resulting in growth in profitability. Crepon et al. (2014) measured the impact of microfinance in remote rural Morrocco from 2006 to 2007 and their findings revealed that, although micro credit access rose amongst surveyed households, it resulted in considerable growth only in asset investment and profit, of which a decline in casual labour income offset the gains by neutralizing consumption expenditure. In addition, the study by Angelucci et al. (2013) on extension of credit to Mexican households

indicated an overall increase in welfare and no material relation between financial inclusion and household consumption.

5   Methodology and data

This section provides an explanation of the proxies of dependent variables and independent variables considered most important in understanding the nexus between food security and financial inclusion. The dependent variables used in this study are food production index (FP), prevalence of undernourishment (PoU), average dietary energy requirement (AVER), and average value of food production (AVOP).

The selection of variables was based on (i) their individual relevance in the context of food security as outlined in the Millennium Development Goals and the Sustainable Development Goals of the United Nations; (ii) the fact that there were no previous studies directly related to food security other than those centred around welfare and poverty, which will be used as refences for this study.

In order to establish an econometric model to analyse the nexus between financial inclusion and food security in the SADC, this study adopts a model by Keynes (1936) that denotes food security as a function of financial inclusion. The model was modified in order to align with the current study so that the regression is specified as:

$$\text{LogFoodsecurity}(y_i) = \alpha + \beta_1 \text{financial inclusion} + \beta_2 \text{controls} + \varepsilon_t \qquad (1)$$

where y_i is the dependent variable (food security), which is proxied by FP, PoU, AVER, and AVOP, each of which will be analysed separately against the determinants; β_1 is the coefficient of financial inclusion; β_2 the coefficient of control variables; and ε_t the stochastic error term. The study uses three aspects of financial inclusion, namely number of ATMs per 100,0000 adults, number of bank accounts per 1,000 adults, and number of bank branches per 100,000 adults. The coefficient of β_1 is expected to be negative, indicating that greater financial inclusion improves (reduces) food insecurity.

However, the coefficient of β_1 can also be positive if the level of financial inclusion is low, especially in SSA, where Saxegaard's (2006) findings documented excess liquidity. The presence of institutional factors such as interest rate caps supports this notion of excess liquidity (Maimbo and Gallegos 2014). Banks are encouraged to hold excess liquidity when credit is not lucrative to contain expenses associated with risk.

The control variables used comprise GDP per capita, to control for economic growth rate; unemployment, to capture the effect of institutions; and inflation rate, to control for the effect of the macroeconomic setting, since extreme inflation harms the less privileged more than the rich, who can cover their exposure.

5.1   Data

To allow for credibility and frequency of observations, panel data for the period 2004–17 were used for the empirical GMM model. The study will focus on 11 of the 16 SADC member states (Angola, Botswana, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, South Africa, Zambia, and Zimbabwe), leaving out five countries (Democratic Republic of Congo, Comoros, Seychelles, Namibia, and Tanzania) due to non-availability of data.

The online statistical query tool was particularly useful in accessing data from the websites of the sources mentioned below. Data for financial inclusion and control variables were obtained from the World Bank. The Food and Agriculture Organization (FAO) was useful in providing data on food security. To avoid including closely associated variables in the same model and to establish interrelated variables a simple correlation was performed. In addition, robust standard error selections in the valuation of all the models are performed to control for heteroskedasticity.

5.2 Estimation techniques

A panel model was used for the purpose of this study, mainly owing to the model's ability to utilize both cross-sectional variation and time-series variation in the data. The assumptions made on POLS models are also applicable to panel data models. It is assumed that parameter estimates are unbiased and consistent. Although panel data studies are expected to breach the assumption of no cross-section or time series correlation because of autocorrelation of the disturbances within individuals, biased estimates of the standard errors are likely to result (Mwangi 2017). Underestimation of the standard errors can lead to overestimation of the t-statistics. Errors are minimized through the use of clustered standard errors.

Wooldridge (2016) asserts that in several applications the main motive for employing panel data is to let the unobserved effect (i.e. εi) be associated with the independent variables. Other benefits of using panel data include their ability to increase the sample size considerably; the fact that they are better suited to study the dynamics of change (through studying repeated cross-section observations); and that they permit the analysis of more complicated behavioural models.

