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Governance quality, remittances and their implications for food and nutrition security in Sub-Saharan Africa

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ABSTRACT

Despite impressive progress in the fight against malnutrition and hunger in recent years, food and nutrition insecurity remains a major concern in Sub-Saharan Africa (SSA) countries. In this study, we employ a panel data covering 15 SSA countries from 1996 to 2015 to investigate the growth effects of remittances and quality of governance on food and nutrition security, proxied by the average value of food production and the average dietary energy supply adequacy, respectively. We use a dynamic empirical model based on system GMM to control for unobserved heterogeneity and potential endogeneity of the explanatory variables. The empirical results emanating from our analysis show that the interaction of remittances and the composite index of governance quality exerts positive and significant effects on the average value of food production, and also contributes to the improvement of average dietary energy supply adequacy in SSA. In addition, the control of corruption, government effectiveness, political stability and rule of law scores increase both measures of food and nutrition security. Albeit, the contribution of control over corruption score is relatively the largest as compared to other indicators of governance.

1. Introduction

In response to attaining the 2030 deadline set for achieving the Sustainable Development Goals (SDGs), Sub-Saharan Africa (SSA) has made some progress towards reducing the proportion of its population suffering from food insecurity. Overall, the prevalence of hunger in the region declined by 31 percent between the base period (1990–92) and 2015, according to the estimates of the State of Food Insecurity in the World (FAO, 2016). Despite this impressive development, which may still be considered unsatisfactory, SSA still remains the region of the world with the highest prevalence and persistence of food insecurity through the lenses of "hunger experience" (Liu et al., 2008; Shah, Fischer, & van Velthuizen, 2008; Mohammed & Uraguchi, 2013). According to a recent report by FAO, "153 million individuals, about 26 percent of the population above 15 years of age in Sub-Saharan Africa, suffered from severe food insecurity in 2014/15. In other words, one out of four individuals above 15 years of age in the region, on average, was "hungry but did not eat or went without eating for a whole day because there was not enough money or other resources for food" (FAO, 2016). The consequences of food insecurity and malnutrition pose a threat for human development, social peace, health and consequently, the overall economic development of the region (World Bank, 2006; Ogunniyi, Olagunju, Kabir, & Adeyemi, 2016; Upton, Cisse & Barrett, 2016). This clearly calls for urgent efforts to create and spur an enabling policy environment for improving food and nutrition security in the region (FAO, 2016).

The SSA region has witnessed a significant increase in the receipt of international capital flows in the form of remittances, constituting a major component of capital inflow as compared to other external flows (World Bank, 2016). Compared to other types of external finance, such as Official Development Assistance (ODA) and portfolio equity, the inflow of remittances in SSA has overridden others and it was regarded as the most stable source of external finance in 2015 (African Economic Outlook, 2016). The continuous increase of remittances to SSA signaled the renewed attention this type of external finance has received among policy analysts, policy makers and researchers in recent years. The impact of remittances on the livelihood of households, food security and

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economic growth is well researched in literature, but with mixed results. Adams and Page (2005), Banga and Sahu (2010), Williams, Paudel, and Pandit (2013) and Lim & Basnet (2017) establish the significance of remittances in improving economic conditions of households in low-income economies. The impact of remittances is particularly visible in the rural and resource-poor communities of developing countries (Adams & Page, 2005; Thieme & Wyss, 2005). Similarly, Ratha (2003) reveals that economic growth depends on remittances through the investment multiplier. Babatunde and Martinetti (2010) show that remittances have a positive and significant effect on calorie intake in Kwara state in Nigeria, but no effect on dietary quality, micro nutrient and child nutritional status. Meanwhile, the studies of Ahamada and Coulibaly (2013), Zuniga (2011) and Chami, Fullenkamp, and Jahjah (2003) suggest that remittances fuel inflation of food prices and reduce labor market participation, thereby resulting to inability of poorer households and perhaps households that do not receive remittances to afford food.

The quality of governance is perceived to be an essential element for fostering adequate environment that is key to enhancing national food and nutrition security and economic growth. According to Rodrik, Subramanian, and Trebbi (2004), the quality of institutions is vital for all economic processes since they determine the volume and efficiency of all investments in the economy. Despite the importance of governance quality, most studies only focus on the impact of government policies that are targeted directly at improving food and nutrition security, with less attention given to the relevance of the quality of governance such as rule of law and order, government effectiveness, and voice and accountability. Some studies stress the potential of political initiatives that (re-) connect the demand and supply ends of the food system (Lang & Barling, 2012; Marsden & Sonnino, 2012). Food and nutrition insecurity is closely associated with weak and unstructured institutions, or failure of the state to adopt strategies that ensure that legal rights and entitlements of its citizens (Sen, 1981). For instance, the financial misappropriation and neglect of the rule of law on part of the Malawian government in the sale of the country's strategic grain reserves played a significant role in spurring the worst famine experienced in Malawi in 1949 (Clover, 2003).

With the complex interplay of social, economic, cultural, legal, and political factors in SSA, the overall governance quality-remittances–food and nutrition security nexus becomes absolutely central to analyze. As noted in previous paragraphs, most empirical studies focused on the sole contribution of remittances on food and nutrition security, albeit with inconclusive results. The inconclusiveness of these findings may be due to differences in the quality of financial development and the quality of institutions of the recipient countries (Issahaku, Abu, & Nkegbe, 2018). According to Crush (2013), the mediating role of governance is strikingly absent from existing debates on remittances, food and nutrition security, and economic growth. To the best of our knowledge, we are not aware of any previous study that examines the impact of remittances and governance quality on food and nutrition security in SSA.

In this paper, we take a broader outlook and focus our attention on the overall level of food and nutrition of population in the SSA region as specified by the average dietary energy consumption and the average value of food production. With this approach, we are able to rigorously, for the first time in literature, examine the impact of governance quality, remittances and other factors on food and nutrition security. More specifically, we employ a dynamic modeling approach that is better suitable for the analysis of policy reforms that have long-term effects. In particular, we employ a two-step Generalized Method of Moments (GMM) estimator to control for unobserved heterogeneity and potential endogeneity of the key explanatory variables.

The remainder of the paper is structured as follows. The next section discusses studies on the relationship between remittances, governance quality and food and nutrition security. Section 3 provides details regarding the empirical specification and estimation techniques used in the analysis, while section 4 describes the data. Section 5 presents the empirical results. The last section offers concluding remarks along with some policy recommendations emanating from the empirical findings.

2. Remittances, governance quality and food and nutrition security nexus

Issues surrounding governance, migration and their nexus to food and nutrition security (FNS from now on) is an Africa-wide growing consideration and a matter of serious concern in SSA (Paarlberg, 2002; Sahley, Groelsema, Marchione, & Nelson, 2005; UN, 2010; Garrity et al., 2010; Zezza, Carletto, Davis, & Winters, 2011; Boyd and Holly Wang, 2011; Pereira & Ruysenaar, 2012). Governance can be the main driver of food (in)security (Boyd and Holly Wang, 2011; Pereira & Ruysenaar, 2012; Vos, 2015). This suggests that the bond between governance quality and FNS can be destructive or supportive; a country with adequate food secured citizens is expected to have stable governance, whereas a food-insecure country can undermine governance (Brinkman & Hendrix, 2011). Arguably, most of the extreme terrorism and armed conflicts in the world take place in low-income, food-deficit and highly malnourished countries (for instance, SSA countries like Somalia, Eritrea, Nigeria, Sudan, Liberia, etc.) that depend on traditional agricultural production (Paarlberg, 2002).