The beta parameters are estimated using GMM in a differenced food security function where the lagged dependent values are used as instruments (Arrelano and Bover 1995). The dynamic relationship between parameters in a food security function is expressed as:

$$y_{i} = \alpha\beta_1 + x_{it}\beta + \varepsilon_{it} \tag{2}$$

In this case i ranges from 1 to N countries, capturing the cross-sectional dimension, while t ranges between 1 and 3, measuring the time dimension in the panel, β_1 measures endogenous variables of interest, and x captures the vector of regressors. The error component is assumed to have zero mean and is expressed as:

$$\varepsilon_{it} = u_{it} + v_{it} \tag{3}$$

In this instance v represents the distinctive error term with zero mean while u represents the fixed effect. First, the GMM is applied to come up with the parameters, after which the lagged values of the endogenous variable from an auxiliary regression are used as instruments in a dynamic model (Mckenzie 2004). Dynamic estimation of panel data follows the GMM estimator and includes the lagged dependent variables as a regressor due to the small t and a large N panel. Where t is large, the dynamic panel bias is insignificant.

$$y_{i} = x\beta_1 + y_{i(t-1)}\beta_2 + \alpha_i + \varepsilon_{it} \tag{4}$$

The use of an orthodox linear panel data assessment results in biased and inconsistent estimates owing to the endogeneity bias, since time-invariant unobservable components are related to the independent variables (Mwangi and Atieno 2018). This issue is resolved through use of second lags of the dependent variable, a process that yields a set of moment conditions expressed as:

$$E = \Delta y_{i(t-2)} \Delta \varepsilon_{it}) = 0 \qquad (5)$$

$$E = \Delta y_{i(t-3)} \Delta \varepsilon_{it}) = 0$$

$$E = \Delta y_{i(t-j)} \Delta \varepsilon_{it}) = 0$$

The above process will give rise to the number of GMM instrument variables depending on the t. The specific models for the estimation of food security are expressed as:

$$\text{InFP} = \alpha + \beta_1\text{ATMFP} + \beta_2\text{BAFP} + \beta_3\text{BBFP} + \beta_4\text{GDPFP} + \beta_5\text{UFP} + \beta_5\text{CPIFP} + \varepsilon_{t\text{FP}} \qquad (6)$$

$$\text{InPrev} = \alpha + \beta_1\text{ATMPrev} + \beta_2\text{BAPrev} + \beta_3\text{BBPrev} + \beta_4\text{GDPPrev} + \beta_5\text{UPrev} + \beta_5\text{CPIPrev} + \varepsilon_{t\text{Prev}} \qquad (7)$$

$$\text{InADER} = \alpha + \beta_1\text{ATMAder} + \beta_2\text{BAAder} + \beta_3\text{BBAder} + \beta_4\text{GDPAder} + \beta_5\text{UAder} + \beta_5\text{CPIAder} + \varepsilon_{t\text{Ader}} \qquad (8)$$

$$\text{InAVOP} = \alpha + \beta_1\text{ATMAvop} + \beta_2\text{BAAvop} + \beta_3\text{BBAvop} + \beta_4\text{GDPAvop} + \beta_5\text{UAvop} + \beta_5\text{CPIAvop} + \varepsilon_{t\text{Avop}} \qquad (9)$$

The above models are econometric models to be estimated for each proxy of food security. The lagged dependent variable is included in the model to minimize the occurrence of autocorrelation emanating from model misspecification. Thus lagged dependent variables protect against the presence of autocorrelation in the model, affording robust estimates of the effects of independent variables.

6   Discussion of results

6.1   Descriptive statistics

Table 2 provides descriptive statistics relating to the variables of interest, including the number of observations, their mean, the standard error, and the minimum and maximum values of the variables. This helps define the distribution of the variables and their frequencies. Tables for individual countries are available on request.