In most of SSA countries, recent policies and programs implemented to address challenges linking agriculture and FNS are stalled by difficult political procedures and connections between "important" interested parties (stakeholders such as public sectors, private sectors, and farmers) who are in possession of imbalanced power and reduced access to resources (Ndulu et al., 2008). Therefore, in order to design and implement food and nutrition security approaches that respond to different and ever-changing needs by supporting objectives and actions across all levels of the government, the role of governance cannot be undermined and must be systematically integrated (Persson & Tabellini, 2006; Pereira & Ruysenaar, 2012).

Migration, on the other hand, has become a crucial component in the livelihood strategies of an increasing number of households across the developing world (especially SSA) and remittances have stretched intensely in the last decade (De Brauw, 2015; Lambert, Ravallion, & van de Walle, 2014; FAO, 2014; Nagler & Naude, 2017). Over the years, various studies (Hildebrandt, McKenzie, Esquivel, & Schargrodsky, 2005; Zezza et al., 2011; Davis & Brazil, 2016) have established a dual (positive and negative)[1] relationship between remittances and food and nutrition security. Remittances can generate a positive, undeviating income effect on the receiving household, increasing the household's ability to access important FNS inputs such as adoption of productivity enhancing agricultural practices, purchase of improved seeds, fertilizer and possibly produce micronutrient rich food. The income elasticities of these food and nutrition-related expenditures may vary significantly and the empirical evidence on the subject, although rather rich, is still quite contentious[2]. On the other hand, other studies (Hamilton, Villarreal,

[1] The sending of a migrant means the loss or reduced presence of one or more members of the household. On the consumption side this clearly means fewer mouths to feed and to support in other ways. On the production side, migration means the loss of labor and, in fact, the negative consequences of migration on food and nutrition security are likely to come through this labor loss (Zezza et al., 2011).

[2] See, for example, among many others, Behrman and Deolalikar (1987), Bouis and Haddad (1992), Subramanian and Deaton (1996), and Zezza et al. (2011).

& Hummer, 2009; Davis & Brazil, 2016) revealed that remittances through migration can have a negative effect on FNS through the disruptive effects on the left behind members. Particularly in the long run, migration of the household member with view of sending remittances, reduces the household labor endowment, with hypothetically negative effects on food production and income generation (McKay, 2007; Schmeer, 2009). Waidler and Deveroux (2019) have recently estimated the effects of both social grants and remittances on (and) food security and nutrition, in the case of South Africa. By using the National Income Dynamic Survey, South Africa's first nationally representative survey that follows more than 28,000 individuals over time, they found significant and positive impacts of the Older Person's Grant and of remittances on the dietary diversity index, but not of the Child Support Grant. They also found no effect on food expenditure or on anthropometry (BMI) by the Older Person's Grant, or remittances. The authors, however, report some positive effects on children's BMI from the Child Support Grant.

Other studies (Zezza et al., 2011; Ahmed, 2013; Uchendu & Abolarin, 2015; Davis & Brazil, 2016) also asserted that remittances might not have sustainable effect on food and nutrition security in a regime of weak or poor governance. Remittances will not thrive, hence have little or no effect on FNS, where corruption, government ineffectiveness, political instability, impoverished regulatory quality, depraved regulatory quality and stumpy voice and accountability is the order of the day in the public domain in SSA (Aziz, 2001; Uchendu & Abolarin, 2015). Therefore, the disintegration of quality governance, even in the presence of remittances, will not have a sustainable impact in reducing food and nutrition insecurity in SSA.

3. Empirical specification and estimation

We employ a dynamic estimation approach to analyse the impact of governance quality and remittances on food and nutrition security for a number of Sub-Saharan African countries. The dynamic aspects of remittances and governance coupled with the need to satisfactorily address potential endogeneity bias that may arise from such specification requires that we use a dynamic panel model framework. The functioning of economic process is dynamic in nature which is anticipated in the context of policy reforms that have potential long-term effects that extend far beyond the immediate term into the future. Therefore, employing a dynamic model to measure the impact of independent/explanatory variables over time is appropriate. Based on this premise, many studies that conducted a cross-country analysis have drifted from the use of a static model to dynamic approach (e.g. Headey, 2013). To this end, we model food security and nutrition security level as a function of past food security and nutrition security level (accounting for the impact of past policy reforms) and current factors/set of explanatory variables[3]. Hence, we specify the dynamic model for this study as[4]:

$$Y_{it} = \rho Y_{it-1} + \beta G_{it} + \varnothing R_{it} + \partial X_{it} + \eta_i + \delta_t + \varepsilon_{it} \quad (1)$$

where Y_{it} denotes nutrition security and food security proxied by the average dietary energy supply adequacy of country and the average value of food production, respectively. The average dietary energy supply adequacy and average value of food production are commonly quantitative proxies for national food and nutrition security used in the literature (Dithmer & Abdulai, 2017; Kennedy et al., 2010; Babatunde & Martinetti, 2010). Also, the adoption of these two measures is premised on their great data availability across SSA countries and years understudied, coupled with the fact that they are among the major indicators of food and nutrition security (as in FAO, 2013). ρY_{it-1} represents average dietary energy supply adequacy and average value of food production lagged one year. G_{it} is the composite of governance quality indicator measured as the first principal component of indicators of governance quality indicators such as the control of corruption, government effectiveness, political stability, rule of law, voice and accountability and regulatory of law (see Emara & Jhonsa, 2014); R_{it} is the personal remittances. We treat governance quality measure and remittances as endogenous because of the potential reverse causality problem that may arise between the governance quality, remittances and food and nutritional outcomes, as countries may experience improved quality of governance, and reduced remittances in response to past food and nutrition security shocks. X_{it} denotes the set of control variables included in the model that are determinants of food and nutrition security and are elucidated below. $\eta_i is$ unobserved country-specific effects, for instance country specific characteristics such as geographical and institutional factors that do not change with time; δ_t denotes the time-specific effect, which accounts for shocks that do not vary among countries such as global demand shocks while ε_{it} is the error term. $\rho, \beta, \varnothing, \partial$ are the estimated parameters. The subscripts i and t represent the country and time periods, respectively.

The presence of the lagged dependent variable in combination with the time invariant unobserved heterogeneity (μ_i) subjects Eq. (1) to two main estimation problems. First, because unobserved heterogeneity (μ_i) is time invariant, if overlooked, it will cause serial correlation and bias the coefficient, especially if it is correlated with the independent variables. Second, Y_{it} is a function of unobserved heterogeneity, and because this is also true forY_{it-1}, it is correlated with ε_{it} which will make estimation using OLS bias upward (Bond, 2002). A common way of handling this problem is to use the Fixed Effects Model, a within transformation approach. Nickell (1981) has argued, however, that using a fixed effects model does not offer solution to this problem because the lagged dependent variable Y_{it-1} is correlated with ε_{it} which also leads to estimation bias. Approaches to remove both the time invariant term and the unobserved heterogeneity include first differencing the data (Anderson & Hsiao, 1982; Holtz-Eakin, Newey, & Rosen, 1988; Arellano & Bond, 1991), and the use of forward orthogonal deviations (Arellano & Bover, 1995). Another approach commonly used in the empirical literature is demeaning the data, however, this approach is not efficient because the lags of the explanatory variable would still be correlated with the demeaned variable (O'Neil, 2016). In this study, we employ the first-difference approach, although there are no significant differences in results we obtain using the forward orthogonal deviations. By taking the first difference of the data, Eq. (1) becomes:

$$Y_{it} - Y_{i,t-1} = \rho(Y_{i,t-1} - Y_{i,t-2}) + \beta(B_{it} - B_{i,t-1}) + (\delta_t - \delta_{t-1}) + (\varepsilon_{itit} - \varepsilon_{iti,t-1}),$$

with B_{it} including G_{it}, R_{it} and X_{it}. Instruments are required to deal with the problem that, by construction, the error term of Eq. (2), $(\varepsilon_{itit} - \varepsilon_{iti,t-1})$, is correlated with the lagged dependent variable $(Y_{i,t-1} - Y_{i,t-2})$. The instruments take advantage of the panel nature of the data and consist of previous observations of the lagged dependent variable. The same procedure can also be applied to account for the potential endogeneity of other explanatory variables contained in B_{it}. Under the (identifying) assumptions that the error term, ε_{it}, is not serially correlated, and the explanatory variables are weakly exogenous (meaning that they are uncorrelated with future realizations of the error term), lagged levels of the explanatory variables can be used as instruments in the specification (DeJong & Ripoll, 2006).