Table 2: Summary statistics and measurement of variables

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
ATMs	203	18.75317	19.58002	0.275133	79.1638
Bank account	157	343.6302	405.594	0.368933	2020
Bank branch	205	8.836467	11.58729	0.550529	53.3478
Food production	208	115.8387	26.66899	83.42	206.96
Prevalence	182	27.47692	13.98269	4.3	57.8
ADESA	173	96.03295	25.94277	15.5	129
GDP per capita	224	3410.185	3420.607	292.3508	14014.87
Unemployment	210	11.30619	9.204624	599	31.786
Inflation	212	7.507184	8.390697	-60.4964	43.54211

Source: author's construction.

6.2 Unit root test

A Harris–Tzavalis unit root test was conducted on Stata for log(L) of GDP to assess whether the data were stationary, the null hypothesis being that the data contained unit root (Table 3). The results gave strong evidence in favour of the null hypothesis, since the data contained unit root with a p-value of 99.03.

Table 3: Harris–Tzavalis unit root test for L.GDP per capita (constant 2010 US$) (demean)

Ho: Panels contain unit roots		Number of panels = 16	
Ha: Panels are stationary		Number of periods = 13	
AR parameter: Common		Asymptotics: N -> Infinity	
Panel means: Included		T Fixed	
Time trend: Not included		Cross-sectional means removed	
	Statistic	Z	p-value
rho	0.9137	2.3384	0.9903

Source: author's construction.

The demean GDP was also tested for unit root, which indicated a p-value of 0.0 and a statistic value of -0.0039, suggesting that the null hypothesis can be rejected at 1 per cent—strong evidence that the demean GDP does not suffer from unit root (Table 4).

Table 4: Harris–Tzavalis unit root test for GDP per capita (constant 2010 US$) (demean)

Ho: Panels contain unit roots		Number of panels = 16	
Ha: Panels are stationary		Number of periods = 13	
AR parameter: Common		Asymptotics: N -> Infinity	
Panel means: Included		T Fixed	
Time trend: Not included		Cross-sectional means removed	
	Statistic	Z	p-value
rho	-0.0039	-14.4281	0.0000

Source: author's construction.

6.3 Arellano–Bond test for zero autocorrelation in first-differenced errors

The output for food production has a chi2(58) = 76.65111 and Prob > chi2 = 0.0510 with first order, reflecting a coefficient of z as -4.2886 and a probability of 0, while the second order has a z coefficient of -.14001 and a probability of 0.8886. Prevalence of food security has a chi2 (64) = 85.25901 and Prob > chi2 = 0.0391, the first order having a z coefficient of -2.3324 and a probability of 0.0197, and the second order showing a z of -.50539 and a probability of 0.6133.

The ADER has a chi2(58) = 52.67544 and Prob > chi2 = 0.6729, the first- and second-order coefficients being -4.346 and 1.6344 and probabilities 0 and 0.1022, respectively. The AVOP has a chi2(51) = 63.17596 and Prob > chi2 = 0.1178, while the first- and second-order coefficients are -.5907 and -.39298 with probabilities of 0 and 0.6943. At first order, all proxies of the dependent variables are found to have small probabilities, while at second level, all variables have a probability that is greater than 5 per cent, indicating that the proposed models do not suffer from the presence of autocorrelation. The results of the Arellano–Bond test are given in the Appendix.

Table 5 shows the GMM results above for the nexus between food security and financial inclusion.

Table 5: GMM results

Variables	Food production index	Prevalence of undernourishment	Average dietary energy requirement	Average value of food production
ATMs per 100,000 adults	-0.695**	0.302***	-0.333***	-1.404*
	(0.336)	(0.0587)	(0.110)	(0.767)
Bank accounts per 1,000 adults	0.0153	-0.00934***	0.00785*	0.0195
	(0.0184)	(0.00319)	(0.00447)	(0.0321)
Bank branches per 100,000 adults	12.03***	-2.213***	1.814***	6.484**
	(1.725)	(0.293)	(0.361)	(2.714)
GDP per capita (constant 2010 US$)	0.00547	0.00302***	0.00296***	-0.00434
	(0.00603)	(0.000987)	(0.00107)	(0.00764)
Unemployment (% of total labour force)	-2.212**	-0.425***	0.0361	-0.305
	(0.947)	(0.161)	0.00296***	(1.262)
Inflation (consumer price)	-0.167	0.00764	0.00189	-0.192
	(0.186)	(0.0327)	(0.0314)	(0.215)
2.country	-34.87	3.512	-7.535*	67.74**
	(23.55)	(3.950)	(3.985)	(28.49)
3.country	22.49		28.39***	-14.62
	(15.06)		(2.874)	(20.06)
4.country	9.635	-11.98***	9.137**	127.9***
	(22.29)	(3.767)	(4.533)	(32.07)
5.country	53.81**	-32.85***	-61.42***	-40.02
	(24.31)	(4.145)	(5.223)	(36.56)
6.country	31.01	-25.69***	18.21***	21.64
	(18.69)	(3.170)	(3.424)	(24.02)
7.country	74.85***	-36.80***	31.70***	36.52
	(18.92)	(3.206)	(3.587)	(25.11)
9.country	-265.8***	21.41***	-15.71**	-27.79
	(34.01)	(5.776)	(6.309)	(44.46)
11.country	-92.78***	10.43***		
	(21.55)	(3.730)		
14.country	(21.55)	(3.730)		
	50.49***	-25.79***		
15.country	51.20***	-1.466	5.663**	-20.33
	(13.39)	(2.283)	(2.694)	(18.59)
16.country	-23.75	-6.521**	4.626	-54.51**
	(16.27)	(2.742)	(3.099)	(21.68)
Constant	69.60***	67.45***	73.08***	117.6***
	(22.31)	(3.801)	(4.121)	(28.88)
Observations	124	121	110	103
R-squared	0.773	0.961	0.993	0.909

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: author's construction.

Table 5 shows that ATMs per 100,000 adults is significant on all proxies of food security. PoU is found to positively related with ATMs at the 1 per cent level, while FP, AVOP, and ADER are found to be negatively related with ATMs at varying levels of significance (1, 5, and 10 per cent). This is in line with the a priori expectation that an increase in ATMs per 100,000 adults will reduce the prevalence of undernourishment while increasing AVOP, FP, and ADER.

Bank account shows a negative relationship with PoU and a positive relationship with ADER (significant at 1 and 10 per cent, respectively). This conforms with our a priori expectation. CGAP (2009) asserts that policies to promote basic accounts have potential, but only if banks are on board, as basic bank accounts are viewed as an entry product with the eventual goal of users 'graduating' to full-scale banking. Conversely, Sarma (2008) challenges the use of a single indicator of financial inclusion due to its inability to inform on the extent of financial inclusion, as evidenced by the Indian case.

Bank branches per 1,000 adults is found to be positively related to FP, ADER, and AVOP and negatively related to PoU (significant at 1 and 5 per cent (AVOP)). This is in line with a priori expectations, although broad availability of bank branches does not by itself imply that a system is inclusive, since the geo-location of the point of sale is unknown (Camara and Tuesta 2017). In contrast, Ulwodi (2017) reported that the expansion of bank branches to remote areas is more likely to reduce poverty.

GDP per capita is at 1 per cent in both PoU and ADER and reveals a positive relationship with ADER and a negative relationship with PoU. This conforms to our a priori expectation that GDP will increase ADER and reduce PoU. Smith et al. (2017), in their study for Latin America and the Caribbean, reported that a 10 per cent increase in a country's GDP per capita reduced the probability of moderate to severe food insecurity by 11.5 per cent and of severe food insecurity by 9.7 per cent. The study of 134 countries also finds the same negative relationship between GDP and PoU, but with smaller effects and with statistically significant results only for low- and high-income countries. The FAO (2019) also finds a negative relationship between GDP per capita and severe food insecurity.

Unemployment is found to be negatively associated with PoU and is significant at 0.01 per cent, implying a strong negative relationship with the dependent variable PoU. The results are not in line with the expectation that an increase in unemployment will increase food security. The FAO, IFAD, UNICEF, WFP, and WHO (2018) assert that unemployment has a negative impact on access to high-quality, nutritious food, which tends to be less affordable mainly for poor people, who spend most of their income on food. Birkenmaier et al. (2016) found that unemployment and loss of income are significantly associated with food insecurity for the population at large.