[3] The lagged dependent variable in the model controls for long-run effect of all control variables in the model (Dithmer & Abdulai, 2017).

[4] The framework assumes a Cobb–Douglas constant returns to scale production function in which the dependent and the explanatory variables are transformed into logarithmic forms (Barrett, Bellemare, & Hou, 2010).

First differencing accompanied with using the level of past values as instruments then gives rise to the well-known "Difference-Generalised Method of Moments (GMM)" estimator (Arellano & Bond, 1991). Despite its superiority over simpler panel data estimators, a problem with this Difference-GMM estimator is that lagged levels have been shown to be weak instruments for first-differences, if the series are very persistent (Bound, Jaeger, & Baker, 1995). Furthermore, by taking first differences, we can lose information related to the (long-run) relationship between the explanatory variables and the dependent variable. The presence of weak instruments affects the asymptotic and small-sample performance of the Difference-GMM estimator and may lead to inefficient and biased coefficient estimates (Baltagi, 2008).

According to Arellano and Bover (1995), efficiency can be increased by adding the original equation in levels to the system, which is known as the "System-GMM" estimator. In view of this, we also employ the two-step System-GMM estimator incorporating Windmeijer's (2005) finite-sample correction for standard errors. The two-step variant of the GMM estimator uses an optimal weighting matrix for the moment conditions. It weights the instruments by a consistent estimate of their covariance matrix, or more specifically, weights the moments in inverse proportion to their variances and covariances, such that highly correlated instruments get less weight in the estimation process (Roodman, 2009). The consistency of the GMM estimator depends on whether lagged values of the explanatory variables are valid instruments. We use the following misspecification tests of the validity of the identifying assumptions to address this issue: Arellano and Bond (1991) AR (1) and AR(2) tests of the serial correlation properties, and the Hansen (1982) J-test of over-identifying restrictions, which tests the validity of the instruments.[5]

4. Data sources and description

We employ a longitudinal data of fifteen selected Sub-Saharan African countries[6] over the period of 1996–2015. The choice of the variables and years understudied is based on the past studies and data availability. Data used in the study are taken mainly from the World Bank, 2016 World Development Indicators (WDI), World Bank Governance Indicators (WGI) and FAO's FAOSTAT.

We consider five groups of food and nutritional security determinants: First, variables that account for the country's economic and demographic structure; second, variables capturing the domestic macroeconomic policies and conditions; and finally, our composite governance index and remittances, which are the variables of interest in the study.

With regards to the first group of food and nutrition security determinants, the regressions include three variables capturing the country's economic and demographic structure. We use the percentage share of agriculture in GDP from the WDI. Differences in the contribution of agriculture in the value added in considered as a channel to scale food insecurity (Godfray et al., 2010). It drives economic growth in developing countries which is expected to result in increased aggregate supply of food, thereby influencing households' food poverty (Ames, Brown, Devarajan, & Izquierdo, 2001; Haddad, Alderman, Appleton, Song, & Yohannes, 2003). Also, we include the annual population growth rate (WDI) to capture demographic pressure on food and nutrition security. Annual population growth is intended to capture broadly one important facet of demographic development. Demographic pressure as indicated by high population growth leads to growing food requirements for the whole population and could reduce per capita food availability. Finally, to control for human capital formation, we include enrollment in secondary schools. Although there is no consensus on what constitutes education as human capital, we adopted enrollment in secondary schools, one of the indicators suggested in Ogundari and Awokuse (2018).

To account for macroeconomic factors, we use the consumer price index (CPI) inflation rate (WDI) as a measure for macroeconomic stability (also related to monetary policy), with high inflation being associated with bad macroeconomic policies (Loayza, Olaberria, Rigolini, & Christiaensen, 2012). Domestic stabilization policies that create an economically stable environment tend to have welfare enhancing effects, whereas macroeconomic instability has been found to increase poverty, thereby adversely affecting food and nutrition security (Ames et al., 2001, Agénor, 2004).

To measure the governance quality, we employed six main proxies including corruption-control, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability taken from WGI. According to Asongu and Nwachukwu (2016), these six proxies capture the three main aspects of governance including political, economic, and legal aspects of governance. Several governance quality measures have been developed, (e.g. Kunčič (2014)), however, most of these measures have been criticised for inconsistencies and cannot be used for cross-country studies. According to Kar and Saha (2012) and Sani, Said, Ismail, and Mazlan (2019), corruption and regulatory quality variables obtained from World Bank's compilation of the governance quality measures are the best and suitable for cross-country analysis. However, as a result of the possibility of correlation between the six governance indicators which may subject the model to multicollinearity, the six governance measures were used to construct the composite governance index as a principal component to form a single index (Kar and Saha (2012). The description of the variables employed in the study is provided in Table 1 below.

5. Empirical results

5.1. Correlation matrix of the explanatory variables

Tables 2 and 3 comprise the estimates of the model specification in Eq. (2) with three (3) alternative specifications in the choice of the governance and remittances variables. The first model presents the estimated results of the impact of remittances and composite governance index on average dietary energy supply adequacy and average value of food production, while the second model introduces the interaction effect of remittances and the composite governance index. The third specification reports the joint effect of remittances and individual indicators of governance quality on the outcome variables. All models contain the control variables. We examine the pattern of the relationships between the regression models' explanatory variables. The results of the correlation matrix of the explanatory variables employed are presented in Tables A1–B3 in the Appendix, respectively. Tables A1–A3 represent the correlation matrices for nutrition security while Tables B1–B3 represent the correlation matrices for food security. Correlation matrices provide instinctive evidence on the strong point of the bivariate relationships between variables (Self & Grabowski, 2004; Ogundari & Awokuse, 2018). We found that most of the correlation coefficients among the explanatory variables are <0.50. These weak values of the bivariate correlations in the study suggest that the issue of multicollinearity should not be a serious problem for the estimated model. Additionally, we estimate the aforementioned models using a static model approach. We used OLS, random effects and fixed effects to show static models results

[5] The 'joint null hypothesis' of the Hansen test is that the instruments are exogenous, i.e. they are not correlated with the error term, and the excluded instruments are correctly excluded from the estimated equation (Roodman, 2009).

[6] Angola, Gabon, Mauritius, Equatorial-Guinea, Botswana, Central Africa Republic, Ethiopia, Uganda, Niger, Togo, Cape-Verde, Ivory Coast, Nigeria, Swaziland and Sudan.

Table 1
Description of data used in the empirical analysis.

Variable	Description	Source	Mean	S.D.
Share of agriculture in GDP	Agriculture, forestry, and fishing, value added (% of GDP)	WDI	21.331	17.734
Remittances	Personal Remittances received in USD	WDI	1.03e + 09	3.88e + 09
Population growth	Percentage of population growth	WDI	2.358	0.889
Inflation	Consumer price index as proxy for inflation	WDI	25.652	260.174
Secondary school enrollment	Secondary school enrollment (percentage of gross) is used as a proxy for human capital.	WDI	24.880	29.811
Composite governance index (CGI)	Composite value of governance indicators	Authors' estimation	0.279	0.259
Remittances × CGI	Interaction between logged composite of governance indicator and logged remittances	WDI	0.131	16.365
Control of corruption score	Control of corruption score	WGI	−0.633	0.733
Government effectiveness score	Government Effectiveness score	WGI	−0.723	0.692
Political stability score	Political Stability score	WGI	−0.601	1.067
Rule of law score	Rule of law score	WGI	−0.653	0.764
Voice and accountability score	Voice and Accountability score	WGI	−0.730	0.842
Regulatory quality score	Regulatory quality score	WGI	−0.607	0.652
Average dietary energy supply adequacy	Average dietary energy supply adequacy (%) (3-year average)	FAOSTAT	83.431	46.579
Average value of food production	Average value of food production (constant I$ per person) (3-year average)	FAOSTAT	141.678	53.675

Source: Authors.

Table 2
The effect of governance quality and remittances on nutrition security (alternative model specifications).

Dep. Variable: Average dietary energy supply adequacy.	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
	Difference GMM			System GMM		
Lagged dep. Variable(t-1)	1.466***	0.0451***	1.986***	0.746**	1.084***	0.646*
	(0.647)	(0.108)	(0.508)	(0.315)	(0.299)	(0.340)
Remittances	0.082**		0.041	0.099***		0.098***
	(0.037)		(0.038)	(0.026)		(0.027)
Composite governance index (CGI)	0.424**			0.266**		
	(0.170)			(0.127)		
Control of corruption score			0.195***			0.519***
			(0.033)			(0.186)
Government effectiveness score			0.025			0.274***
			(0.391)			(0.026)
Political stability score			−0.189***			−0.168***
			(0.047)			(0.103)
Rule of law score			−0.387			0.609***
			(1.537)			(0.092)
Voice and accountability score			−1.240			0.926
			(1.724)			(0.916)
Regulatory quality score			−0.105			−0.168
			(0.181)			(0.162)
Remittances × CGI		0.149***			0.101***	
		(0.011)			(0.009)	
Population growth	−0.238	−0.204	−0.646	0.394	0.868	−0.036
	(0.703)	(0.659)	(0.760)	(0.541)	(0.534)	(0.579)
Inflation	−0.237**	−0.302***	−0.304***	−0.235**	−0.282***	−0.292***
	(0.106)	(0.096)	(0.109)	(0.096)	(0.096)	(0.097)
Secondary school enrollment	0.351***	0.315***	0.336***	0.359***	0.305***	0.344***
	(0.061)	(0.055)	(0.065)	(0.055)	(0.055)	(0.057)
Share of agriculture in GDP	−0.017	−0.052	−0.082	−0.014	−0.059	−0.096
	(0.094)	(0.086)	(0.098)	(0.086)	(0.086)	(0.088)
Constant	−1.704***	2.888***	11.220***	0.874***	−2.179***	1.682***
	(0.245)	(0.362)	(0.612)	(0.402)	(0.121)	(0.527)
Number of countries	15	15	15	15	15	15
Observations	285	285	285	285	285	285
Time fixed effect included	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect included	Yes	Yes	Yes	Yes	Yes	Yes
Test *(p-values)*						
AR (1) *p-values*	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
AR (2) *p-values*	0.421	0.303	0.310	0.110	0.326	0.647
Harsen test *p-values*	0.942	0.879	0.962	0.911	0.901	0.928

Notes: Values in parentheses are standard errors of the estimates. All variables are in logarithmic form; *** p < 0.01, ** p < 0.05, * p < 0.1. It is also important to note that we have followed Roodman (2009) to address the problem of proliferation by using lags of endogenous variables (including remittances, governance quality indicators, population growth, secondary school enrolments and the interactive remittances × CGI term).

Table 3
The effect of governance quality and remittances on food security (Difference GMM and System GMM approach).

Dep. Variable: Average value of food production	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	Difference GMM			System GMM		
Lagged dep. Variable(t-1)	0.825***	0.833***	0.794***	0.819***	0.822***	0.786***
	(0.066)	(0.065)	(0.067)	(0.059)	(0.056)	(0.060)
Remittances	−0.049		−0.050	−0.004		−0.005
	(0.048)		(0.047)	(0.034)		(0.034)
Composite governance index (CGI)	−0.020			−0.068		
	(0.187)			(0.177)		
Control of corruption score			0.345***			0.644***
			(0.006)			(0.059)
Government effectiveness score			0.729			0.843*
			(0.484)			(0.452)
Political stability score			0.167			−0.319*
			(0.178)			(0.171)
Rule of law score			0.403			0.528
			(1.704)			(1.519)
Voice and accountability score			−2.012			−1.430
			(2.091)			(1.946)
Regulatory quality score			−0.300			−0.333
			(0.206)			(0.205)
Remittances × CGI		0.166***			0.131***	
		(0.013)			(0.001)	
Population growth	−0.174	−0.319	−0.327	−0.122	−0.237	−0.331
	(0.613)	(0.619)	(0.601)	(0.508)	(0.504)	(0.498)
Inflation	0.197	0.224	−0.241*	−0.287**	−0.298**	−0.306**
	(0.140)	(0.138)	(0.140)	(0.136)	(0.134)	(0.136)
Secondary school enrollment	0.136	0.116	0.164*	0.166*	0.157*	0.187**
	(0.088)	(0.086)	(0.091)	(0.087)	(0.084)	(0.088)
Share of agriculture in GDP	0.0958	0.0962	0.0550	0.0539***	0.0458***	0.0231***
	(0.123)	(0.121)	(0.122)	(0.010)	(0.008)	(0.001)
Constant	0.540	−0.126	0.746	−0.309	−0.290	0.133
	(0.859)	(0.516)	(0.889)	(0.734)	(0.445)	(0.766)
Number of countries	15	15	15	15	15	15
Observations	285	285	285	285	285	285
Time fixed effect included	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect included	Yes	Yes	Yes	Yes	Yes	Yes
Test *(p-values)*						
AR (1) *p-values*	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
AR (2) *p-values*	0.197	0.335	0.190	0.200	0.956	0.667
Harsen test *p-values*	0.814	0.811	0.715	0.902	0.877	0.959

Notes: Values in parentheses are standard errors of the estimates. All variables are in logarithmic form; *** p < 0.01, ** p < 0.05, * p < 0.1. It is also important to note that we have followed Roodman (2009) to address the problem of proliferation by using lags of endogenous variables (including remittances, governance quality indicators, population growth, secondary school enrolments and the interactive remittances × CGI term).

(see Tables C1 and C2 in the Appendix). The core results of the static models are discussed in the sub-section dedicated to preliminary findings.

5.2. Preliminary findings

Fig. 1 shows the bivariate relationship between food security outcome variable and the remittance-governance interaction variable, without including the control variables. The relationship displayed in Fig. 1 reveals that there is a positive bivariate relationship between the between food security outcome variable and the remittance-governance interaction variable in the SSA region. A similar relationship, as shown in Fig. 2, was observed between nutrition security variable and the remittance-governance interaction variable, suggesting than an improvement in the remittance-governance interaction will lead to increase in nutrition security in the region.

The results of the static models including the pooled OLS, random effects and fixed effects are reported in Tables C1 and C2 in the Appendix. In Table C1, the empirical findings from all the static models revealed that the remittances variable was negative and significantly related to the food security outcome variable, and the composite governance index was found to be positive and significant in affecting food security outcome in the SSA region. Among the components of the composite governance index, only regulatory quality was found to be negative and significant in reducing food security in SSA region. This is rather unexpected, however, since the results could be associated with the endogeneity which might have affected the consistency of the coefficient.