At country level, FP was significant at different levels in seven of the eleven countries that were estimated. PoU and AVER was significant in nine of the eleven countries with varying levels of significance, while AVOP was significant in four of the eleven countries at different levels of significance.

6.4   Overall level of significance

In order to measure how well the model fits the data, consideration is given to the value of R-squared (R^2). According to Brooks (2008) and Wooldridge (2016), a high value of R^2 implies an adequate and reliable model. Using GMM results, R^2 of 77.3, 96.1, 99.1, and 90.9 per cent were obtained for FP, PoU, AVER, and AVOP, respectively. This indicates that all models are a good fit with the data.

7   Conclusions and recommendations

This study reported interesting results with regard to the financial inclusion and food security nexus. The macroeconomic analysis of the nexus between financial inclusion and welfare using a

panel estimation technique reported a strong argument in favour of the nexus, indicating that financial inclusion is associated with improved food security in terms of lower prevalence of undernourishment and increased average dietary energy consumption, food production, and average value of food production. However, the marginal effect varies with the number of ATMs per 100,000 adults, number of bank accounts per 1,000 adults, and number of bank branches per 100,000 adults, as well as with the index of financial inclusion, resulting in a significant positive effect on food security.

These findings indicate that there is a relationship between financial inclusion and food security. The majority of financial inclusion variables/proxies support this conclusion. While all proxies of food security are found to have some sort of association with financial inclusion, two proxies of food security are found to be highly related with the explanatory variable—namely, prevalence of undernourishment and average dietary energy requirement.

This study therefore strongly suggests that financial inclusion plays an integral part in food security. This is observed in different components of food security, although the magnitude of the impact varies with the components in question. In addition, the direction of the impact seems to differ from that initially proposed, which could be attributed to the fact that financial inclusion in the region is still developing.

The study also sought to explore trends in financial inclusion and food security in the SADC region. It is notable that the number of accounts with financial institutions is still low in the region (and the African continent as a whole) compared with the global average, with the exception of South Africa, Mauritius, Botswana, and Namibia, while Madagascar and Mozambique have particularly low levels of account penetration. The prevalence of saving at a formal institution is also fairly low in most countries compared with the global average, with saving clubs seen as attractive in the region. In addition, borrowing from a formal institution is still low, while borrowing from private lenders seems to be attractive in most countries in the region.

7.1   Policy recommendations

The study establishes that there is a positive nexus between financial inclusion and food security, the research identifying a need to expand access to targeted financial services within the region—especially to the poor and vulnerable population—in order to increase financial literacy and empower consumers to make good financial decisions, increase the supply of basic services by the government, and stimulate economic activity targeted at employment creation, which in turn would improve incomes and welfare.

Extending access to a broad range of formal financial services would also improve competition in the financial services sector and result in lower transaction costs. Financial literacy could even be added to the school curriculum in order to acquaint individuals with various financial products at an early age.

Moreover, the problem of food security should not be viewed as a rural problem, thereby formulating policies that are biased towards rural areas and ignoring the urban food crisis. The world is becoming more urbanized as most rural inhabitants migrate to cities in search of greener pastures, thereby increasing dependence on purchased produce and basic services from the government. It is therefore proposed that government increase service delivery in both rural and urban areas to cushion against rural dwelling migration to cities in search of better opportunities. In addition, concerted effort should be directed at the expansion of processing of agricultural produce, mainly in rural areas, to increase employment and income beyond the primary agriculture sector.

Finally, research on the nexus between food security and financial inclusion should be advanced, so as to strengthen the methodological framework. This study focused on the link between financial inclusion and food security in sub-Saharan Africa, for which data are sparse in some countries. Thus, future studies on the subject ought to look at Africa as a whole or adopt a regional-level or perhaps city-level approach, as emerging evidence suggest that the continent is becoming more urbanized.