Table C1 in the Appendix section presents the static models of the growth effect of remittances and governance quality on nutrition security. Remittances are statistically significant with a negative growth effect on nutrition in the static models. In support of this negative relationship, Kanaiaupuni and Donato (1999) and Hamilton et al. (2009) suggested that the temporary or long-term loss of a household breadwinner has contributed to poor children's nutritional outcomes, including higher rates of infant mortality.

In addition, the results showed that the control of corruption variable is positive although insignificant. The lack of significance for this variable in the static models could be associated with endogeneity which resulted in biased estimates. The coefficient for government effectiveness was insignificant on the level of nutritional security. Regarding political stability, the coefficients were found to be positive in the static models though only significant in the random and fixed effect models. The composite value of governance indicators estimated in the static models was positive and significant. However, the coefficients in the pooled OLS were higher than those in the random and fixed effect models. Finally, the coefficients of the interaction variable between remittances and quality of governance in the static models revealed that remittances and quality of government have a positive growth effect on nutrition security.

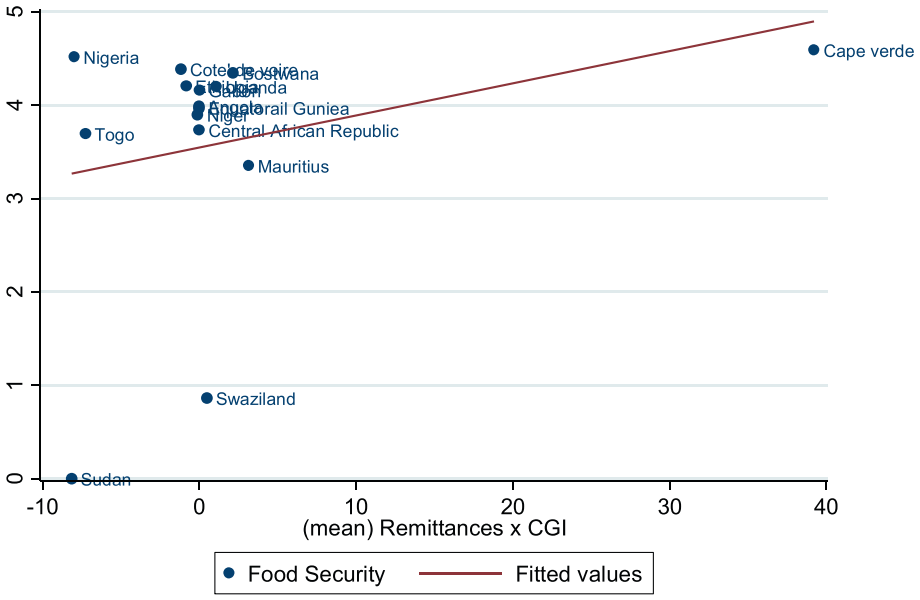

Fig. 1. Bivariate relationship – food security and the remittance-governance interaction in SSA (1996 to 2015).

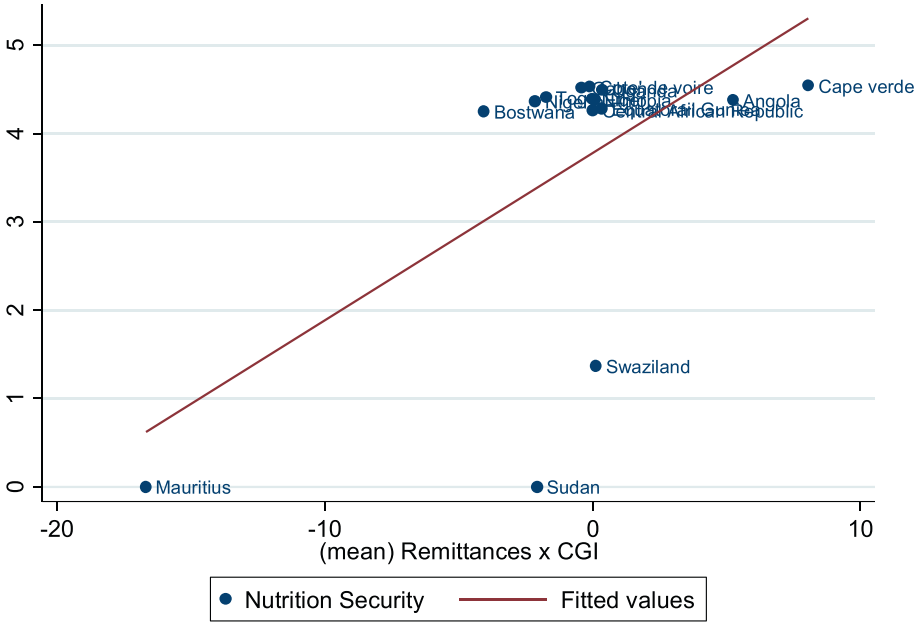

Fig. 2. Bivariate relationship – nutrition security and the remittance-governance interaction in SSA (1996 to 2015).

5.3. Effect of governance quality and remittances on nutrition security

Table 2 presents the estimated results of the effect of governance quality and remittances on nutrition security (proxied by average dietary energy supply adequacy) using a two-step difference GMM estimator, and the more robust system GMM estimator which incorporates the Windmeijer (2005) finite sample correction standard error. Additionally, we show the results of the alternative model specifications. The baseline models – (1) and (4) for difference and systems GMM respectively - present the estimated results of the impact of remittances and composite governance index on average dietary energy supply adequacy, while models (2) and (4) introduce the interaction effect of remittances and the composite governance index. The third category, models (3) and (6), report the joint effect of remittances and individual indicators of governance quality on the outcome variable. All models contain the control variables.

Following the standard practice, we start with the misspecification diagnostics of the results obtained from the empirical analysis – see models (1) to (6). The Arellano-Bond statistics, AR (1) and AR (2), test for the autocorrelation of the residuals. As anticipated, we reject the null hypothesis of no first-order residual serial correlation but accept the hypothesis of no second-order serial correlation. The Hansen test fails to reject the hypothesis of jointly valid instruments for all models estimated. The Hansen test statistic of overidentifying restrictions is insignificant, which suggests that the set of instruments employed fulfils the exogeneity condition required to obtained consistent estimates in the estimated models.

The results show that remittances are statistically significant with a positive growth effect on nutrition. With the inclusion of

governance indicators in the difference GMM, the coefficient on remittances lost its significance, while in the system GMM model, the significance remained the same. Similar findings were also reported for Tanzania by Isoto and Kraybill (2017) who identified that remittances improved the consumption of nutrients such as proteins and vitamins but did not improve the consumption of carbohydrates and fats, which implies that remittances receiving households were likely to consume healthier diets. The composite value of governance indicators estimated in GMM models was positive and significant. The lower coefficients in the system GMM model when compared to difference GMM model indicate the incorporation of finite sample correction standard error (Roodman, 2009).

In model (2) and model (4), the coefficients of interaction variable between remittances and quality of governance on both the difference and the system GMM models reveal that remittances and the quality of government have a positive growth effect on nutrition security. This is a striking information regarding the linkages and pathways of remittances and good governance. It suggests that both variables are complementary rather than supplementary in the overall process. Turning to models (3) and (6), the coefficient of the control of corruption is significant and positive in the difference and system GMM models. The growth effect of the control of corruption in the system GMM is quite higher than that in the difference GMM model. This implies that corruption has a higher effect on nutrition security when endogeneity is controlled for and when the variations in the level of corruption are considered across countries in the region. In a review of the determinants of malnutrition in SSA Bain et al. (2013) explained that the high level of corruption has aggravated the burden of malnutrition and its subsequent outcomes. The effect of various interventions put in place to tackle the problem in the region has been minimal due to misappropriation of funds and the failure to accord the problem of nutrition security the attention it requires.

In the difference GMM model, the coefficient for governance quality was insignificant on the level of nutritional security. However, in the system GMM model, the extent to which governance is effective has a positive and significant effect on the level of nutrition security among countries in SSA. This indicates that when the differences in the quality of governance across different countries are considered, its impact has significant influence on the nutritional security of households. Having said that, Fan et al. (2011) and Pardey, Alston, and Piggott (2006), have found that government ineffectiveness is a major factor undermining attempts at curbing nutrition insecurity in Africa, especially SSA countries. Regarding political stability, the coefficients were found to have a negative and significant effect on nutrition security. It is of note that a similar relationship was observed regarding the nexus between political stability and food security (see Table 3). Although, this is contrary to a priori expectations, Bello-Schünemann and Moyer (2018) have noted that Sub-Saharan Africa countries face many structural pressures that have escalated the risk of political instability and violent conflict, which has affected the welfare indicators such as food and nutrition security of the citizenry of the region over the years. Therefore, maintaining nutrition security in the context of political instability may likely not be realistic in the absence of other governance indicators (Maxwell, 2012; Deaton & Lipka, 2015; Simmons, 2017). This further suggests that the effect of governance quality will be more pronounced and operational when the relationship is being viewed in a composite form rather than solitary (see Table 2). Additionally, this suggests that each of the governance indicators plays important complementing roles on each other in order to have long-lasting efficiency and effectiveness.

The coefficient of the rule of law score in the difference GMM model was negative but insignificant. In contrast, the coefficient in the system GMM model was positive and significant which implies that the rule of law had a significant effect on nutrition security in the SSA when the differences in the effectiveness of the rule of law among countries in the region are considered. Despite the fact that women produce over half of the food consumed in the world, they account for more than half of those who suffer from poor nutrition in the world. Magnusson (2017) explains that laws and social norms in many counties prevent women from access to inputs and capacity building thus contributing to high levels of food insecurity among them. In countries where there is effective rule of law that ensures women have access to land and other productive assets, women are able to make a living and feed themselves and their households, thus, reducing the level of food insecurity.

Turning to the control variables, we observe a significant positive growth effect of school enrollment on nutrition security in both models. High literacy levels, especially among mothers, have been known to influence the nutritional status of children and the entire household. Nutritional security is dependent on the quality and quantity of food and food choices selected by the mother or household care giver. Bain et al. (2013) explain that the educational status of the household care giver has positive influence on the type of choices they make, thus promoting reductions in malnutrition. Population growth had no significant growth effect on nutrition security in both models. Although the coefficients lost their significance, they revealed that increases in population size had a negative growth effect on nutrition. The coefficients in the system GMM model without the governance indicators, also indicated a positive growth effect. In contrast, the coefficients after controlling for governance indicators, revealed a negative but insignificant relationship between population growth and nutrition security. Large household size and the subsequent fast population growth have been identified to have a negative relationship with nutritional security. Bremner (2012) explains that due to the continuous rise in population, the proportion of undernourished children in absolute numbers continue to rise, thus making the control and reduction of hunger in SSA difficult. Our measure of inflation (consumer price index) was found to have a significant negative growth effect on nutrition security in all models employed in our analysis. This implies that high inflation rates and the subsequent rise in prices reduce the quality of nutrition. High food prices have adverse effects on the nutritional status of households especially among the poor as the drop in their purchasing power could force them to buy cheaper and low quality food options, thus reducing the quality of their nutrition (Swinnen, 2011).

5.4. Effect of governance quality and remittances on food security

Table 3 reports results for the six alternative model specifications estimated but this time with food security (proxied by the average value of food production) as the outcome variable. Here, the baseline models - (7) and (10) for the difference and system GMM estimators, respectively - present the estimated results of the impact of remittances and composite governance index on average food production. Similar to Table 2, models (8) and (11) report the interaction effect of remittances and the composite governance index. The third category, models (9) and (12), presents the joint effect of remittances and individual indicators of governance quality on the outcome variable. All models contain the control variables.

We also base the consistency of the estimated parameters of the models (7) to (12) on the diagnostic test results from the estimated

dynamic GMM models indicated by the presence of first-order autocorrelation (AR [1]) and the absence of second-order autocorrelation (AR [2]) in the residuals of the models. The results confirm absence of second-order serial correlation for all the models employed. Regarding the validity of the instruments, the Hansen test statistic shows that the instruments used are valid.

In all model specifications (see models 7–12), remittances received by households had a negative effect on the average value of food production. Although not significant, the results imply that a rising rate of migration, and subsequent remittances inflow, is associated with declining average food production in SSA continues. Knoll, Rampa, Torres, Bizotto, and Cascone (2017) have argued that while remittances had the potential to promote investment in agriculture and rural economic activities which would in turn result in higher levels of food and nutrition security, the over dependence on this foreign source of income could have negative effects on local production systems as recipients could fail to invest their income on nutrition enhancing foods[7]. Surprisingly, the composite index of governance quality was negative and insignificant in both GMM models. However, the interactive effect of the composite index of governance quality and remittances is significant and positive. Examining model (8) for the difference GMM and model (11) for the system GMM, remittances received under good governance will increase average value of food production by 0.131, as reported in model (11).

When the effect of the governance quality is disaggregated as in models (9) and (11), the corruption control has a strong and positive association with food security proxy. This result is in line with Mehta and Jha (2012) who revealed that globally, corruption had a significant positive growth effect on food insecurity. Deficiency in the rule of law encourages high rates of corruption, and social and gender inequalities. Conflicts are often linked to unequal access to land and other natural resources. Inequalities in access to natural resources and to inputs and services such as seeds, fertilizers or credit strongly limit agricultural productivity. Poor governance diminishes the performance of a given sector's institutions and actors, as well as the concrete outcomes of policies (Dube & Phiri, 2015).[8] The coefficient was, however, positive in both GMM models, albeit only significant in the system GMM model.

The extent of food security in communities is dependent on how the rule of law is utilized to protect their rights and access to economic resources (Sen, 1981). Furthermore, the extent of the availability and access to markets, land and other natural resources, which determines the extent to which communities are food secure, is highly dependent on the effectiveness of laws and public institutions (Constantine, 2017). The regulatory quality score had a negative coefficient in all models employed in our analysis. Chronic food insecurity is predominantly rooted in aspects of poverty, power and inequality, and good governance is recognized as playing an essential role in dealing with them. Of course, quality dimensions of good governance do not necessarily ensure that food security is achieved; nor do they guarantee sustainable development of sectors affecting food availability, accessibility, utilization and stability.

With regards to the effect of the control variables, population growth has a negative but not statistically significant relationship with food security in both models. The result indicates that the fast and rising population has reducing, though insignificant, effects on the quantity and quality of food available to people in the region when the variations in the level of population growth is considered across countries in the region. The Food and Agriculture Organization (FAO, 2009) explains that in order to promote the availability of food in developing countries where there is high population growth and high levels of people with poor nutrition, there would be need to produce as twice as much as the current level of production. A high level of inflation translates to increases in the price of food and other necessities. Inflation is negatively associated with food security. The increasing cost of food as a result of high levels of inflation has been known to have adverse effects on people's capacity to purchase food items. High food prices reduce the purchasing power of households and forces them to reduce the quantity of food they purchase (Green et al., 2013). Education across the countries was positive and significant in all GMM models. Higher levels of literacy have a significant reducing effect on food insecurity (Burchi and De Muro, 2007; Ogundari & Awokuse, 2018), and education promotes increased productivity and income, and access to other essential factors required to promote food security (Burchi and De Muro, 2007).