Abbreviations

ADER   Average Dietary Energy Requirement

ATM   Automated Teller Machine

AVOP   Average Value of Food Production

FP   Food Production

FPI   Food Production Index

GMM   Generalized Method of Moments

PoU   Prevalence of Undernourishment

SADC   Southern African Development Community

SOFI   State of Food Security

UN   United Nations

DRC   Democratic Republic of Congo

References

Abdalla, Y.I. (2007). 'Causes of Food Insecurity in Southern Africa: an Assessment'. MSc thesis. University of Stellenbosch.

AFDB (2011). 'Recent Trends in Global Food Prices'. Abidjan: African Development Bank.

Angelucci, M., D. Karlan, and J. Zinman (2013). 'Win Some Lose Some? Evidence from a Randomized Microeconomic Programme'. NBER Working Paper 19119. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w19119

Arcand, J.L., E. Berkes, and U. Panizza (2012). 'Too Much Finance?'. IMF Working Paper WP/12/161. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781475504668.001

Arrelano, M., and O. Bover (1995). 'Another Look at the Instrument Variable Estimation of Error-components Models'. *Journal of Econometrics*, 68(1): 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Beck, T., L. Senbet, and W. Simbanegavi (2014). 'Financial Inclusion and Innovation in Africa: an Overview'. *Journal of African Economics*, 24 (s1): i3–i11. https://doi.org/10.1093/jae/eju031

Benerjee, A., D. Karlan, and J. Zinman (2015). 'Six Randomised Evolutions of Microcredit Introduction and Further Steps'. *American Journal: Applied Economics*, 7(1): 1–21. https://doi.org/10.1257/app.20140287

Bernanke, B., and M. Gertler (1989). 'Agency Costs, Net Worth, and Business Fluctuations'. *American Economic Review*, 79: 14–31.

Birkenmaier, J., J. Huang, and Y. Kim (2016). 'Food Insecurity and Financial Access During an Economic Recession: Evidence from the 2008 SIPP'. *Journal of Poverty*, 20(2): 194–213. https://doi.org/10.1080/10875549.2015.1094767

Brooks, C. (2008). *Introductory Econometrics for Finance*. 2nd Edition. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511841644

Brune, L., X. Giné, X., J. Goldberg, and D. Yang (2016). 'Facilitating Savings for Agriculture: Field Experimental Evidence from Malawi'. *Economic Development and Cultural Change*, 64(2): online. https://doi.org/10.1086/684014

Buera, F., J. Kaboski, and Y. Shin (2012). 'The Macroeconomics of Microfinance'. NBER Working Paper 17905. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w17905

Camara, N., and D. Tuesta (2017). 'Measuring Financial Inclusion: a Multidimensional Index'. Presented at Bank of Morocco-CEMLA-IFC Satellite Seminar at the ISI World Statistics Congress on Financial Inclusion, Marrakech, 14 July.

CGAP (2009). 'Measuring Access to Financial Services around the World'. Washington, DC: Consultative Group to Assist the Poor.

Chen, P.F., C.C. Lee, and C.F. Lee (2012). 'How Does the Development of the Life Insurance Market Affect Economic Growth? Some International Evidence'. *Journal of International Development*, 24(7): 865–93. https://doi.org/10.1002/jid.1765

Christiaensen, L., L. Demery, and J. Kuhl (2011). 'The (Evolving) Role of Agriculture in Poverty Reduction—an Empirical Perspective'. *Journal of Development Economics*, 96(2): 239–54. Available at: https://ideas.repec.org/a/eee/deveco/v96y2011i2p239-254.html (accessed 2 August 2021).

Crepon, B., F. Devoto, E., Duflo, and W. Pariente (2014). 'Estimating the Impact of Microcredit on Those Who Take It up: Evidence from a Randomized Experiment in Morocco'. NBER Working Paper 20144. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w20144

Demirguc-Kunt, A., and L. Klapper (2012). 'Measuring Financial Inclusion: the Global Findex Database'. Washington, DC: The World Bank. https://doi.org/10.1596/1813-9450-6025

Demirgüç-Kunt, A., L. Klapper, D. Singer, S. Ansar, and J. Hess (2017). 'The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution'. Washington, DC: The World Bank https://doi.org/10.1596/978-1-4648-1259-0