6. Concluding remarks

The study investigates the effect of quality of governance and migration on nutrition and food security in SSA using a balanced panel data of 15 SSA countries covering the period 1996–2015. We primarily employ a two-step dynamic empirical model for the empirical analysis in order to account for unobserved heterogeneity and potential endogeneity of the main explanatory variables. Our empirical results revealed that the composite governance indicator does have a significant positive effect on nutrition security measure but not on food security. This implies that the beneficial effect of governance quality is more nuanced on nutrition security. For both nutrition and food security, the control of corruption specifically, had a positive and significant effect as a measure of quality of governance. Remittances on the other hand, were also found to be significant and had a positive effect on both the food and nutrition security outcomes of interest. An interesting finding from this study is that the interaction between remittances and the quality of governance had a higher and positive significant effect on food and nutrition security. Similarly, secondary school enrollment and the share of agriculture in GDP have positive effects on the outcome variables. On the contrary, inflation and a high population growth negatively impact food and nutrition security in SSA.

Although our results seem to suggest an overall positive association of remittances with food security and nutrition it is also important to stress here (and in line with Waidler & Deveroux, 2019) that remittances are unpredictable in terms of their frequency and value and accessed only by certain households. Of relevance to the above is also that food security and nutrition security are not the same and that some improvements in food security can be achieved with no necessarily improvement in nutrition status; and this leads to the conclusion that both sets of indicators must be monitored by government authorities in SSA countries in order specific policy interventions to be designed to tackle each of them (Waidler & Deveroux, 2019).

Both the conceptual and empirical analyses seem to point to the fact that good governance can play a crucial role on how remittances affect food security and nutrition in SSA countries. A sound institutional environment has been found to affect the volume and efficiency of investment; hence in the presence of quality governance, remittances could be invested in a greater amount and more efficiently, ultimately leading to higher output in both the agriculture and non-agriculture sectors of the economy. Accordingly, we

[7] Remittances can substantially increase 'bad food consumption habits' such as 'junk food (see Steyn, Labadarios, & Nel, 2011).

[8] Ineffective governance has been commonly associated with food insecurity. A report of the Federal Ministry of Food and Agriculture (2015) in Germany stresses that the failure of governments to adopt appropriate policies and investments that would promote rural and agricultural development is one of the fundamental contributors to food insecurity.

can possibly argue that policies geared toward increasing government investment on curbing corruption and improving quality of governance, which have been killing livelihood outcomes such as welfare, food and nutritional security over the years, would likely raise economic growth and subsequently food and nutritional security levels in the region.

Needless to say, such a policy conclusion warrants further research in this important research and policy area. We acknowledge the limitations associated with the data used in the study, especially the use of aggregated data from the World Bank (see world governance indicators) and FAO database (FAOSTAT) on average dietary energy supply adequacy as a substitute for actual nutritional intake voiding out micronutrients availability and accessibility at regional level. But despite this limitation, we believe that the findings emanating from this paper conform to the previous macro studies in other regions of the world and shed more light on the important impact governance quality and remittances may have on food and nutrition security. Finally, we would like to echo here Waidler and Deveroux (2019) who have rightly pointed out that more holistic approaches in order to tackle malnutrition are needed and which may well include sanitation facilities, access to health care and potable water, along with education campaigns on the centrality of dietary diversity to mention just a few. And needless to say, substantial improvements on governance quality can also play a crucial role in making the above desired policy interventions the norm in SSA countries in the coming years.

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Appendix

Table A1
Correlation matrix for explanatory variables in first food security model.

	ln_ave_adeq	ln_per_rem ~ d	ln_pop_gro ~ h	log_infl_c ~ p	ln_enroll	agric_growth	ln_gov_ind
ln_ave_adeq	1.0000						
ln_per_rem ~ d	−0.1462	1.0000					
ln_pop_gro ~ h	0.4654	−0.0335	1.0000				
log_infl_c ~ p	−0.1385	0.0708	0.0444	1.0000			
ln_enroll	−0.1849	0.3572	−0.3711	0.0885	1.0000		
agric_growth	−0.0109	0.1515	0.0035	0.0764	0.1042	1.0000	
ln_gov_ind	−0.0821	0.0943	−0.4585	0.1270	0.2209	−0.0736	1.0000

Table A2
Correlation matrix for explanatory variables in second food security model.

	ln_ave ~ q	ln_pop ~ h	log_in ~ p	ln_enr ~ l	agric_~h	rem_gov
ln_ave_adeq	1.0000					
ln_pop_gro ~ h	0.4654	1.0000				
log_infl_c ~ p	−0.1385	0.0444	1.0000			
ln_enroll	−0.1849	−0.3711	0.0885	1.0000		
agric_growth	−0.0109	0.0035	0.0764	0.1042	1.0000	
rem_gov	−0.0406	−0.4517	0.0624	0.1336	−0.0307	1.0000

Table A3
Correlation matrix for explanatory variables in third food security model.

	ln_ave ~ q	ln_per ~ d	ln_pop ~ h	log_in ~ p	ln_enr ~ l	agric_~h	ln_cc	ln_ge	ln_pv	ln_rl	ln_va	ln_rq
ln_ave_adeq	1.0000											
ln_per_rem ~ d	−0.1462	1.0000										
ln_pop_gro ~ h	0.4654	−0.0335	1.0000									
log_infl_c ~ p	−0.1385	0.0708	0.0444	1.0000								
ln_enroll	−0.1849	0.3572	−0.3711	0.0885	1.0000							
agric_growth	−0.0109	0.1515	0.0035	0.0764	0.1042	1.0000						
ln_cc	0.2138	−0.0757	0.5426	0.1059	−0.3201	0.0450	1.0000					
ln_ge	−0.0070	−0.1410	0.3610	0.0711	−0.2707	−0.0190	0.2613	1.0000				
ln_pv	0.0938	0.1644	0.0725	0.0908	0.0561	0.0474	0.0234	−0.0556	1.0000			
ln_rl	−0.1239	−0.1555	0.2827	0.1104	−0.2806	0.0445	0.4907	0.5234	−0.0684	1.0000		
ln_va	−0.0081	−0.1152	0.2778	−0.0214	−0.1705	0.0499	0.3341	0.3680	−0.0974	0.6293	1.0000	
ln_rq	−0.0439	−0.0569	0.1282	0.0729	−0.1561	−0.0215	0.0831	0.3845	−0.0474	0.1993	0.1916	1.0000

Table B1
Correlation matrix for explanatory variables in first nutrition security model.

	ln_foo ~ o	ln_per ~ d	ln_pop ~ h	log_in ~ p	ln_enr ~ l	agric_~h	ln_gov ~ d
ln_food_fao	1.0000						
ln_per_rem ~ d	−0.1045	1.0000					
ln_pop_gro ~ h	0.1173	−0.0335	1.0000				
log_infl_c ~ p	−0.0132	0.0708	0.0444	1.0000			
ln_enroll	0.0769	0.3572	−0.3711	0.0885	1.0000		
agric_growth	0.0458	0.1515	0.0035	0.0764	0.1042	1.0000	
ln_gov_ind	0.1382	0.0943	−0.4585	0.1270	0.2209	−0.0736	1.0000

Table B2
Correlation matrix for explanatory variables in second nutrition security model.

	ln_foo ~ o	ln_pop ~ h	log_in ~ p	ln_enr ~ l	agric_~h	rem_gov
ln_food_fao	1.0000					
ln_pop_gro ~ h	0.1173	1.0000				
log_infl_c ~ p	−0.0132	0.0444	1.0000			
ln_enroll	0.0769	−0.3711	0.0885	1.0000		
agric_growth	0.0458	0.0035	0.0764	0.1042	1.0000	
rem_gov	0.1560	−0.4517	0.0624	0.1336	−0.0307	1.0000

Table B3
Correlation matrix for explanatory variables in third nutrition security model.

	ln_foo ~ o	ln_per ~ d	ln_pop ~ h	log_in ~ p	ln_enr ~ l	agric_~h	ln_cc	ln_ge	ln_pv	ln_rl	ln_va	ln_rq
ln_food_fao	1.0000											
ln_per_rem ~ d	−0.1045	1.0000										
ln_pop_gro ~ h	0.1173	−0.0335	1.0000									
log_infl_c ~ p	−0.0132	0.0708	0.0444	1.0000								
ln_enroll	0.0769	0.3572	−0.3711	0.0885	1.0000							
agric_growth	0.0458	0.1515	0.0035	0.0764	0.1042	1.0000						
ln_cc	−0.0847	−0.0757	0.5426	0.1059	−0.3201	0.0450	1.0000					
ln_ge	−0.0534	−0.1410	0.3610	0.0711	−0.2707	−0.0190	0.2613	1.0000				
ln_pv	0.0957	0.1644	0.0725	0.0908	0.0561	0.0474	0.0234	−0.0556	1.0000			
ln_rl	−0.1569	−0.1555	0.2827	0.1104	−0.2806	0.0445	0.4907	0.5234	−0.0684	1.0000		
ln_va	−0.1010	−0.1152	0.2778	−0.0214	−0.1705	0.0499	0.3341	0.3680	−0.0974	0.6293	1.0000	
ln_rq	−0.1543	−0.0569	0.1282	0.0729	−0.1561	−0.0215	0.0831	0.3845	−0.0474	0.1993	0.1916	1.0000

Table C1
Static model of Food Security: Pooled OLS, Random Effect (RE) and Fixed Effect(FE).

	MODEL13	MODEL14	MODEL15	MODEL16	MODEL 17	MODEL 18	MODEL 19	MODEL 20	MODEL 21
VARIABLES	**POOLED OLS**			**RANDOM EFFECT (RE)**			**FIXED EFFECT (FE)**		
ln_per_rem_usd	−0.0529***		−0.0563***	−0.0743***		−0.0636**	−0.0785**		−0.0640*
	(0.0174)		(0.0176)	(0.0277)		(0.0291)	(0.0333)		(0.0326)
ln_pop_growth	1.149***	1.115***	1.046***	1.068***	0.988***	0.788*	1.030**	0.901*	0.800*
	(0.248)	(0.239)	(0.255)	(0.379)	(0.378)	(0.407)	(0.457)	(0.459)	(0.470)
log_infl_cpi_p	−0.116	−0.105	−0.00506	0.248**	0.249**	0.332***	0.332***	0.350***	0.372***
	(0.0927)	(0.0958)	(0.0900)	(0.109)	(0.110)	(0.110)	(0.113)	(0.114)	(0.114)
ln_enroll	0.244***	0.183**	0.178*	0.375***	0.339***	0.370***	0.398***	0.376***	0.390***
	(0.0877)	(0.0807)	(0.0913)	(0.0763)	(0.0756)	(0.0774)	(0.0767)	(0.0765)	(0.0783)
ln_gdp_gro	0.0733	0.0859	0.0693	−0.0486	−0.0285	−0.0689	−0.0683	−0.0514	−0.0913
	(0.118)	(0.119)	(0.126)	(0.113)	(0.114)	(0.114)	(0.114)	(0.115)	(0.115)
ln_cc			−0.987**			−0.253			−0.199
			(0.389)			(0.628)			(0.664)
ln_ge			0.133			0.698*			1.023**
			(0.387)			(0.385)			(0.438)
ln_pv			0.180			0.0947			0.0847
			(0.114)			(0.123)			(0.125)
ln_rl			−1.057**			−0.236			0.568
			(0.500)			(1.011)			(1.152)
ln_va			−0.350			−0.125			0.289
			(1.111)			(1.362)			(1.508)
ln_rq			−0.558***			−0.487**			−0.498**
			(0.188)			(0.216)			(0.218)
ln_gov_ind	0.545***			0.378**			0.341*		
	(0.174)			(0.175)			(0.190)		
rem_gov		0.0365***			0.0216*			0.0160	
		(0.00953)			(0.0116)			(0.0129)	

(*continued on next page*)

Table C1 (*continued*)

	MODEL13	MODEL14	MODEL15	MODEL16	MODEL 17	MODEL 18	MODEL 19	MODEL 20	MODEL 21
Constant	3.168***	2.484***	3.019***	2.834***	1.840***	2.782***	2.770***	1.703***	2.849***
	(0.383)	(0.340)	(0.405)	(0.606)	(0.485)	(0.719)	(0.611)	(0.430)	(0.643)
Observations	285	285	285	285	285	285	285	285	285
R-squared	0.110	0.093	0.129				0.159	0.139	0.181
Number of pid				15	15	15	15	15	15

Robust standard errors in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.

Table C2
Static model of Nutrition Security: Pooled OLS, Random Effect (RE) and Fixed Effect (FE).

	Model22	Model23	Model 24	Model 25	Model 26	Model 27	Model28	Model29	Model30
VARIABLES	Pooled-Ols			Random effect (RE)			Fixed effect (FE)		
ln_per_rem_usd	−0.0399***		−0.0467***	−0.0411**		−0.0335*	−0.0374*		−0.0290
	(0.0130)		(0.0132)	(0.0198)		(0.0199)	(0.0212)		(0.0210)
ln_pop_growth	1.944***	1.931***	1.723***	0.739***	0.708***	0.459	0.425	0.360	0.199
	(0.167)	(0.153)	(0.178)	(0.272)	(0.272)	(0.283)	(0.292)	(0.292)	(0.304)
log_infl_cpi_p	−0.275***	−0.263***	−0.185**	0.0805	0.0883	0.115	0.109	0.121*	0.137*
	(0.0782)	(0.0792)	(0.0753)	(0.0723)	(0.0729)	(0.0728)	(0.0726)	(0.0728)	(0.0736)
ln_enroll	0.0583	0.0172	0.00434	0.177***	0.163***	0.175***	0.191***	0.184***	0.185***
	(0.0683)	(0.0622)	(0.0735)	(0.0494)	(0.0493)	(0.0504)	(0.0489)	(0.0487)	(0.0504)
agric_growth	0.00907	0.00160	0.00698	−0.00258	−0.00481	−0.00558	−0.00300	−0.00517	−0.00610
	(0.0130)	(0.0129)	(0.0113)	(0.00970)	(0.00976)	(0.00965)	(0.00957)	(0.00956)	(0.00965)
ln_cc			0.601			−0.0317			−0.244
			(0.472)			(0.418)			(0.429)
ln_ge			−0.294			0.115			0.159
			(0.281)			(0.264)			(0.283)
ln_pv			0.134			0.155*			0.173**
			(0.0889)			(0.0805)			(0.0811)
ln_rl			−2.202***			−0.192			0.162
			(0.552)			(0.697)			(0.744)
ln_va			0.164			0.0453			0.0140
			(0.695)			(0.926)			(0.974)
ln_rq			−0.110			−0.0854			−0.0917
			(0.0977)			(0.141)			(0.141)
ln_gov_ind	0.408***			0.246**			0.261**		
	(0.127)			(0.119)			(0.122)		
rem_gov		0.0280***			0.0115			0.0120	
		(0.00720)			(0.00799)			(0.00821)	
Constant	3.047***	2.536***	3.122***	3.216***	2.646***	3.299***	3.325***	2.814***	3.396***
	(0.271)	(0.255)	(0.304)	(0.494)	(0.411)	(0.570)	(0.385)	(0.272)	(0.410)
Observations	285	285	285	285	285	285	285	285	285
R-squared	0.295	0.285	0.349				0.094	0.077	0.097
Number of pid				15	15	15	15	15	15

Robust standard errors in parentheses.
***p < 0.01, ** p < 0.05, * p < 0.1.

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