Dupas, P., and J. Robinson (2013). 'Savings Constraints and Microenterprise Development: Evidence from a Field Experiment in Kenya'. *American Economic Journal: Applied Economics*, 5(1): 163–92. https://doi.org/10.1257/app.5.1.163

Fama, E.F. (1970). 'Efficient Capital Markets: a Review of Theory and Empirical Work'. The Journal of Finance, 25(2): 383–417. https://doi.org/10.2307/2325486

FAO (2019). 'Safeguarding against Economic Slowdowns and Downturns Food Security and Nutrition in the World Food and Agriculture Organization of the United Nations'. Rome: Food and Agriculture Organization. Available at: www.fao.org/3/ca5162en/ca5162en.pdf (accessed 2 August 2021).

FAO, IFAD, UNICEF, WFP, and WHO (2017). 'The State of Food Security and Nutrition in the World 2017. Building Resilience for Peace and Food Security'. Rome: Food and Agriculture Organization. Available at: www.faostat.org (accessed 17 October 2019).

FAO, IFAD, UNICEF, WFP, and WHO (2018). 'The State of Food Security and Nutrition in the World 2017. Building Climate Resilience for Food Security and Nutrition'. Available at: www.faostat.org (accessed 17 October 2019).

FAO, IFAD, UNICEF, WFP, and WHO (2019). 'The State of Food Security and Nutrition in the World. Safeguarding against Economic Slowdowns and Downturns'. Available at: www.faostat.org (accessed 17 October 2019).

Finmark Trust (2016). 'SADC Financial Inclusion Strategy Workshop'. Report. Available at: https://finmark.org.za/sadc-financial- inclusion-indaba-report/ (accessed 17 May 2019).

Greenwood, J., and B. Jovanovich (1990). 'Financial Development Growth and the Distribution of Income'. NBER Working Paper 3189. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.1086/261720

Honohon, P., and M. King (2012). 'Cause and Effect of Financial Access: Cross-country Evidence from the Finscope Surveys'. In R. Cull, A. Demirguc-Kunt, and J. Murdoch (eds). *Banking the World: Empirical Foundations of Financial Inclusion*. Cambridge, MA: MIT Press.

Ikhede, S.I. (2015). 'The Finance and Growth Debate in Africa: What Role for Financial Inclusion?'. Cape Town: SUN Media.

Kaboski, J.P., and R.M. Townsend (2012). 'The Impact of Credit on Village Economies'. *American Economic Journal: Applied Economics*, 4(2): 98–133. https://doi.org/10.1257/app.4.2.98

Keynes, M. (1936). *The General Theory of Employment Interest and Money*. In *The Collected Writings of John Maynard Keynes*. New York: Polygraphic Company of America.

Kiyotaki, N., and J. Moore (1997). 'Credit Cycles'. *Journal of Political Economy*, 105: 211–48. https://doi.org/10.1086/262072

Maimbo, S.M., and C.A.H. Gallegos (2014). 'Interest Rate Caps around the World'. World Bank Policy Research Working Paper 7070. Washington, DC: The World Bank.

Manyame, C. (2002). 'Food Security in SADC'. Johannesburg: Institute for Global Dialogue.

Mckenzie, D. (2004). 'Asymptotic Theory for Heterogeneous Dynamic Pseudo-panel'. *Journal of Econometrics*, 120(2): 235–62. https://doi.org/10.1016/S0304-4076(03)00213-6

Mwangi, I.W. (2017). 'Dynamic of Financial Inclusion and Welfare in Kenya'. Thesis. University of Nairobi. Available at: http://wtochairs.org/sites/default/files/Mwangi_Dynamics%20Of%20Financial%20Inclusion%20And%20Welfare%20In%20Kenya.pdf (accessed 2 August 2021).

Mwangi, I., and R. Atieno (2018). 'Impact of Financial Inclusion on Consumption Expenditure in Kenya'. *International Journal of Economics and Finance*, 10(5): 114–28. 10.5539/ijef.v10n5p114

Ouma, S.A., T.M. Odongo, and M. Were (2017). 'Mobile Financial Services and Financial Inclusion: Is It a Boon for Savings Mobilization?'. *Review of Development Finance*, 7(1): 29–35. https://doi.org/10.1016/j.rdf.2017.01.001

Romer, P.M. (1986). 'Increasing Returns and Long-run Growth'. *Journal of Political Economy*, 94(5): online. https://doi.org/10.1086/261420

Rousseau, P.L., and P. Wachtel (2011). 'What is Happening to the Impact of Financial Deepening on Economic Growth?'. *Economic Inquiry*, 49(1): 276–88. https://doi.org/10.1111/j.1465-7295.2009.00197.x

Sarma, M. (2008). 'Index of Financial Inclusion: a Concept Note'. ICRIER Working Paper 215. New Delhi: Indian Council for Research in International Economic Relations.

Saxegaard, M. (2006). 'Excess Liquidity and Effectiveness of Monetary Policy: Evidence from Sub-Saharan Africa'. IMF Working Paper WP/06/115. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781451863758.001

Schumpeter, J.A. (1934). *The Theory of Economic Development: an Inquiry into Profits Capital Credit Interest and the Business Cycle*. Cambridge, MA: Harvard University Press.

Sen, A. (1977). 'Social Choice Theory: a Re-examination'. *Econometrica*, 45(1): 53–88. https://doi.org/10.2307/1913287

Sen, A. (1981). *Poverty and Famines: an Essay on Entitlement and Deprivation*. New York: Oxford University Press.

Smith, M.D., M.P. Rabbitt, and A. Coleman-Jensen (2017). 'Who are the World's Food Insecure? New Evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale'. *World Development*, 93: 402–12. https://doi.org/10.1016/j.worlddev.2017.01.006

Ulwodi, D.W. (2017). 'Financial Inclusion and Welfare Evidence from the Global Findex and Financial Access Surveys'. PhD Thesis. University of Nairobi.

Wooldridge, J.M. (2016). *Introductory Econometrics: A Modern Approach* (6th edition). Cambridge, MA: South-Western College Publishing.

Wright, R., E. Teckin, V. Topalli, C. McClellan, T. Dickson, and R. Rosenfeld (2014). 'Cashless Crime Less: Evidence from the Electronic Benefit Transfer Program'. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w19996

Appendix

Food production index

Sargan test of overidentifying restrictions

> H0: overidentifying restrictions are valid
>
> chi2(58) = 76.65111
>
> Prob > chi2 = 0.0510

Arellano–Bond test for zero autocorrelation in first-differenced errors

```
+---------------------------+
|Order |  z    Prob > z|
|------+---------------|
|  1  |-4.2886  0.0000 |
|  2  |-.14001  0.8886 |
+----------------------+
```

Prevalence of undernourishment

Sargan test of overidentifying restrictions

> H0: overidentifying restrictions are valid
>
> chi2(64)   = 85.25901
>
> Prob > chi2 =   0.0391

Arellano–Bond test for zero autocorrelation in first-differenced errors

```
+----------------------+
|Order |  z    Prob > z|
|------+---------------|
|  1  |-2.3324  0.0197 |
|  2  |-.50539  0.6133 |
+----------------------+
```

> H0: no autocorrelation

Average dietary energy requirement

Sargan test of overidentifying restrictions

H0: overidentifying restrictions are valid

chi2(58) = 52.67544

Prob > chi2 = 0.6729

Arellano–Bond test for zero autocorrelation in first-differenced errors

```
+----------------------+
|Order |  z    Prob > z|
|------+---------------|
|  1  | -4.346  0.0000 |
|  2  | 1.6344  0.1022 |
+----------------------+
```

H0: no autocorrelation

Average value of food production

Sargan test of overidentifying restrictions

H0: overidentifying restrictions are valid

chi2(51) = 63.17596

Prob > chi2 = 0.1178

Arellano–Bond test for zero autocorrelation in first-differenced errors

```
+----------------------+
|Order |  z    Prob > z|
|------+---------------|
|  1  |-3.5907  0.0003 |
|  2  |-.39298  0.6943 |
+----------------------+
```

H0: no autocorrelation